2021 Electric Integrated Resource Plan

Appendix E – AEG Conservation Potential & Demand Response Potential Assessments

AVISTA CONSERVATION POTENTIAL ASSESSMENT FOR 2022-2045

December 1, 2020

Report prepared for:
AVISTA CORPORATION

Energy Solutions. Delivered.

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INTRODUCTION

Avista Corporation (Avista) engaged Applied Energy Group (AEG) to conduct a Conservation Potential Assessment (CPA). The CPA is a 20-year study, performed in accordance with Washington Initiative 937 (I-937), that provides data on conservation resources to support development of Avista's 2022 Integrated Resource Plan (IRP). AEG first performed an electric CPA for Avista in 2013, and since then has performed both electric and gas CPAs for Avista's planning cycles to date.

Notable udates to this study from prior CPAs include:

- The base-year for the analysis was brought forward from 2017 to 2019.
- For the residential sector, the study still incorporates Avista's GenPOP residential saturation survey from 2012, which provides a more localized look at Avista's customers than regional surveys. This provided the foundation for the base-year market characterization and energy market profiles. The Northwest Energy Efficiency Alliance's (NEEA's) 2016 Residential Building Stock Assessment (RBSA II) supplemented the GenPOP survey to account for trends in the intervening years.
- For the commercial sector, analysis was performed for the major building types in the service territory. Results from the 2019 Commercial Building Stock Assessment (CBSA), including hospital and university data, provided useful information for this characterization.
- This study also incorporated changes to the list of energy conservation measures, as a result of research by the Regional Technical Forum (RTF). In particular, LED lamps continue to drop in price and provide a significant opportunity for savings even under market transformation assumptions by the RTF.
- Measure characterizations which previously relied on data from the Northwest Power Council's Sventh Power Plan is now updated to the 2021 Power Plan, including measure data, adoption rates, and updated measure applicability.
- The study incorporates updated forecasting assumptions that line up with the most recent Avista load forecast.

Enhancements retained from the 2019 CPA include:

- Analysis of economic potential was excluded from this study. Avista will screen for cost-effective opportunities directly within the IRP model. As such, economic potential and achievable potential have been replaced by a Technical Achievable Potential case.
- In addition to analyzing annual energy savings, the study also estimated the opportunity for reduction of summer and winter peak demand. This involved a full characterization by sector, segment and end use of peak demand in the base year.
- Finally, this year's study included an update to the 2019 assessment of demand-response potential, including analysis of residential programs as well as commercial and industrial (C&I), and options for both summer and winter demand reduction.

Compared to the 2019 Study, 10-year technical achievable potential has increased from 110.1 aMW to 150.3 aMW. This is a net effect of changes in the measure list, market transformation, and baseline growth.

Abbreviations and Acronyms

Table 1-1 provides a list of abbreviations and acronyms used in this report, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
ACS	American Community Survey
AEO	Annual Energy Outlook forecast developed by EIA
AHAM	Association of Home Appliance Manufacturers
AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
Auto-DR	Automated Demand Response
B/C Ratio	Benefit to Cost Ratio
BEST	AEG's Building Energy Simulation Tool
C&I	Commercial and Industrial
CAC	Central Air Conditioning
CFL	Compact fluorescent lamp
CPP	Critical Peak Pricing
C&I	Commercial and Industrial
DHW	Domestic Hot Water
DLC	Direct Load Control
DR	Demand Response
DSM	Demand Side Management
EE	Energy Efficiency
EIA	Energy Information Administration
EUL	Estimated Useful Life
EUI	Energy Usage Intensity
FERC	Federal Energy Regulatory Commission
HH	Household
HID	High intensity discharge lamps
HVAC	Heating Ventilation and Air Conditioning
ICAP	Installed Capacity
IOU	Investor Owned Utility
LED	Light emitting diode lamp
LoadMAP	AEG's Load Management Analysis and Planning™ tool
LCOE	Levelized cost of energy

Acronym	Explanation
MW	Megawatt
NPV	Net Present Value
O&M	Operations and Maintenance
PCT	Programmable Communicating Thermostat
RTU	Roof top unit
TRC	Total Resource Cost test
UEC	Unit Energy Consumption

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ANALYSIS APPROACH AND DATA DEVELOPMENT

This section describes the analysis approach taken for the study and the data sources used to develop the potential estimates.

Overview of Analysis Approach

To perform the potential analysis, AEG used a bottom-up approach following the major steps listed below. We describe these analysis steps in more detail throughout the remainder of this chapter.

1. Perform a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, 2019.
2. Develop a baseline projection of energy consumption and peak demand by sector, segment, and end use for 2019 through 2045.
3. Define and characterize several hundred conservation measures to be applied to all sectors, segments, and end uses.
4. Estimate technical and Technical Achievable Potential at the measure level in terms of energy and peak demand impacts from conservation measures for 2019-2045.

LoadMAP Model

AEG used its Load Management Analysis and Planning tool (LoadMAP™) version 5.0 to develop both the baseline projection and the estimates of potential. AEG developed LoadMAP in 2007 and has enhanced it over time, using it for the EPRI National Potential Study and numerous utility-specific forecasting and potential studies since that time. Built in Excel, the LoadMAP framework (see Figure 2-1) is both accessible and transparent and has the following key features.

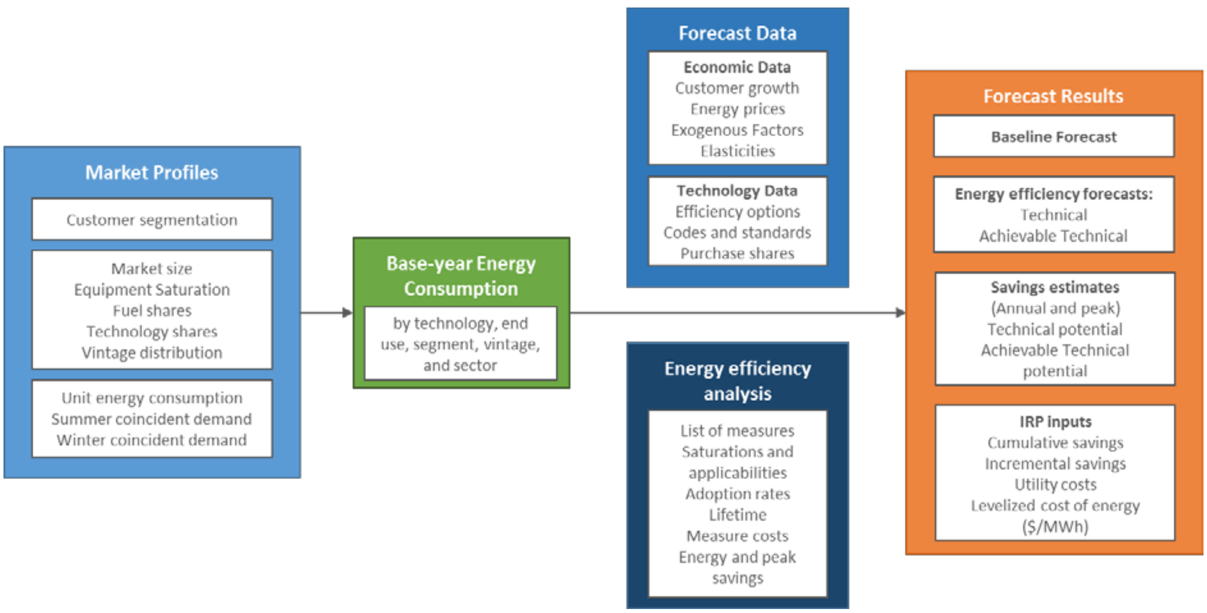
- Embodies the basic principles of rigorous end-use models (such as EPRI's REEPS and COMMEND) but in a more simplified, accessible form.
- Includes stock-accounting algorithms that treat older, less efficient appliance/equipment stock separately from newer, more efficient equipment. Equipment is replaced according to the measure life and appliance vintage distributions defined by the user.
- Balances the competing needs of simplicity and robustness by incorporating important modeling details related to equipment saturations, efficiencies, vintage, and the like, where market data are available, and treats end uses separately to account for varying importance and availability of data resources.
- Isolates new construction from existing equipment and buildings and treats purchase decisions for new construction and existing buildings separately.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex decision choice algorithms or diffusion assumptions, and the model parameters tend to be difficult to estimate or observe and sometimes produce anomalous results that require calibration or even overriding. The LoadMAP approach allows the user to drive the appliance and equipment choices year by year directly in the model. This flexible approach allows users to import

the results from diffusion models or to input individual assumptions. The framework also facilitates sensitivity analysis.

- Includes appliance and equipment models customized by end use. For example, the logic for lighting is distinct from refrigerators and freezers.
- Can accommodate various levels of segmentation. Analysis can be performed at the sector level (e.g., total residential) or for customized segments within sectors (e.g., housing type or income level).
- Can incorporate conservation measures, demand-response options, combined heat and power (CHP) and distributed generation options and fuel switching.

Consistent with the segmentation scheme and the market profiles we describe below, the LoadMAP model provides projections of baseline energy use by sector, segment, end use, and technology for existing and new buildings. It also provides forecasts of total energy use and energy-efficiency savings associated with the various types of potential.[1]

Figure 2-1 LoadMAP Analysis Framework



[1] The model computes energy and peak-demand forecasts for each type of potential for each end use as an intermediate calculation. Annual-energy and peak-demand savings are calculated as the difference between the value in the baseline projection and the value in the potential forecast (e.g., the technical potential forecast).

Definitions of Potential

In this study, the conservation potential estimates represent gross savings developed for two levels of potential: technical potential and Technical Achievable Potential. These levels are described below.

- **Technical Potential** is defined as the theoretical upper limit of conservation potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the efficient option available. In new construction, customers and developers also choose the most efficient equipment option.
  - In new construction, customers and developers also choose the efficient equipment option relative to applicable codes and standards. Non-equipment measures which may be realistically installed apart from equipment replacements are implemented according to ramp rates developed by the NWPCC for its 2021 Power Plan, applied to 100% of the applicable market. This case is a theoretical construct and is provided primarily for planning and informational purposes.
- **Technical Achievable Potential refines** Technical Potential by applying customer participation rates that account for market barriers, customer awareness and attitudes, program maturity, and other factors that may affect market penetration of DSM measures. We used achievability assumptions from the Council's 2021 Power Plan, adjusted for Avista's recent program accomplishments, as the customer adoption rates for this study. For the technical achievable case, ramp rates are applied to bewteen 85%-100% of the applicable market, per Council methodology. This achievability factor represents potential which can reasonably be acquired by all mechanisms available, regardless of how conservation is achieved. Thus, the market applicability assumptions utilized in this study include savings outside of utility programs.[2]
  - Note that in the 2019 CPA, ramp rates used Sventh Plan methdology, which assumed a fixed 85% achievability for all measures. In the 2021 Power Plan, some measures have this limit increased.
  - Details regarding the market adoption factors appear in Appendix B.

Market Characterization

The first step in the analysis approach is market characterization. In order to estimate the savings potential from energy-efficient measures, it is necessary to understand how much energy is used today and what equipment is currently being used. This characterization begins with a segmentation of Avista's electricity footprint to quantify energy use by sector, segment, end-use application, and the current set of technologies used. We rely primarily on information from Avista, NEEA, and secondary sources as necessary.

Segmentation for Modeling Purposes

The market assessment first defined the market segments (building types, end uses, and other dimensions) that are relevant in the Avista service territory. The segmentation scheme for this project is presented in Table 2-1.

[2] Council's 7th Power Plan applicability assumptions reference an "Achievable Savings" report published August 1, 2007. http://www.nwcouncil.org/reports/2007/2007-13/

Table 2-1 Overview of Avista Analysis Segmentation Scheme

Dimension	Segmentation Variable	Description
1	Sector	Residential, commercial, industrial
2	Segment	**Residential**: single family, multifamily, manufactured home, low income **Commercial**: small office, large office, restaurant, retail, grocery, college, school, health, lodging, warehouse, and miscellaneous Industrial: total
3	Vintage	Existing and new construction
4	End uses	Cooling, lighting, water heat, motors, etc. (as appropriate by sector)
5	Appliances/end uses and technologies	Technologies such as lamp type, air conditioning equipment, motors by application, etc.
6	Equipment efficiency levels for new purchases	Baseline and higher-efficiency options as appropriate for each technology

With the segmentation scheme defined, we then performed a high-level market characterization of electricity sales in the base year to allocate sales to each customer segment. We used Avista data and secondary sources to allocate energy use and customers to the various sectors and segments such that the total customer count, energy consumption, and peak demand matched the Avista system totals from 2017 billing data. This information provided control totals at a sector level for calibrating the LoadMAP model to known data for the base-year.

Market Profiles

The next step was to develop market profiles for each sector, customer segment, end use, and technology. A market profile includes the following elements:

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is overall electricity use.
- **Saturations** define the fraction of homes or square feet with the various technologies. (e.g., homes with electric space heating).
- **UEC (unit energy consumption) or EUI (energy-use index)** describes the amount of energy consumed in 2019 by a specific technology in buildings that have the technology. For electricity, UECs are expressed in kWh/household for the residential sector, and EUIs are expressed in kWh/square foot for the commercial sector.
- **Annual Energy Intensity** for the residential sector represents the average energy use for the technology across all homes in 2019. It is computed as the product of the saturation and the UEC and is defined as kWh/household for electricity. For the commercial sector, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space in 2019.
- **Annual Usage** is the annual energy use by an end-use technology in the segment. It is the product of the market size and intensity and is quantified in GWh.

- **Peak Demand** for each technology, summer peak and winter peak are calculated using peak fractions of annual energy use from AEG's EnergyShape library and Avista system peak data.
  - The market characterization results, and the market profiles are presented in Chapter 3.

Baseline Projection

The next step was to develop the baseline projection of annual electricity use and summer peak demand for 2019 through 2045 by customer segment and end use without new utility programs. The end-use projection includes the impacts of relatively certain codes and standards which will unfold over the study timeframe. All such mandates that were defined as of July 2020 are included in the baseline. The baseline projection is the foundation for the analysis of savings from future conservation efforts as well as the metric against which potential savings are measured.

Inputs to the baseline projection include:

- Current economic growth forecasts (i.e., customer growth, income growth)
- Electricity price forecasts
- Trends in fuel shares and equipment saturations
- Existing and approved changes to building codes and equipment standards
- Avista's internally developed sector-level projections for electricity sales

We also developed a baseline projection for summer and winter peak by applying the peak fractions from the energy market profiles to the annual energy forecast in each year.

We present the baseline-projection results for the system as a whole and for each sector in Chapter 4.

Washington HB 1444

While the 2019 CPA was completed before the impacts of HB-1444 could be incorporated, requiring a separate analysis to estimate that impact, this study's foundational setup included assumptions of HB-1444s impact on the available market for energy efficiency measures in Washington.

Conservation Measure Analysis

This section describes the framework used to assess the savings, costs, and other attributes of conservation measures. These characteristics form the basis for measure-level cost-effectiveness analyses as well as for determining measure-level savings. For all measures, AEG assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with the Seventh Plan's updated ramp rates to identify technical achievable measure potential.

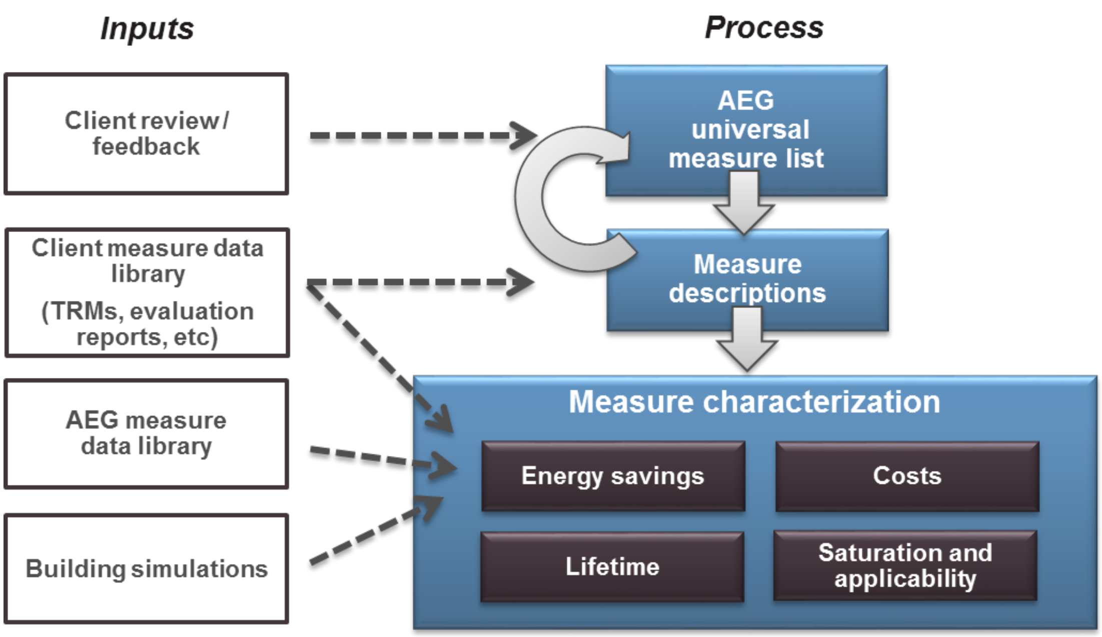
Conservation Measures

Figure 2-2 outlines the framework for conservation measure analysis. The framework for assessing savings, costs, and other attributes of conservation measures involves identifying the list of measures to include in the analysis, determining their applicability to each market sector and segment, fully characterizing each measure, and calculating the levelized cost of energy ($/MWh). Potential measures include the replacement of a unit that has failed or is at the end of its useful life with an efficient unit, retrofit or early replacement of equipment, improvements to the building envelope, the application of controls to optimize energy use, and other actions resulting in improved energy efficiency.

We compiled a robust list of conservation measures for each customer sector, drawing upon Avista's measure database, the Regional Technical Forum (RTF), and the Seventh Plan deemed measures database, as well as a variety of secondary sources. This universal list of conservation measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption.

Since an economic screen was not performed in this Study, we have instead calculated the levelized cost of energy (LCOE) for each measure evaluated. This value, expressed in dollars per first-year megawatt hour (MWh) saved, can be used by Avista's IRP model to evaluate cost effectiveness. To calculate a measure's LCOE, first-year measure costs, annual non-energy benefits, and annual operations and maintenance (O&M) costs are levelized over a measure's lifetime, then divided by the first-year savings in MWh. Note that while non-energy benefits are typically included in the numerator of a traditional Total Resource Cost (TRC) economic screen, the LCOE benefits have not been monetized. Therefore, these benefits are instead subtracted from the costs portion of the test. These benefits are not included in the Utility Cost Test (UCT) used in Idaho.

Figure 2-2 Approach for Conservation Measure Assessment



The selected measures are categorized into two types according to the LoadMAP taxonomy: equipment measures and non-equipment measures.

- **Equipment measures** are efficient energy-consuming pieces of equipment that save energy by providing the same service with a lower energy requirement than a standard unit. An example is an ENERGY STAR refrigerator that replaces a standard efficiency refrigerator. For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the current federal standard SEER 13 unit and spans a broad spectrum up to a maximum efficiency of a SEER 21 unit. The Seventh Plan's "Lost Opportunity" ramp rates are primarily applied to equipment measures.

- **Non-equipment measures** save energy by reducing the need for delivered energy, but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example would be a programmable thermostat that is pre-set to run heating and cooling systems only when people are home. Non-equipment measures can apply to more than one end use. For instance, addition of wall insulation will affect the energy use of both space heating and cooling. The Seventh Plan's "Retrofit" ramp rates are primarily applied to no-equipment measures. Non-equipment measures typically fall into one of the following categories:
  - Building shell (windows, insulation, roofing material)
  - Equipment controls (thermostat, compressor staging and controls)
  - Equipment maintenance (cleaning filters, changing setpoints)
  - Whole-building design (building orientation, advanced new construction designs)
  - Lighting retrofits (assumed to be implemented alongside new LEDs at the equipment's normal end of life)
  - Displacement measures (ceiling fan to reduce use of central air conditioners)
  - Commissioning and retrocommissioning (initial or ongoing monitoring of building energy systems to optimize energy use)

We developed a preliminary list of conservation measures, which was distributed to the Avista project team for review. The list was finalized after incorporating comments and is presented in the appendix to this volume.

Once we assembled the list of conservation measures, the project team characterized measure savings, incremental cost, service life, and other performance factors, drawing upon data from the Avista measure database, the Seventh Power Plan, the RTF deemed measure workbooks, simulation modeling, and other well-vetted sources as required.

Representative Conservation Measure Data Inputs

To provide an example of the conservation measure data, Table 2-2 and Table 2-3 present examples of the detailed data inputs behind both equipment and non-equipment measures, respectively, for the case of residential CAC in single-family homes. Table 2-2 displays the various efficiency levels available as equipment measures, as well as the corresponding useful life, energy usage, and cost estimates. The columns labeled "On Market" and "Off Market" reflect equipment availability due to codes and standards or the entry of new products to the market. Note that in this example no standards come into play and therefore all options are available throughout the forecast.

Table 2-2 Example Equipment Measures for Central AC – Single-Family Home

Efficiency Level	Useful Life (yrs)	Equipment Cost	Energy Usage (kWh/yr)	On Market	Off Market
SEER 13.0	10 to 20	$2,097	1,383	2019	n/a
SEER 14.0	10 to 20	$2,505	1,284	2019	n/a
SEER 15.0	10 to 20	$2,913	1,199	2019	n/a
SEER 16.0	10 to 20	$3,321	1,124	2019	n/a
SEER 18.0	10 to 20	$4,140	999	2019	n/a
SEER 20.0	10 to 20	$4,955	899	2019	n/a

Table 2-3 lists some of the non-equipment measures applicable to a CAC in an existing single family home. LCOE values for all measures are evaluated based on the lifetime costs of the measure divided by the first-year savings. The total costs and savings are calculated for each year of the study and depend on the base year saturation of the measure, the applicability[3] of the measure, and the savings as a percentage of the relevant energy end uses.

Table 2-3 Example Non-Equipment Measures – Single Family Home, Existing

End Use	Measure	Saturation in 2019	Applicability	Lifetime (yrs)	Measure Installed Cost	Energy Savings (%)
Cooling	Insulation - Ceiling Installation	0%	10%	45	$2,084	21.8%
Cooling	Insulation - Wall Cavity Installation	0%	10%	45	$4,374	3.5%
Cooling	Windows - High Efficiency/ENERGY STAR	0%	95%	45	$4,421	7.1%
Cooling	Thermostat – Connected	14%	70%	5	$265.00	6.0%

Table 2-4 summarizes the number of measures evaluated for each segment within each sector.

Table 2-4 Number of Measures Evaluated

Sector	Total Measures	Measure Permutations w/ 2 Vintages	Measure Permutations w/ Segments
Residential	88	176	704
Commercial	130	260	2,860
Industrial	111	222	222
Total Measures Evaluated	**329**	**658**	**3,786**

[3] The applicability factors take into account whether the measure is applicable to a particular building type and whether it is feasible to install the measure. For instance, attic fans are not applicable to homes where there is insufficient space in the attic or there is no attic at all.

Conservation Potential

The approach we used for this study to calculate the conservation potential adheres to the approaches and conventions outlined in the National Action Plan for Energy-Efficiency (NAPEE) Guide for Conducting Potential Studies (November 2007).[4] The NAPEE Guide represents the most credible and comprehensive industry practice for specifying conservation potential. As described in Chapter 2, two types of potential were developed as part of this effort: Technical Potential and Technical Achievable Potential.

- **Technical potential** is a theoretical construct that assumes the highest efficiency measures that are technically feasible to install are adopted by customers, regardless of cost or customer preferences. Thus, determining the technical potential is relatively straightforward. LoadMAP "chooses" the efficient equipment options for each technology at the time of equipment replacement. In addition, it installs all relevant non-equipment measures for each technology to calculate savings. LoadMAP applies the savings due to the non-equipment measures one-by-one to avoid double counting of savings. The measures are evaluated in order of their LCOE ratio, with the measure with the lowest LCOE values (most likely to be cost effective) applied first. Each time a measure is applied, the baseline energy use for the end use is reduced and the percentage savings for the next measure is applied to the revised (lower) usage.
- **Technical Achievable Potential** refines Technical Potential by applying market adoption rates for each measure that estimate the percentage of customers who would be likely to select each measure, given consumer preferences (partially a function of incentive levels), retail energy rates, imperfect information, and real market barriers and conditions. These barriers tend to vary, depending on the customer sector, local energy market conditions, and other, hard-to-quantify factors. In addition to utility-sponsored programs, alternative acquisition methods, such as improved codes and standards and market transformation, can be used to capture portions of these resources, and are included within the Technical Achievable Potential, per 2021 Power Plan methodology.

The calculation of Technical Potential is a straightforward algorithm. To develop estimates for Technical Achievable Potential, we develop market adoption rates for each measure that specify the percentage of customers that will select the highest–efficiency economic option. With the beginning of a new power plan, technical achievable potential aligns with ramp assignments from the 2021 Power Plan. Over time, measure adoption increases from the starting point up to 85% or more, to model increasing market acceptance and program improvements. For measures within the 2021 Power Plan, the Council's prescribed ramp rates were used. For measures outside the 2021 Plan, AEG assigned ramp rates comparable to similar measures within the 2021 Plan. The market adoption rates for each measure appear in Appendix B.

Results of all the potentials analysis are presented in Chapter 5.

Data Development

This section details the data sources used in this study, followed by a discussion of how these sources were applied. In general, data sources were applied in the following order: Avista data, Northwest data, and well-vetted national or other regional secondary sources.

Data Sources

The data sources are organized into the following categories:

[4] National Action Plan for Energy Efficiency (2007). *National Action Plan for Energy Efficiency Vision for 2025: Developing a Framework for Change.* www.epa.gov/eeactionplan.

- Avista data
- Northwest Energy Efficiency Alliance data
- Northwest Power and Conservation Council data
- AEG's databases and analysis tools
- Other secondary data and reports

Avista Data

Our highest priority data sources for this study were those that were specific to Avista.

- **Avista customer data:** Avista provided billing data for development of customer counts and energy use for each sector. We also used the results of the Avista GenPOP survey, a residential saturation survey.
- **Load forecasts:** Avista provided an economic growth forecast by sector; electric load forecast; peak-demand forecasts at the sector level; and retail electricity price history and forecasts.
- **Economic information:** Avista Power provided a discount rate and line loss factor. Avoided costs were not provided due to the economic screen being moved to the IRP model.
- **Avista program data**: Avista provided information about past and current programs, including program descriptions, goals, and achievements to date.

Northwest Energy Efficiency Alliance Data

The Northwest Energy Efficiency Alliance conducts research on an ongoing basis for the Northwest region. The following studies were particularly useful for this study:

- **Northwest Energy Efficiency Alliance, Residential Building Stock Assessment II**, Single-Family Homes Report 2016-2017, https://neea.org/img/uploads/Residential-Building-Stock-Assessment-II-Single-Family-Homes-Report-2016-2017.pdf
- **Northwest Energy Efficiency Alliance, Residential Building Stock Assessment II**, Manufactured Homes Report 2016-2017, https://neea.org/img/uploads/Residential-Building-Stock-Assessment-II-Manufactured-Homes-Report-2016-2017.pdf
- **Northwest Energy Efficiency Alliance, Residential Building Stock Assessment II**, Multifamily Buildings Report 2016-2017, https://neea.org/img/documents/Residential-Building-Stock-Assessment-II-Multifamily-Homes-Report-2016-2017.pdf
- **Northwest Energy Efficiency Alliance, 2019 Commercial Building Stock Assessment**, May 21, 2020, https://neea.org/resources/cbsa-4-2019-final-report
- **Northwest Energy Efficiency Alliance, 2014 Industrial Facilities Site Assessment,** December 29, 2014, http://neea.org/docs/default-source/reports/2014-industrial-facilities-stock-assessment-final-report.pdf?sfvrsn=6

Northwest Power and Conservation Council Data

Several sources of data were used to characterize the conservation measures. We used the following regional data sources and supplemented with AEG's data sources to fill in any gaps.

- **Regional Technical Forum Deemed Measures.** The NWPCC Regional Technical Forum maintains databases of deemed measure savings data, available at http://www.nwcouncil.org/energy/rtf/measures/Default.asp .
- **Northwest Power and Conservation Council 2021 Power Plan Conservation Supply Curve Workbooks.** To develop its 2021 Power Plan, the Council used workbooks with detailed information about measures, available at https://nwcouncil.box.com/s/u0dgjxkoxoj2tttym81uka3wrjcy6bo6
- **Northwest Power and Conservation Council, MC and Loadshape File**, September 29, 2016. The Council's load shape library was utilized to convert CPA results into hourly conservation impacts for use in Avista's IRP process. Generalized Least Square (GLS) versions of these load shapes are available at https://nwcouncil.app.box.com/s/gacr21z8i89hh8ppk11rdzgm6fz4xlz3

AEG Data

AEG maintains several databases and modeling tools that we use for forecasting and potential studies. Relevant data from these tools has been incorporated into the analysis and deliverables for this study.

- **AEG Energy Market Profiles**: For more than 10 years, AEG staff has maintained profiles of end-use consumption for the residential, commercial, and industrial sectors. These profiles include market size, fuel shares, unit consumption estimates, and annual energy use by fuel (electricity and natural gas), customer segment and end use for 10 regions in the U.S. The Energy Information Administration surveys (RECS, CBECS and MECS) as well as state-level statistics and local customer research provide the foundation for these regional profiles.
- **Building Energy Simulation Tool (BEST)**. AEG's BEST is a derivative of the DOE 2.2 building simulation model, used to estimate base-year UECs and EUIs, as well as measure savings for the HVAC-related measures.
- **AEG's EnergyShape™:** AEG's load shape database was used in addition to the Council's load shape database for comparative purposes. This database of load shapes includes the following:
  - Residential – electric load shapes for ten regions, three housing types, 13 end uses
  - Commercial – electric load shapes for nine regions, 54 building types, ten end uses
  - Industrial – electric load shapes, whole facility only, 19 2-digit SIC codes, as well as various 3-digit and 4-digit SIC codes
- **AEG's Database of Energy Efficiency Measures (DEEM):** AEG maintains an extensive database of measure data for our studies. Our database draws upon reliable sources including the California Database for Energy Efficient Resources (DEER), the EIA Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, RS Means cost data, and Grainger Catalog Cost data.
- **Recent studies**. AEG has conducted numerous studies of EE potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, which include Tacoma Power, Idaho Power, PacifiCorp, Ameren Missouri, Vectren Energy, Indianapolis Power & Light, Tennessee Valley Authority, Ameren Missouri, Ameren Illinois, and Seattle City Light. In

addition, we used the information about impacts of building codes and appliance standards from recent reports for the Edison Electric Institute[5].

Other Secondary Data and Reports

Finally, a variety of secondary data sources and reports were used for this study. The main sources are identified below.

- **Annual Energy Outlook.** The Annual Energy Outlook (AEO), conducted each year by the U.S. Energy Information Administration (EIA), presents yearly projections and analysis of energy topics. For this study, we used data from the 2019 AEO.
- **Local Weather Data:** Weather from NOAA's National Climatic Data Center for Spokane, WA was used as the basis for building simulations.
- **EPRI End-Use Models (REEPS and COMMEND).** These models provide the elasticities we apply to electricity prices, household income, home size and heating and cooling.
- **Database for Energy Efficient Resources (DEER).** The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) for the state of California. We used the DEER database to cross check the measure savings we developed using BEST and DEEM.
- **Other relevant regional sources:** These include reports from the Consortium for Energy Efficiency (CEE), the Environmental Protection Agency (EPA), and the American Council for an Energy-Efficient Economy (ACEEE).

Data Application

We now discuss how the data sources described above were used for each step of the study.

Data Application for Market Characterization

To construct the high-level market characterization of electricity use and households/floor space for the residential, commercial and industrial sectors, we used Avista billing data and customer surveys to estimate energy use.

- For the residential sector, Avista estimated the numbers of customers and the average energy use per customer for each of the three segments, based on its GenPOP survey, matched to billing data for surveyed customers. AEG compared the resulting segmentation with data from the American Community Survey (ACS) regarding housing types and income and found that the Avista segmentation corresponded well with the ACS data. (See Chapter 3 for additional details.)
- To segment the commercial and industrial segments, we relied upon the allocation from the previous energy efficiency potential study. For the previous study, customers and sales were allocated to

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- [5] AEG staff has prepared three white papers on the topic of factors that affect U.S. electricity consumption, including appliance standards and building codes. Links to all three white papers are provided: http://www.edisonfoundation.net/IEE/Documents/IEE_RohmundApplianceStandardsEfficiencyCodes1209.pdf
- http://www.edisonfoundation.net/iee/Documents/IEE_CodesandStandardsAssessment_2010-2025_UPDATE.pdf.
- http://www.edisonfoundation.net/iee/Documents/IEE_FactorsAffectingUSElecConsumption_Final.pdf

building type based on SIC codes, with some adjustments between the commercial and industrial sectors to better group energy use by facility type and predominate end uses. (See Chapter 3 for additional details.)

Data Application for Market Profiles

The specific data elements for the market profiles, together with the key data sources, are shown in Table 2-5. To develop the market profiles for each segment, we did the following:

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity.
2. Used the Avista GenPOP Survey, NEEA's RBSA, NEEA's CBSA, NEEA's IFSA, and AEG's Energy Market Profiles database to develop existing appliance saturations, appliance and equipment characteristics, and building characteristics.
3. Ensured calibration to control totals for annual electricity sales in each sector and segment.
4. Compared and cross-checked with other recent AEG studies.
5. Worked with Avista staff to vet the data against their knowledge and experience.

Data Application for Baseline Projection

Table 2-5 summarizes the LoadMAP model inputs required for the baseline projection. These inputs are required for each segment within each sector, as well as for new construction and existing dwellings/buildings.

Table 2-5 Data Applied for the Market Profiles

Model Inputs	Description	Key Sources
Market size	Base-year residential dwellings, commercial floor space, and industrial employment	Avista billing data Avista GenPOP Survey NEEA RBSA and CBSA AEO 2019
Annual intensity	**Residential**: Annual use per household **Commercial**: Annual use per square foot **Industrial**: Annual use per employee	Avista billing data AEG's Energy Market Profiles NEEA RBSA and CBSA AEO 2019 Other recent studies
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology Percentage of C&I floor space/employment with equipment/technology	Avista GenPOP Survey NEEA RBSA and CBSA AEG's Energy Market Profiles
UEC/EUI for each end-use technology	UEC: Annual electricity use in homes and buildings that have the technology EUI: Annual electricity use per square foot/employee for a technology in floor space that has the technology	NWPCC RTF and Seventh Plan and RTF HVAC uses: BEST simulations using prototypes developed for Idaho Engineering analysis DEEM Recent AEG studies
Appliance/equipment age distribution	Age distribution for each technology	RTF and NWPCC Seventh Plan data NEEA regional survey data Utility saturation surveys Recent AEG studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	AEG DEEM AEO 2019 DEER RTF and NWPCC 2021 Plan data Previous studies
Peak factors	Share of technology energy use that occurs during the peak hour	EnergyShape database

Table 2-6 Data Needs for the Baseline Projection and Potentials Estimation in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential and C&I sectors	Avista load forecast AEO 2019 economic growth forecast
Equipment purchase shares for baseline projection	For each equipment/technology, purchase shares for each efficiency level; specified separately for existing equipment replacement and new construction	Shipments data from AEO and ENERGY STAR AEO 2019 regional forecast assumptions[6] Appliance/efficiency standards analysis Avista program results and evaluation reports
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models AEO 2019

In addition, we implemented assumptions for known future equipment standards as of September 2018, as shown in Table 2-6, Table 2-7 and Table 2-8. The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

[6] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2016), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and then held values constant for the study period. This removes any effects of naturally occurring conservation or effects of future EE programs that may be embedded in the AEO forecasts.

Table 2-7 Residential Electric Equipment Standards[7]

End Use	Technology	2019	2020	2021	2022	2023	2024	2025
Cooling	Central AC	SEER 13.0						
	Room AC	EER 10.8						
Cooling/ Heating	Air-Source Heat Pump	SEER 13.0 / HSPF 8.2					SEER 14.0 / HSPF 9.0	
Water Heating	Water Heater (<=55 gallons)	EF 0.95						
	Water Heater (>55 gallons)	EF 2.0 (Heat Pump Water Heater)						
Lighting	General Service	Advanced Incandescent (~20 lumens/watt)	Advanced Incandescent (~45 lumens/watt)					
	Linear Fluorescent	T8 (92.5 lm/W lamp)						
Appliances	Refrigerator	25% more efficient than the 1997 Final Rule (62 FR 23102)						
	Freezer							
	Clothes Washer	IMEF 1.84 / WF 4.7						
	Clothes Dryer	3.73 Combined EF						
Miscellaneous	Furnace Fans	ECM	ECM					

[7] The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

Table 2-8 Commercial Electric Equipment Standards[8]

<table>
<tr><th>End Use</th><th>Technology</th><th>2019</th><th>2020</th><th>2021</th><th>2022</th><th>2023</th><th>2024</th><th>2025</th></tr>
<tr><td rowspan="3">Cooling</td><td>Chillers</td><td colspan="7">2007 ASHRAE 90.1</td></tr>
<tr><td>RTUs</td><td colspan="7">EER 11.9/11.2</td></tr>
<tr><td>PTAC</td><td colspan="2">EER 9.8</td><td colspan="5">EER 11.0</td></tr>
<tr><td rowspan="2">Cooling/ Heating</td><td>Heat Pump</td><td>EER 11.0/
COP 3.3</td><td colspan="6">EER 11.4/
COP 3.3</td></tr>
<tr><td>PTHP</td><td colspan="7">EER 10.4/COP 3.1</td></tr>
<tr><td>Ventilation</td><td>All</td><td colspan="7">Constant Air Volume/Variable Air Volume</td></tr>
<tr><td rowspan="3">Lighting</td><td>General Service</td><td>Advanced Incandescent
(~20 lumens/watt)</td><td colspan="6">Advanced Incandescent
(~45 lumens/watt)</td></tr>
<tr><td>Linear Lighting</td><td colspan="7">T8 (82.5 lm/W lamp)</td></tr>
<tr><td>High Bay</td><td>51.2 lm/W</td><td colspan="6">Metal Halide (55.6 lm/W)</td></tr>
<tr><td rowspan="5">Refrigeration</td><td>Walk-In</td><td>COP 3.2</td><td colspan="6">COP 6.1</td></tr>
<tr><td>Reach-In</td><td colspan="7">32 kWh/sqft</td></tr>
<tr><td>Glass Door</td><td colspan="7">12-28% more efficient than EPACT 2005</td></tr>
<tr><td>Open Display</td><td>1,537 kWh/ft</td><td colspan="6">1,453 kWh/ft</td></tr>
<tr><td>Icemaker</td><td colspan="7">6.1 kWh/100 lbs.</td></tr>
<tr><td>Food Service</td><td>Pre-Rinse</td><td>1.6 GPM</td><td colspan="6">1.0 GPM</td></tr>
<tr><td>Motors</td><td>All</td><td colspan="7">Expanded EISA 2007</td></tr>
</table>

[8] The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

Table 2-9 Industrial Electric Equipment Standards[9]

End Use	Technology	2019	2020	2021	2022	2023	2024	2025
Cooling	Chillers	2007 ASHRAE 90.1						
	RTUs	EER 11.9/11.2						
	PTAC	EER 9.8		EER 11.0				
Cooling/ Heating	Heat Pump	EER 11.0/ COP 3.3; EER 11.4/ COP 3.3						
	PTHP	EER 10.4/COP 3.1						
Ventilation	All	Constant Air Volume/Variable Air Volume						
Lighting	General Service	Advanced Incandescent (~20 lumens/watt)	Advanced Incandescent (~45 lumens/watt)					
	Linear Lighting	T8 (82.5 lm/W lamp)						
	High Bay	51.2 lm/W; Metal Halide (55.6 lm/W)						
Motors	All	Expanded EISA 2007						

[9] The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

Conservation Measure Data Application

Table 2-9 details the energy-efficiency data inputs to the LoadMAP model. It describes each input and identifies the key sources used in the Avista analysis.

Table 2-10 Data Needs for the Measure Characteristics in LoadMAP

Model Inputs	Description	Key Sources
Energy Impacts	The annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects.	Avista measure data NWPCC workbooks, RTF NWPCC Seventh Plan conservation workbooks BEST AEG DEEM AEO 2019 DEER Other secondary sources
Peak Demand Impacts	Savings during the peak demand periods are specified for each electric measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak.	Avista measure data BEST AEG DEEM EnergyShape
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, per employee or per service point basis for the residential, commercial, and industrial sectors, respectively. Non-equipment measures: Existing buildings – full installed cost. New Construction - the costs may be either the full cost of the measure, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks AEG DEEM AEO 2019 DEER RS Means Other secondary sources
Measure Lifetimes	Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooksAEG DEEM AEO 2019 DEER Other secondary sources
Applicability	Estimate of the percentage of dwellings in the residential sector, square feet in the commercial sector, or employees in the industrial sector where the measure is applicable and where it is technically feasible to implement.	Avista measure data NWPCC workbooks, RTF NWPCC 2021 Plan conservation workbooks AEG DEEM DEER Other secondary sources

On Market and Off Market Availability	Expressed as years for equipment measures to reflect when the equipment technology is available or no longer available in the market.	AEG appliance standards and building codes analysis

Data Application for Technical Achievable Potential

To estimate Technical Achievable Potential, two sets of parameters are needed to represent customer decision making behavior with respect to energy-efficiency choices.

- **Technical diffusion curves for non-equipment measures**. Equipment measures are installed when existing units fail. Non-equipment measures do not have this natural periodicity, so rather than installing all available non-equipment measures in the first year of the projection (instantaneous potential), they are phased in according to adoption schedules that generally align with the diffusion of similar equipment measures. Like the 2019 CPA, we applied the "Retrofit" ramp rates from the 2021 Power Plan directly as diffusion curves. For technical potential, these rates summed up to 100% by the 20th year for all measures.
- **Adoption rates**. Customer adoption rates or take rates are applied to technical potential to estimate Technical Achievable Potential. For equipment measures, the Council's "Lost Opportunity" ramp rates were applied to technical potential with a maximum achievability of 85%-100% depending on the measure. For non-equipment measures, the Council's "Retrofit" ramp rates have already been applied to calculate technical diffusion. In this case, we multiply each of these by 85% (for most measures) to calculate Technical Achievable Potential. Adoption rates are presented in Appendix B.

3

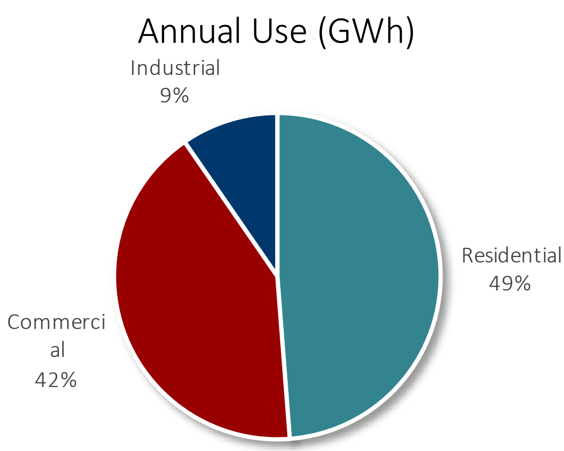
MARKET CHARACTERIZATION AND MARKET PROFILES

In this section, we describe how customers in the Avista service territory use electricity in the base year of the study, 2019. It begins with a high-level summary of energy use across all sectors and then delves into each sector in more detail.

Energy Use Summary

Total electricity use for the residential, commercial, and industrial sectors for Avista in 2019 was 7,794 GWh; 5,205 GWh (WA) and 2,589 GWh (ID). As shown in the tables below, in both states the residential sector accounts for nearly 50% of annual energy use, followed by commercial at around 40% of annual energy use. In terms of winter peak demand, the total system peak in 2019 was 1,530 MW: 1,060 (WA) and 470 MW (ID). In both states, the residential sector contributes the most to the winter peak.

Figure 3-1 Sector-Level Electricity Use in Base Year 2019, Washington



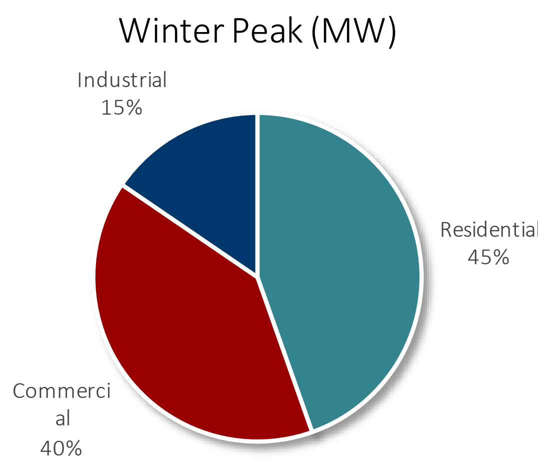


Table 3-1 Avista Sector Control Totals (2019), Washington

Sector	Annual Electricity Use (GWh)	% of Annual Use	Winter Peak Demand (MW)	% of Winter Peak
Residential	2,539	49%	473	45%
Commercial	2,166	42%	423	40%
Industrial	500	10%	164	15%
Total	**5,205**	**100%**	**1,060**	**100%**

Figure 3-2 Sector-Level Electricity Use in Base Year 2019, Idaho

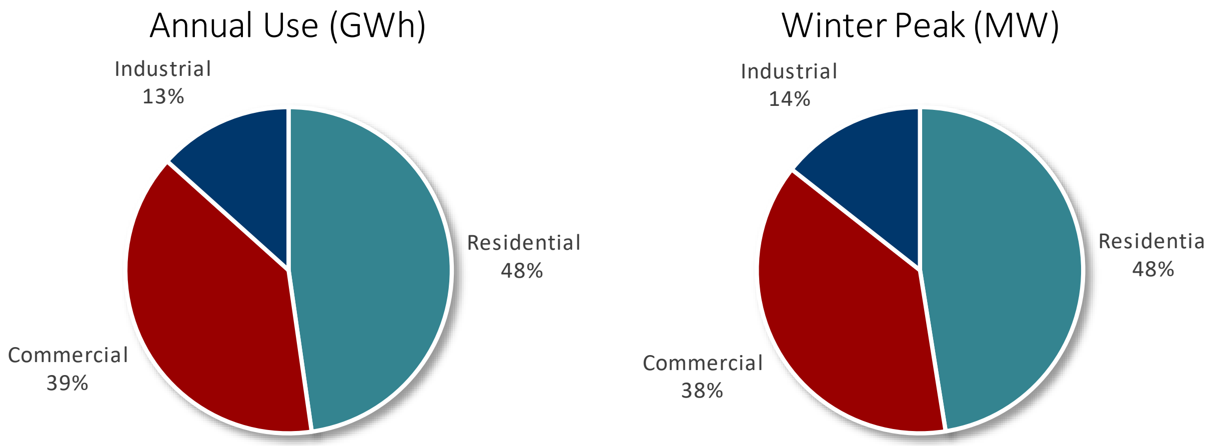


Table 3-2 Avista Sector Control Totals (2019), Idaho

Sector	Annual Electricity Use (GWh)	% of Annual Use	Winter Peak Demand (MW)	% of Winter Peak
Residential	1,236	48%	223	47%
Commercial	1,007	39%	179	38%
Industrial	346	13%	68	14%
Total	**2,589**	**100%**	**470**	**100%**

Residential Sector

The total number of households and electricity sales for the service territory were obtained from Avista's customer database. In 2019, there were 229,171 households in the state of Washington that used a total of 2,539 GWh with winter peak demand of 473 MW. Average use per customer (or household) at 11,080 kWh is about average compared to other regions of the country. We allocated these totals into four residential segments and the values are shown in Table 3-3.

Table 3-4 shows the total number of households and electricity sales in the state of Idaho. In 2019, there were 116,114 households that used a total of 1,236 GWh with winter peak demand of 223 MW. Average use per customer (or household) was 10,643 kWh.

Table 3-3 Residential Sector Control Totals (2019), Washington

Segment	Number of Customers	Electricity Use	% of Annual	Annual Use/Customer (kWh/HH)	Winter Peak
Single Family	139,336	1,778	70%	12,760	330
Multifamily	12,834	98	4%	7,656	18
Mobile Home	8,250	95	4%	11,484	18
Low Income	68,751	568	22%	8,266	107
Total	**229,171**	**2,539**	**100%**	**11,080**	**473**

Table 3-4 Residential Sector Control Totals (2019), Idaho

Segment	Number of Customers	Electricity Use	% of Annual	Annual Use/Customer (kWh/HH)	Winter Peak
Single Family	70,597	863	70%	12,224	154
Multifamily	5,690	42	3%	7,326	7
Mobile Home	5,225	57	5%	10,989	10
Low Income	34,602	274	22%	7,910	51
Total	**116,114**	**1,236**	**100%**	**10,643**	**223**

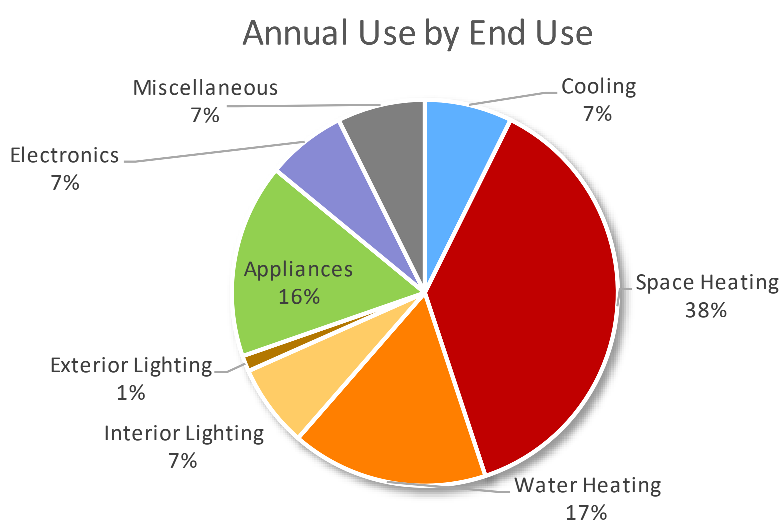
As we describe in the previous chapter, the market profiles provide the foundation for development of the baseline projection and the potential estimates. The average market profile for the residential sector is presented in Table 3-5 (WA) and Table 3-6 (ID). Segment-specific market profiles are presented in Appendix A.

Figure 3-3 (WA) and Figure 3-4 (ID) show the distribution of annual electricity use by end use for all customers. Two main electricity end uses —appliances and space heating— account for approximately 55% of total use. Appliances include refrigerators, freezers, stoves, clothes washers, clothes dryers, dishwashers, and microwaves. The remainder of the energy falls into the water heating, lighting, cooling, electronics, and the miscellaneous category – which is comprised of furnace fans, pool pumps, electric vehicles, and other "plug" loads (all other usage not covered by those listed in Table 3-5 and Table 3-6 such as hair dryers, power tools, coffee makers, etc.).

The charts also show estimates of winter peak demand by end use. As expected, heating is the largest contributor to winter peak demand, followed by appliances, lighting, and water heating.

Figure 3-5 (WA) and Figure 3-6 (ID) present the electricity intensities by end use and housing type. Single family homes have the highest use per customer at 11,699 kWh/year (WA) and 11,158 kWh/year (ID).

Figure 3-3 Residential Electricity Use and Winter Peak Demand by End Use (2019), Washington



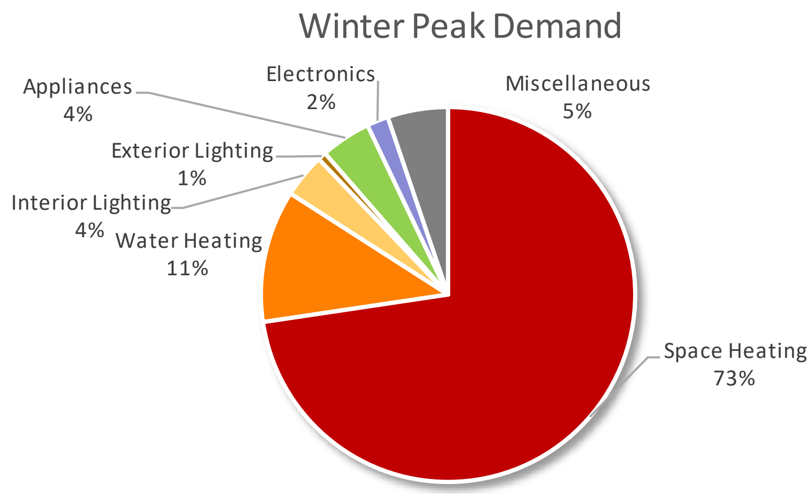
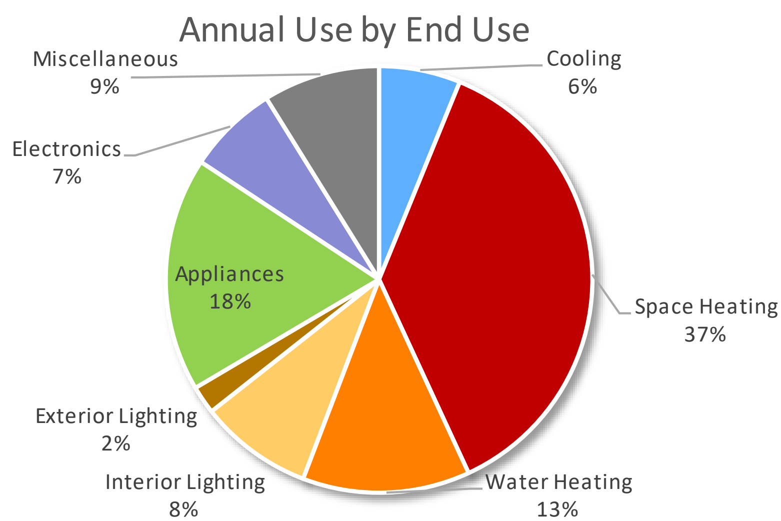


Figure 3-4 Residential Electricity Use and Winter Peak Demand by End Use (2019), Idaho



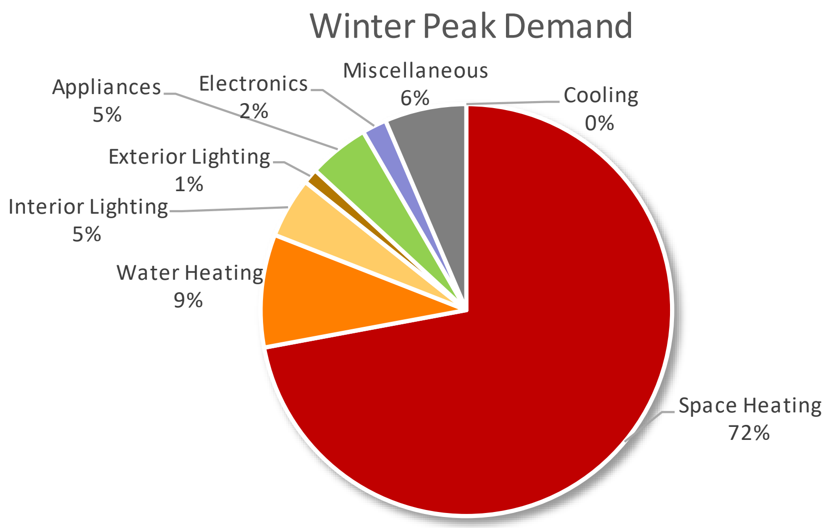


Figure 3-5 Residential Intensity by End Use and Segment (Annual kWh/HH, 2019), Washington

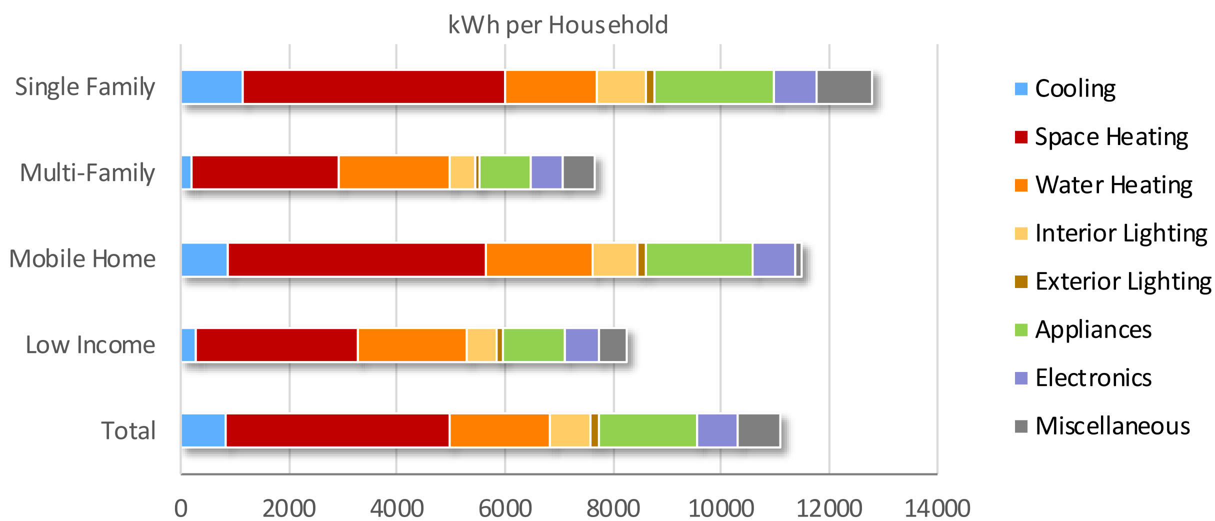


Figure 3-6 Residential Intensity by End Use and Segment (Annual kWh/HH, 2019), Idaho

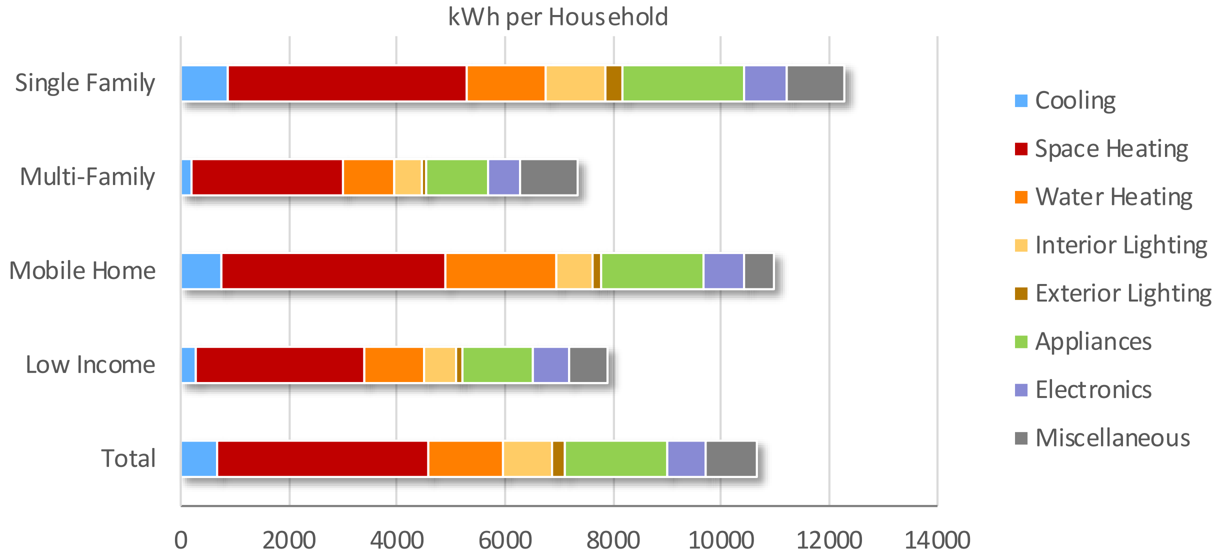


Table 3-5 Average Market Profile for the Residential Sector, 2019, Washington

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/HH)	Usage (MWh)
Cooling	Central AC	23.7%	1,396	331	75,859
Cooling	Room AC	21.3%	307	65	15,008
Cooling	Air-Source Heat Pump	24.1%	1,611	388	88,988
Cooling	Geothermal Heat Pump	1.6%	1,737	28	6,355
Cooling	Evaporative AC	1.2%	163	2	448
Space Heating	Electric Room Heat	25.8%	4,478	1,153	264,334
Space Heating	Electric Furnace	8.8%	9,062	794	182,039
Space Heating	Air-Source Heat Pump	24.1%	7,030	1,695	388,343
Space Heating	Geothermal Heat Pump	1.6%	3,627	58	13,267
Space Heating	Secondary Heating	65.2%	724	472	108,184
Water Heating	Water Heater <= 55 Gal	61.1%	2,816	1,720	394,122
Water Heating	Water Heater > 55 Gal	3.7%	3,006	112	25,582
Interior Lighting	General Service Lighting	100.0%	443	443	101,528
Interior Lighting	Linear Lighting	100.0%	105	105	23,961
Interior Lighting	Exempted Lighting	100.0%	223	223	51,103
Exterior Lighting	Lighting	100.0%	147	147	33,657
Appliances	Clothes Washer	78.0%	104	81	18,656
Appliances	Clothes Dryer	72.3%	756	546	125,139
Appliances	Dishwasher	76.9%	85	65	15,006
Appliances	Refrigerator	98.8%	520	513	117,677
Appliances	Freezer	34.3%	460	158	36,171
Appliances	Second Refrigerator	22.9%	816	187	42,805
Appliances	Stove/Oven	90.8%	165	150	34,370
Appliances	Microwave	94.8%	113	108	24,655
Electronics	Personal Computers	50.1%	146	73	16,774
Electronics	Monitor	93.2%	58	54	12,299
Electronics	Laptops	39.9%	38	15	3,472
Electronics	TVs	190.7%	100	191	43,848
Electronics	Printer/Fax/Copier	46.2%	40	19	4,262
Electronics	Set-top Boxes/DVRs	153.8%	95	146	33,360
Electronics	Devices and Gadgets	100.0%	243	243	55,706
Miscellaneous	Electric Vehicles	0.5%	3,153	16	3,641
Miscellaneous	Pool Pump	1.1%	1,313	14	3,185
Miscellaneous	Pool Heater	1.1%	3,517	37	8,592
Miscellaneous	Hot Tub / Spa	8.8%	1,468	130	29,679
Miscellaneous	Furnace Fan	50.1%	201	100	23,030
Miscellaneous	Well pump	2.4%	551	14	3,094
Miscellaneous	Miscellaneous	100.0%	507	507	116,158
Generation	Solar PV	0.3%	-7,809	-23	-5,183
	Total			**11,080**	**2,539,174**

Table 3-6 Average Market Profile for the Residential Sector, 2019, Idaho

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/HH)	Usage (MWh)
Cooling	Central AC	28.9%	1,405	406	47,107
Cooling	Room AC	16.6%	364	61	7,025
Cooling	Air-Source Heat Pump	11.8%	1,529	181	21,029
Cooling	Geothermal Heat Pump	0.5%	1,743	9	1,063
Cooling	Evaporative AC	1.5%	157	2	282
Space Heating	Electric Room Heat	23.2%	6,008	1,391	161,557
Space Heating	Electric Furnace	11.1%	8,590	953	110,663
Space Heating	Air-Source Heat Pump	11.8%	6,956	824	95,672
Space Heating	Geothermal Heat Pump	0.5%	6,387	34	3,895
Space Heating	Secondary Heating	49.7%	1,482	736	85,472
Water Heating	Water Heater <= 55 Gal	44.7%	2,884	1,290	149,797
Water Heating	Water Heater > 55 Gal	2.1%	3,010	64	7,379
Interior Lighting	General Service Screw-in	100.0%	627	627	72,828
Interior Lighting	Linear Lighting	100.0%	99	99	11,477
Interior Lighting	Exempted Screw-In	100.0%	189	189	21,997
Exterior Lighting	Screw-in	100.0%	227	227	26,365
Appliances	Clothes Washer	83.0%	103	86	9,963
Appliances	Clothes Dryer	80.2%	748	600	69,687
Appliances	Dishwasher	74.4%	85	64	7,390
Appliances	Refrigerator	100.0%	520	520	60,341
Appliances	Freezer	39.9%	461	184	21,390
Appliances	Second Refrigerator	24.8%	809	200	23,269
Appliances	Stove/Oven	84.0%	165	138	16,045
Appliances	Microwave	91.2%	114	104	12,028
Electronics	Personal Computers	66.0%	146	96	11,204
Electronics	Monitor	119.8%	58	69	8,011
Electronics	Laptops	45.0%	38	17	1,986
Electronics	TVs	187.8%	100	188	21,870
Electronics	Printer/Fax/Copier	55.1%	40	22	2,577
Electronics	Set-top Boxes/DVRs	101.2%	95	96	11,119
Electronics	Devices and Gadgets	100.0%	243	243	28,225
Miscellaneous	Electric Vehicles	0.5%	3,153	16	1,845
Miscellaneous	Pool Pump	1.1%	1,313	14	1,613
Miscellaneous	Pool Heater	0.2%	3,517	7	823
Miscellaneous	Hot Tub / Spa	4.7%	1,881	88	10,169
Miscellaneous	Furnace Fan	41.4%	290	120	13,931
Miscellaneous	Well pump	1.7%	555	10	1,104
Miscellaneous	Miscellaneous	100.0%	691	691	80,180
Generation	Solar PV	0.3%	-7,809	-23	-2,626
	Total			**10,643**	**1,235,752**

Commercial Sector

The total electric energy consumed by commercial customers in Avista's service area in 2017 was 2,166 GWh (WA) and 1,007 GWh (ID). Avista billing data, CBSA and secondary data were used to allocate this energy usage to building type segments and to develop estimates of energy intensity (annual kWh/square foot). Using the electricity use and intensity estimates, we infer floor space which is the unit of analysis in LoadMAP for the commercial sector. The values are shown in Table 3-7 (WA) and Table 3-8 (ID). The average building intensities by segment are based on regional information from the CBSA, therefore the intensity is the same both states. However, due to the different mix of building types, overall end use mix is different as shown in Figure 3-9 and Figure 3-10.

Table 3-7 Commercial Sector Control Totals (2019), Washington

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity
Small Office	192	9%	15.6
Large Office	507	23%	17.3
Restaurant	113	5%	40.9
Retail	278	13%	12.2
Grocery	193	9%	43.4
College	114	5%	16.2
School	146	7%	9.1
Health	119	5%	23.3
Lodging	86	4%	12.2
Warehouse	95	4%	4.7
Miscellaneous	324	15%	10.3
Total	**2,166**	**100%**	**13.7**

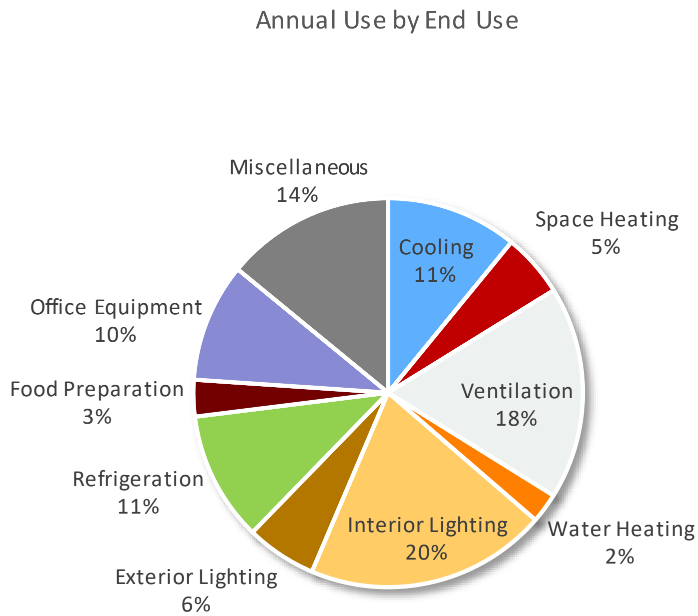
Table 3-8 Commercial Sector Control Totals (2019), Idaho

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity
Small Office	186	9%	15.6
Large Office	167	8%	17.3
Restaurant	33	2%	40.9
Retail	143	7%	12.2
Grocery	10	0%	43.5
College	72	3%	16.2
School	5	0%	9.1
Health	59	3%	23.3
Lodging	76	4%	12.3
Warehouse	55	3%	4.7
Miscellaneous	201	9%	10.3
Total	**1,007**	**100%**	**12.7**

Figure 3-7 (WA) and Figure 3-8 (ID) show the distribution of annual electricity consumption and summer peak demand by end use across all commercial buildings. Electric usage is dominated by lighting and ventilation, which comprise almost 44% of annual electricity usage. Lighting and ventilation also make up the largest portions of winter peak, however electric space heating represents a greater part of the peak than it does annual energy.

Figure 3-9 (WA) and Figure 3-10 (ID) presents the electricity usage in GWh by end use and segment. In Washington, Large offices, retail, and miscellaneous buildings use the most electricity in the service territory. For Idaho, Large and Small Offices are more balanced in terms of total consumption. HVAC and lighting are the major end uses across most segments, aside from Large Offices and grocery, where office equipment and refrigeration equipment, respectively, are highly concentrated.

Figure 3-7 Commercial Electricity Use and Winter Peak Demand by End Use (2019), Washington



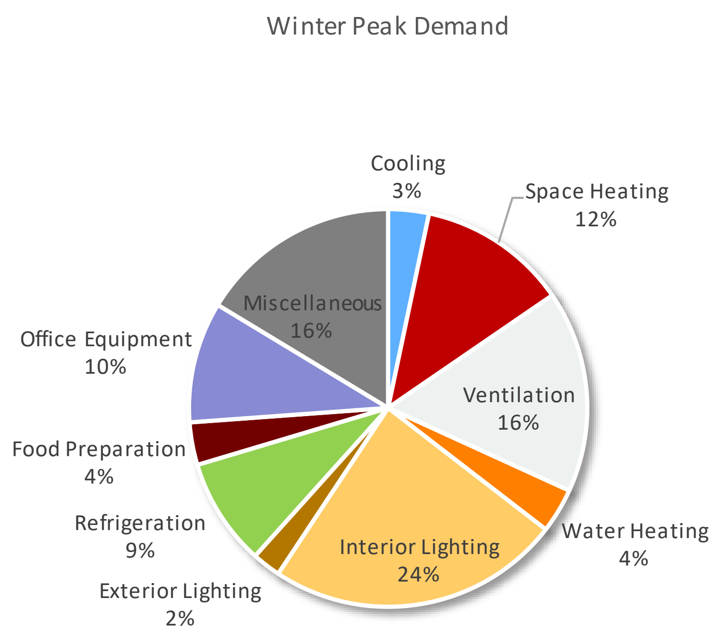
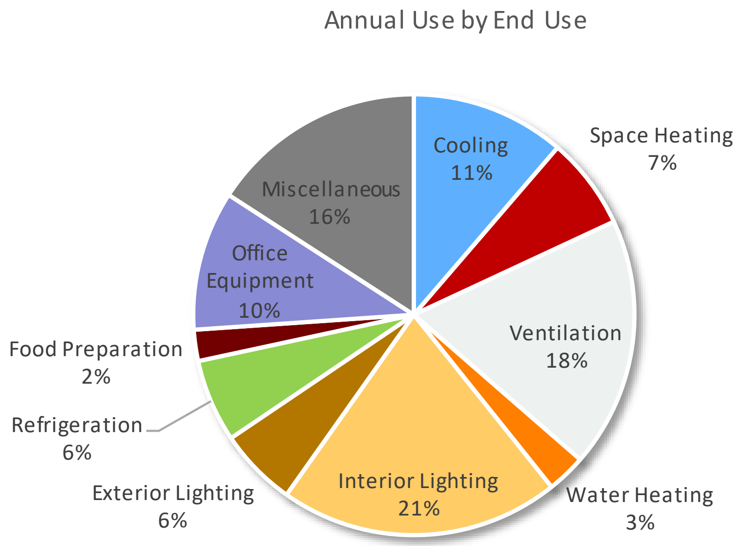


Figure 3-8 Commercial Electricity Use and Winter Peak Demand by End Use (2019), Idaho



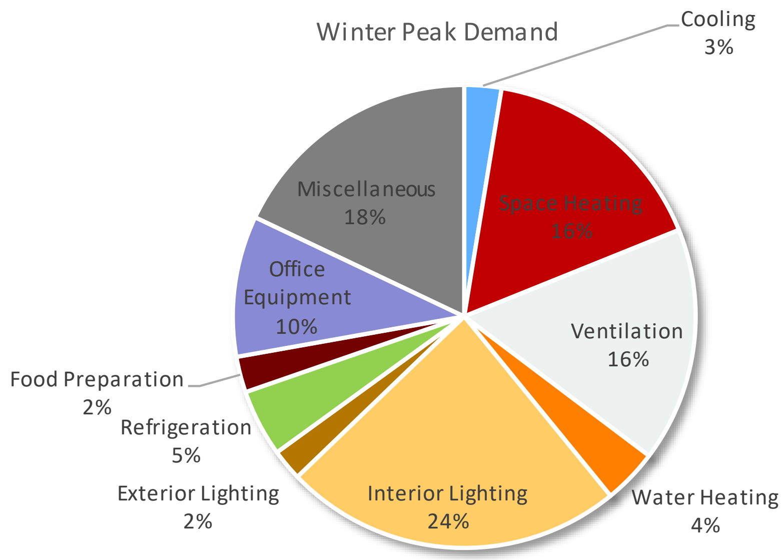


Figure 3-9 Commercial Electricity Usage by End Use Segment (GWh, 2019), Washington

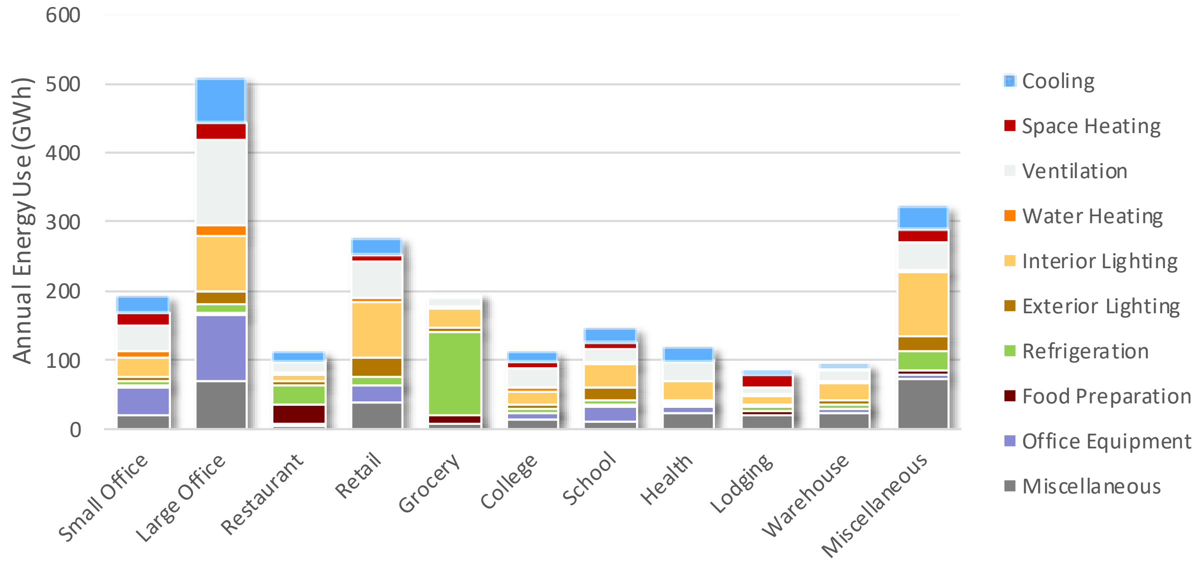


Figure 3-10 Commercial Electricity Usage by End Use Segment (GWh, 2019), Idaho

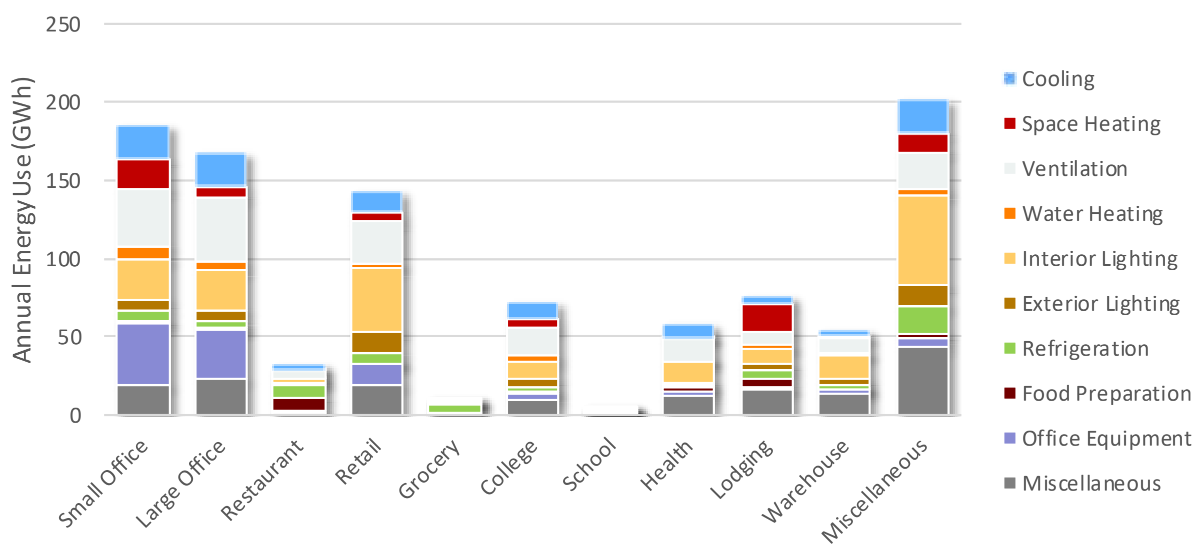


Table 3-9 (WA) and Table 3-10 (ID) show the average market profile for electricity of the commercial sector as a whole, representing a composite of all segments and buildings. Market profiles for each segment are presented in the appendix to this volume.

Table 3-9 Average Electric Market Profile for the Commercial Sector, 2019, Washington

End Use	Technology	Saturation	EUI	Intensity	Usage
			(kWh/Sq.Ft.)	(kWh/Sq.Ft.)	(GWh)
Cooling	Air-Cooled Chiller	8.4%	2.25	0.19	31.0
Cooling	Water-Cooled Chiller	4.7%	3.32	0.15	25.5
Cooling	RTU	43.1%	1.88	0.81	133.2
Cooling	PTAC	4.2%	1.51	0.06	10.4
Cooling	PTHP	1.6%	1.57	0.03	4.2
Cooling	Evaporative AC	0.6%	0.79	0.00	0.7
Cooling	Air-Source Heat Pump	6.8%	2.00	0.14	22.5
Cooling	Geothermal Heat Pump	3.1%	1.72	0.05	8.8
Heating	Electric Furnace	2.6%	2.58	0.07	11.1
Heating	Electric Room Heat	14.1%	2.67	0.38	61.9
Heating	PTHP	1.6%	2.45	0.04	6.6
Heating	Air-Source Heat Pump	6.8%	2.12	0.14	23.8
Heating	Geothermal Heat Pump	3.1%	2.06	0.06	10.6
Ventilation	Ventilation	100.0%	2.33	2.33	383.2
Water Heating	Water Heater	31.5%	1.04	0.33	53.8
Interior Lighting	General Service Lighting	100.0%	0.32	0.32	52.8
Interior Lighting	Exempted Lighting	100.0%	0.08	0.08	13.1
Interior Lighting	High-Bay Lighting	100.0%	0.33	0.33	54.9
Interior Lighting	Linear Lighting	100.0%	1.91	1.91	313.4
Exterior Lighting	General Service Lighting	100.0%	0.18	0.18	28.9
Exterior Lighting	Area Lighting	100.0%	0.39	0.39	63.4
Exterior Lighting	Linear Lighting	100.0%	0.21	0.21	34.5
Refrigeration	Walk-in Refrigerator/Freezer	7.8%	1.16	0.09	14.8
Refrigeration	Reach-in Refrigerator/Freezer	15.5%	1.25	0.19	31.9
Refrigeration	Glass Door Display	33.0%	1.05	0.35	56.8
Refrigeration	Open Display Case	33.0%	1.39	0.46	75.6
Refrigeration	Icemaker	32.7%	0.73	0.24	39.1
Refrigeration	Vending Machine	32.7%	0.28	0.09	15.2
Food Preparation	Oven	22.9%	0.18	0.04	6.6
Food Preparation	Fryer	28.3%	0.54	0.15	25.0
Food Preparation	Dishwasher	19.8%	0.35	0.07	11.6
Food Preparation	Hot Food Container	20.9%	0.13	0.03	4.3
Food Preparation	Steamer	18.2%	0.34	0.06	10.1
Food Preparation	Griddle	17.7%	0.28	0.05	8.3
Office Equipment	Desktop Computer	100.0%	0.39	0.39	64.5
Office Equipment	Laptop	99.0%	0.12	0.12	20.0
Office Equipment	Server	91.0%	0.69	0.63	103.0
Office Equipment	Monitor	100.0%	0.07	0.07	11.4
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	5.1
Office Equipment	POS Terminal	57.1%	0.11	0.06	10.0
Miscellaneous	Non-HVAC Motors	48.3%	0.54	0.26	42.5
Miscellaneous	Pool Pump	8.8%	0.13	0.01	1.9
Miscellaneous	Pool Heater	3.1%	0.17	0.01	0.8
Miscellaneous	Clothes Washer	10.2%	0.05	0.01	0.9
Miscellaneous	Clothes Dryer	6.6%	0.19	0.01	2.1
Miscellaneous	Other Miscellaneous	100.0%	1.56	1.56	256.1
Generation	Solar PV	0.0%	0.00	0.00	0.0
Total				**13.17**	**2,166.0**

Table 3-10 Average Electric Market Profile for the Commercial Sector, 2019, Idaho

End Use	Technology	Saturation	EUI (kWh/Sq.Ft.)	Intensity (kWh/Sq.Ft.)	Usage (GWh)
Cooling	Air-Cooled Chiller	0.8%	1.57	0.01	0.2
Cooling	Water-Cooled Chiller	0.5%	1.71	0.01	0.1
Cooling	RTU	58.5%	1.59	0.93	11.3
Cooling	PTAC	2.6%	1.67	0.04	0.5
Cooling	PTHP	0.5%	1.58	0.01	0.1
Cooling	Evaporative AC	3.0%	0.63	0.02	0.2
Cooling	Air-Source Heat Pump	3.1%	1.58	0.05	0.6
Cooling	Geothermal Heat Pump	0.0%	1.24	0.00	0.0
Heating	Electric Furnace	1.0%	3.09	0.03	0.4
Heating	Electric Room Heat	11.5%	2.95	0.34	4.1
Heating	PTHP	0.5%	2.09	0.01	0.1
Heating	Air-Source Heat Pump	3.1%	2.32	0.07	0.9
Heating	Geothermal Heat Pump	0.0%	2.02	0.00	0.0
Ventilation	Ventilation	100.0%	2.23	2.23	27.1
Water Heating	Water Heater	38.2%	0.73	0.28	3.4
Interior Lighting	General Service Lighting	100.0%	0.19	0.19	2.3
Interior Lighting	Exempted Lighting	100.0%	0.05	0.05	0.6
Interior Lighting	High-Bay Lighting	100.0%	0.71	0.71	8.6
Interior Lighting	Linear Lighting	100.0%	2.36	2.36	28.8
Exterior Lighting	General Service Lighting	100.0%	0.33	0.33	4.0
Exterior Lighting	Area Lighting	100.0%	0.67	0.67	8.1
Exterior Lighting	Linear Lighting	100.0%	0.20	0.20	2.5
Refrigeration	Walk-in Refrigerator/Freezer	0.0%	1.27	0.00	0.0
Refrigeration	Reach-in Refrigerator/Freezer	5.4%	1.52	0.08	1.0
Refrigeration	Glass Door Display	5.4%	1.56	0.08	1.0
Refrigeration	Open Display Case	5.4%	5.03	0.27	3.3
Refrigeration	Icemaker	5.1%	1.28	0.07	0.8
Refrigeration	Vending Machine	5.1%	0.61	0.03	0.4
Food Preparation	Oven	3.6%	0.12	0.00	0.1
Food Preparation	Fryer	3.6%	0.17	0.01	0.1
Food Preparation	Dishwasher	3.6%	0.11	0.00	0.0
Food Preparation	Hot Food Container	3.6%	0.03	0.00	0.0
Food Preparation	Steamer	3.6%	0.18	0.01	0.1
Food Preparation	Griddle	3.6%	0.17	0.01	0.1
Office Equipment	Desktop Computer	100.0%	0.16	0.16	2.0
Office Equipment	Laptop	100.0%	0.05	0.05	0.6
Office Equipment	Server	100.0%	0.46	0.46	5.6
Office Equipment	Monitor	100.0%	0.03	0.03	0.4
Office Equipment	Printer/Copier/Fax	100.0%	0.05	0.05	0.6
Office Equipment	POS Terminal	100.0%	0.32	0.32	3.9
Miscellaneous	Non-HVAC Motors	22.0%	1.17	0.26	3.1
Miscellaneous	Pool Pump	0.0%	0.77	0.00	0.0
Miscellaneous	Pool Heater	0.0%	1.00	0.00	0.0
Miscellaneous	Clothes Washer	0.0%	0.24	0.00	0.0
Miscellaneous	Clothes Dryer	0.0%	0.79	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	1.32	1.32	16.1
Generation	Solar PV	0.0%	0.00	0.00	0.0
Total				**11.75**	**143.0**

Industrial Sector

The total electricity used in 2019 by Avista's industrial customers was 846 GWh; 500 GWh (WA) and 346 GWh (ID). Avista billing data and load forecast, NEEA's IFSA, and secondary sources were used to develop estimates of energy intensity (annual kWh/employee). Using the electricity use and intensity estimates, we infer the number of employees which is the unit of analysis in LoadMAP for the industrial sector. These are shown in Table 3-11.

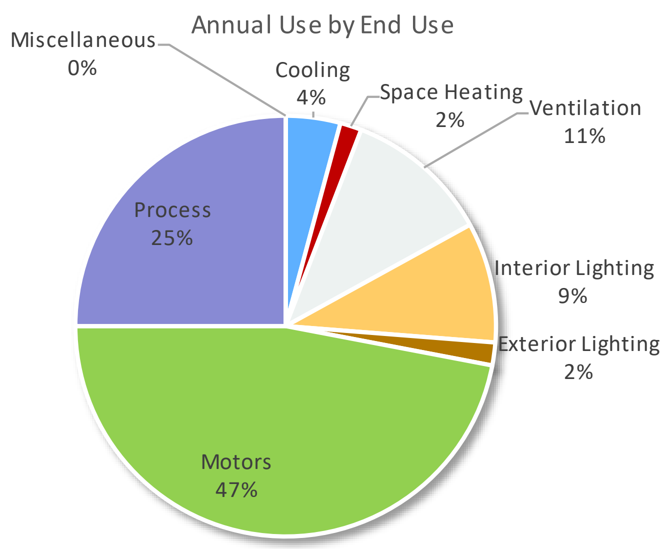
Table 3-11 Industrial Sector Control Totals (2019)

State	Electricity Sales (GWh)	Intensity (Annual kWh/employee)	Winter Peak (MW)
Washington	500	42,527	164
Idaho	346	29,394	68

Figure 3-12 shows the distribution of annual electricity consumption and summer peak demand by end use for all industrial customers. Motors are the largest overall end use for the industrial sector, accounting for 47% of energy use. Note that this end use includes a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for 25% of annual energy use, which includes heating, cooling, refrigeration, and electro-chemical processes. Lighting is the next highest, followed by cooling, miscellaneous, heating and ventilation.

Table 3-12 and Table 3-13 show the composite market profile for the industrial sector.

Figure 3-11 Industrial Electricity Use and Winter Peak Demand by End Use (2019), All Industries, WA



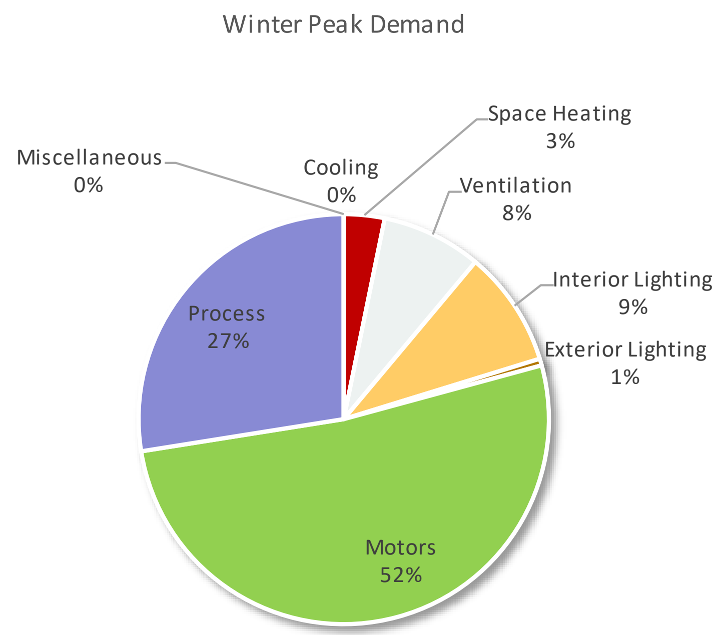
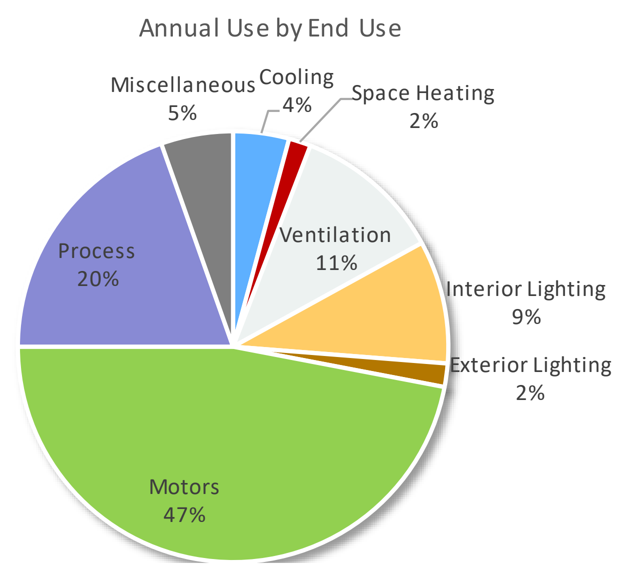


Figure 3-12 Industrial Electricity Use and Winter Peak Demand by End Use (2019), All Industries, ID



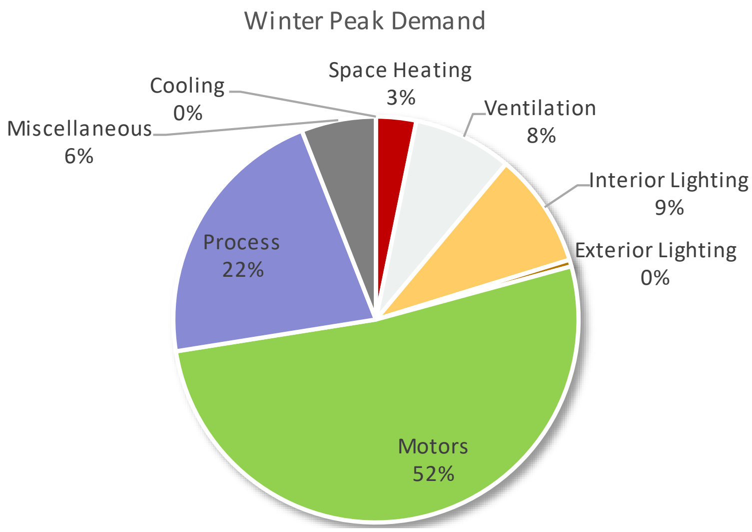

Winter Peak Demand
Space Heating 3%
Ventilation 8%
Interior Lighting 9%
Exterior Lighting 0%
Motors 52%
Process 22%
Miscellaneous 6%
Cooling 0%

Table 3-12 Average Electric Market Profile for the Industrial Sector, 2019, Washington

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	2.5%	10,819.85	270.50	3.2
Cooling	Water-Cooled Chiller	2.5%	12,534.09	313.35	3.7
Cooling	RTU	10.2%	10,083.74	1,030.52	12.1
Cooling	Air-Source Heat Pump	1.7%	10,077.53	170.41	2.0
Cooling	Geothermal Heat Pump	0.0%	1.00	0.00	0.0
Heating	Electric Furnace	0.5%	16,090.76	76.54	0.9
Heating	Electric Room Heat	2.6%	15,324.53	394.31	4.6
Heating	Air-Source Heat Pump	1.7%	13,686.41	231.44	2.7
Heating	Geothermal Heat Pump	0.0%	1.00	0.00	0.0
Ventilation	Ventilation	100.0%	4,742.42	4,742.42	55.8
Interior Lighting	General Service Lighting	100.0%	106.36	106.36	1.3
Interior Lighting	High-Bay Lighting	100.0%	1,912.71	1,912.71	22.5
Interior Lighting	Linear Lighting	100.0%	1,912.71	1,912.71	22.5
Exterior Lighting	General Service Lighting	100.0%	134.90	134.90	1.6
Exterior Lighting	Area Lighting	100.0%	254.16	254.16	3.0
Exterior Lighting	Linear Lighting	100.0%	357.08	357.08	4.2
Motors	Pumps	100.0%	4,252.64	4,252.64	50.0
Motors	Fans & Blowers	100.0%	2,976.85	2,976.85	35.0
Motors	Compressed Air	100.0%	2,976.85	2,976.85	35.0
Motors	Material Handling	100.0%	8,505.29	8,505.29	100.0
Motors	Other Motors	100.0%	1,275.79	1,275.79	15.0
Process	Process Heating	100.0%	4,677.91	4,677.91	55.0
Process	Process Cooling	100.0%	1,275.79	1,275.79	15.0
Process	Process Refrigeration	100.0%	1,275.79	1,275.79	15.0
Process	Process Electrochemical	100.0%	2,625.61	2,625.61	30.9
Process	Process Other	100.0%	776.51	776.51	9.1
Miscellaneous	Miscellaneous	0.0%	1.00	0.00	0.0
Total				**42,526.45**	**500.1**

Table 3-13 Average Electric Market Profile for the Industrial Sector, 2019, Idaho

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	2.5%	15,505.86	387.65	2.2
Cooling	Water-Cooled Chiller	2.5%	17,962.52	449.06	2.5
Cooling	RTU	10.2%	14,450.94	1,476.83	8.4
Cooling	Air-Source Heat Pump	1.7%	14,442.05	244.21	1.4
Cooling	Geothermal Heat Pump	0.0%	1.00	0.00	0.0
Heating	Electric Furnace	0.5%	23,059.55	109.70	0.6
Heating	Electric Room Heat	2.6%	21,961.48	565.09	3.2
Heating	Air-Source Heat Pump	1.7%	19,613.90	331.67	1.9
Heating	Geothermal Heat Pump	0.0%	1.00	0.00	0.0
Ventilation	Ventilation	100.0%	6,796.33	6,796.33	38.5
Interior Lighting	General Service Lighting	100.0%	152.42	152.42	0.9
Interior Lighting	High-Bay Lighting	100.0%	2,741.09	2,741.09	15.5
Interior Lighting	Linear Lighting	100.0%	2,741.09	2,741.09	15.5
Exterior Lighting	General Service Lighting	100.0%	193.33	193.33	1.1
Exterior Lighting	Area Lighting	100.0%	364.23	364.23	2.1
Exterior Lighting	Linear Lighting	100.0%	511.72	511.72	2.9
Motors	Pumps	100.0%	6,094.44	6,094.44	34.6
Motors	Fans & Blowers	100.0%	4,266.10	4,266.10	24.2
Motors	Compressed Air	100.0%	4,266.10	4,266.10	24.2
Motors	Material Handling	100.0%	12,188.87	12,188.87	69.1
Motors	Other Motors	100.0%	1,828.33	1,828.33	10.4
Process	Process Heating	100.0%	6,703.88	6,703.88	38.0
Process	Process Cooling	100.0%	1,828.33	1,828.33	10.4
Process	Process Refrigeration	100.0%	1,828.33	1,828.33	10.4
Process	Process Electrochemical	100.0%	426.33	426.33	2.4
Process	Process Other	100.0%	1,148.34	1,148.34	6.5
Miscellaneous	Miscellaneous	100.0%	3,300.88	3,300.88	18.7
Total				**60,944.36**	**345.6**

4

BASELINE PROJECTION

Prior to developing estimates of energy-efficiency potential, we developed a baseline end-use projection to quantify what the consumption is likely to be in the future and in absence of any future conservation programs. The savings from past programs are embedded in the forecast, but the baseline projection assumes that those past programs cease to exist in the future. Possible savings from future programs are captured by the potential estimates.

The baseline projection incorporates assumptions about:

- Customer population and economic growth
- Appliance/equipment standards and building codes already mandated (see Chapter 2)
- Forecasts of future electricity prices and other drivers of consumption
- Trends in fuel shares and appliance saturations and assumptions about miscellaneous electricity growth

Although it aligns closely with it, the baseline projection is not Avista's official load forecast. Rather it was developed to serve as the metric against which EE potentials are measured. This chapter presents the baseline projections we developed for this study. Below, we present the baseline projections for each sector and state, which include projections of annual use in GWh and summer peak demand in MW. We also present a summary across all sectors.

Please note that the base-year for the study is 2019. Annual energy use and summer peak demand values for 2019 reflect weather-normalized values. In future years, energy use and peak demand reflect normal weather, as defined by Avista.

Residential Sector

Annual Use

Table 4-1 (WA) and Table 4-2 (ID) present the baseline projection for electricity at the end-use level for the residential sector as a whole. Overall in Washington, residential use increases from 2,539 GWh in 2019 to 2,976 GWh in 2041, an increase of 17%. Residential use in Idaho increases from 1,236 GWh in 2019 to 1,513 GWh in 2041, an increase of 22%. This reflects a substantial customer growth forecast in both states. Figure 4-1 (WA) and Figure 4-3 (ID) display the graphical representation of the baseline projection.

Figure 4-2 (WA) and Figure 4-4 (ID) present the baseline projection of annual electricity use per household. Most noticeable is that lighting use decreases throughout the time period – this is the combined effect of the RTF market baseline assumption in both states, and is further enhanced in Washington by state lighting standards in effect from 2020 forward.

Table 4-1 Residential Baseline Sales Projection by End Use (GWh), Washington

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	187	202	205	218	247	350	87%
Space Heating	956	924	926	932	940	958	0%
Water Heating	420	408	405	398	387	369	-12%
Interior Lighting	177	158	149	118	93	82	-54%
Exterior Lighting	34	28	26	20	16	13	-61%
Appliances	414	425	429	442	463	498	20%
Electronics	170	185	190	206	234	294	73%
Miscellaneous	187	202	207	226	269	461	146%
Generation	-5	-7	-8	-11	-18	-48	825%
Total	**2,539**	**2,525**	**2,529**	**2,548**	**2,631**	**2,976**	**17%**

Figure 4-1 Residential Baseline Projection by End Use (GWh), Washington

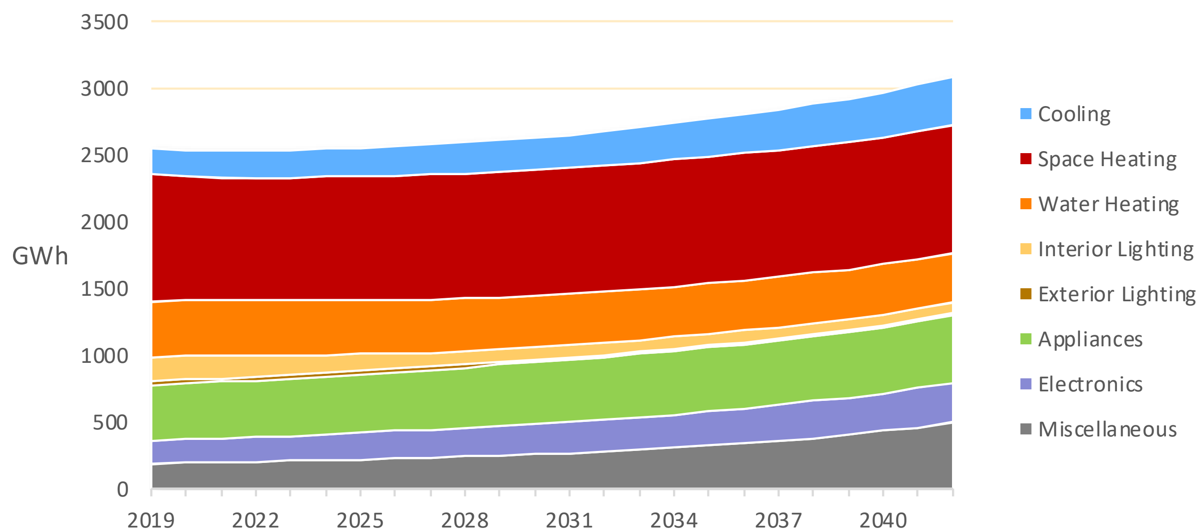


Figure 4-2 Residential Baseline Projection by End Use – Annual Use per Household, Washington

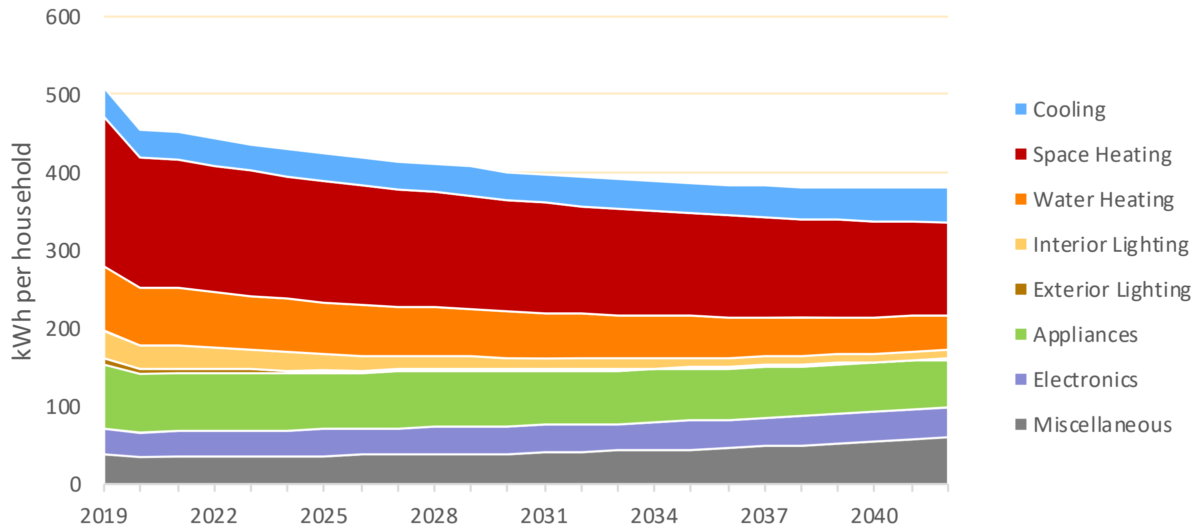


Table 4-2 Residential Baseline Sales Projection by End Use (GWh), Idaho

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	77	88	91	102	125	185	142%
Space Heating	457	447	449	455	460	469	2%
Water Heating	157	155	155	153	150	143	-9%
Interior Lighting	106	101	95	73	55	48	-55%
Exterior Lighting	26	20	18	12	9	7	-75%
Appliances	220	229	232	241	253	271	23%
Electronics	85	92	94	101	110	131	54%
Miscellaneous	110	122	126	141	171	285	160%
Generation	-3	-4	-4	-6	-9	-25	848%
Total	**1,236**	**1,250**	**1,256**	**1,272**	**1,322**	**1,513**	**22%**

Figure 4-3 Residential Baseline Projection by End Use (GWh), Idaho

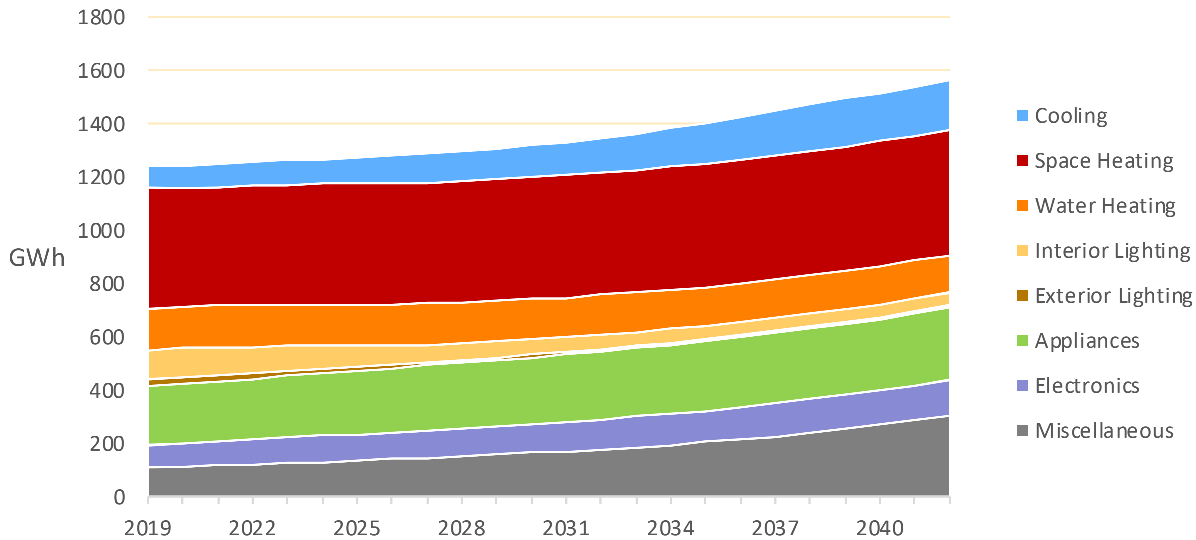
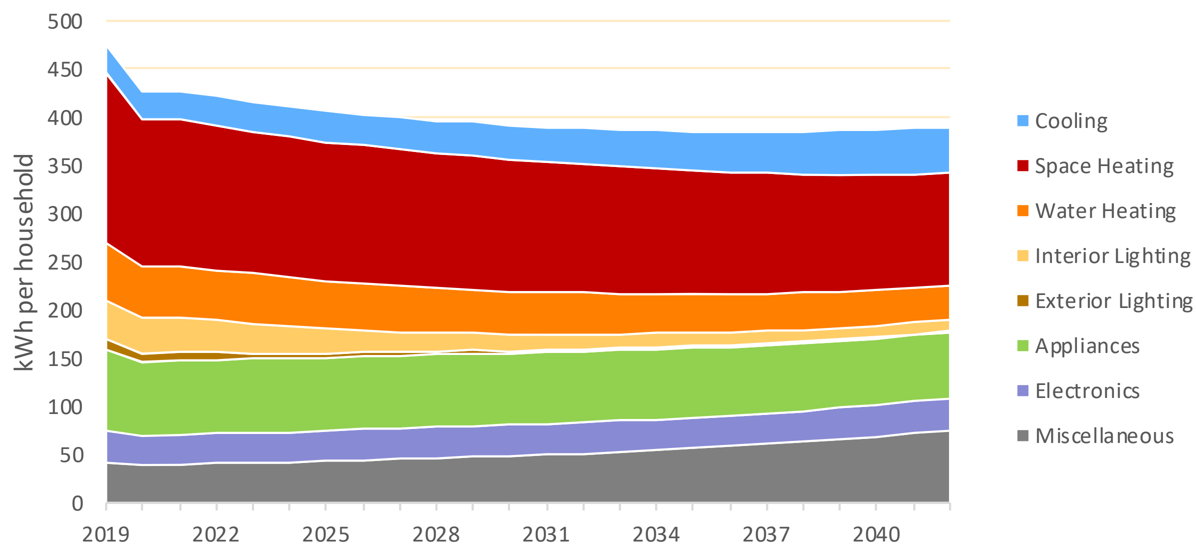


Figure 4-4 Residential Baseline Sales Projection by End Use – Annual Use per Household, Idaho



Commercial Sector Baseline Projections

Annual Use

In Washington, annual electricity use in the commercial sector grows during the overall forecast horizon, starting at 2,166 GWh in 2019, and increasing to 2,811 in 2041, an increase of 30%. In Idaho, annual electricity use grows from 1,007 GWh in 2017 to 1,112 GWh in 2041, an increase of 10%. The tables and graphs below present the baseline projection at the end-use level for the commercial sector as a whole.

Table 4-3 Commercial Baseline Sales Projection by End Use (GWh), Washington

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	236	250	250	251	254	265	12%
Space Heating	114	112	112	115	120	130	14%
Ventilation	383	379	379	374	365	359	-6%
Water Heating	54	55	55	56	58	63	18%
Interior Lighting	434	417	411	395	388	404	-7%
Exterior Lighting	127	118	115	108	105	107	-16%
Refrigeration	233	243	247	260	283	346	48%
Food Preparation	66	69	70	72	81	106	60%
Office Equipment	214	217	217	218	239	299	39%
Miscellaneous	304	341	355	402	492	733	141%
Total	**2,166**	**2,201**	**2,211**	**2,252**	**2,385**	**2,811**	**30%**

Table 4-4 Commercial Baseline Sales Projection by End Use (GWh), Idaho

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	114	122	122	124	126	134	18%
Space Heating	68	68	68	70	74	82	20%
Ventilation	185	185	185	184	181	182	-2%
Water Heating	29	30	30	31	32	36	24%
Interior Lighting	207	204	201	191	188	198	-4%
Exterior Lighting	58	56	55	51	49	51	-13%
Refrigeration	61	62	63	64	67	74	20%
Food Preparation	23	24	24	25	26	29	25%
Office Equipment	103	106	108	111	117	127	23%
Miscellaneous	160	165	167	172	181	201	26%
Total	**1,007**	**1,022**	**1,023**	**1,022**	**1,041**	**1,112**	**10%**

Figure 4-5 Commercial Baseline Projection by End Use, Washington

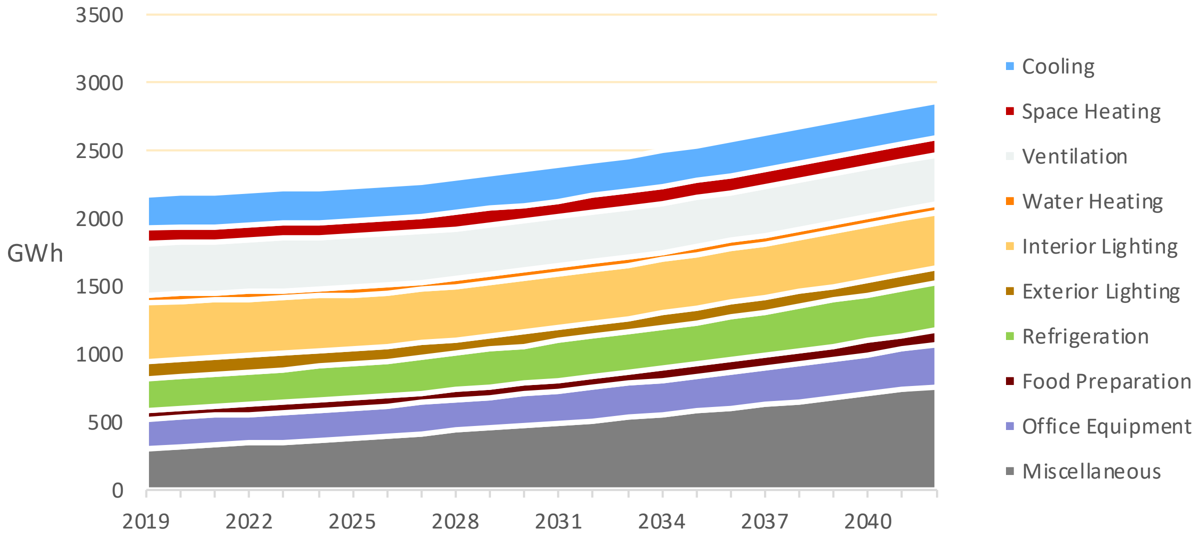
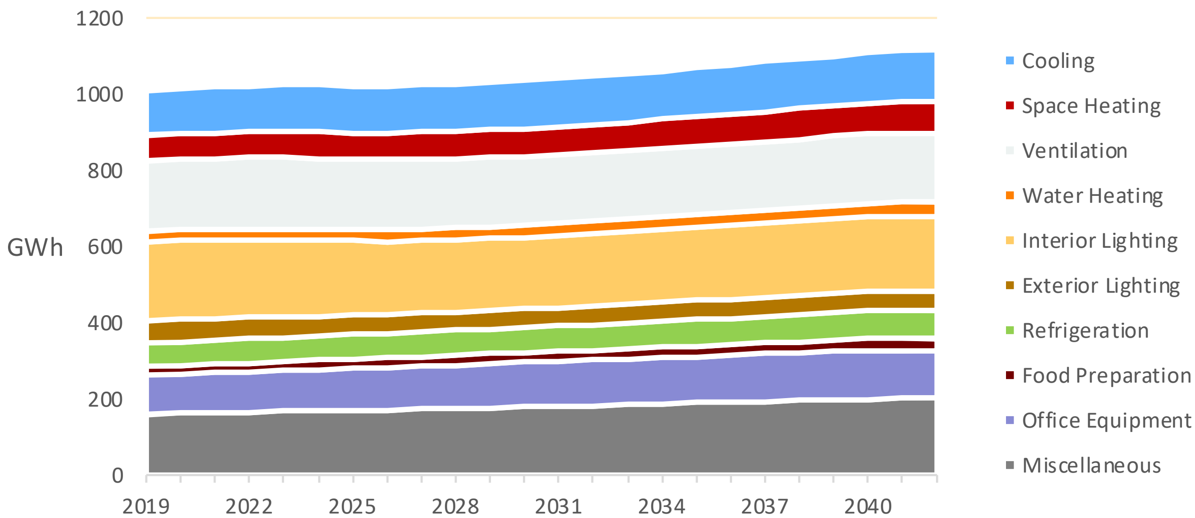


Figure 4-6 Commercial Baseline Projection by End Use, Idaho



Industrial Sector Baseline Projections

Annual Use

Annual industrial use declined by 8% through the forecast horizon, consistent with trends from Avista's industrial load forecast. The tables and graphs below present the projection at the end-use level. Overall in Washington, industrial annual electricity use decreases from 500 GWh in 2017 to 455 GWh in 2041. In Idaho, annual electricity use drops from 346 GWh in 2019 to 325 GWh in 2041.

Table 4-5 Industrial Baseline Projection by End Use (GWh), Washington

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	21	21	21	20	20	19	-11%
Space Heating	8	8	8	8	8	8	-9%
Ventilation	56	51	51	50	47	42	-24%
Interior Lighting	46	42	42	41	40	38	-17%
Exterior Lighting	9	8	7	7	7	6	-28%
Process	125	119	119	119	119	119	-5%
Motors	235	223	224	224	224	223	-5%
Miscellaneous	0	0	0	0	0	0	76%
Total	**500**	**471**	**472**	**468**	**463**	**455**	**-9%**

Table 4-6 Industrial Baseline Projection by End Use (GWh), Idaho

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Cooling	15	16	16	16	15	13	-9%
Space Heating	6	6	6	6	6	5	-7%
Ventilation	39	41	40	38	35	30	-23%
Interior Lighting	32	33	33	31	30	27	-15%
Exterior Lighting	6	6	6	5	5	4	-27%
Process	68	74	73	72	70	66	-3%
Motors	162	177	176	173	168	158	-3%
Miscellaneous	19	21	21	21	22	22	18%
Total	**346**	**374**	**371**	**362**	**349**	**325**	**-6%**

Figure 4-7 Industrial Baseline Projection by End Use (GWh), Washington

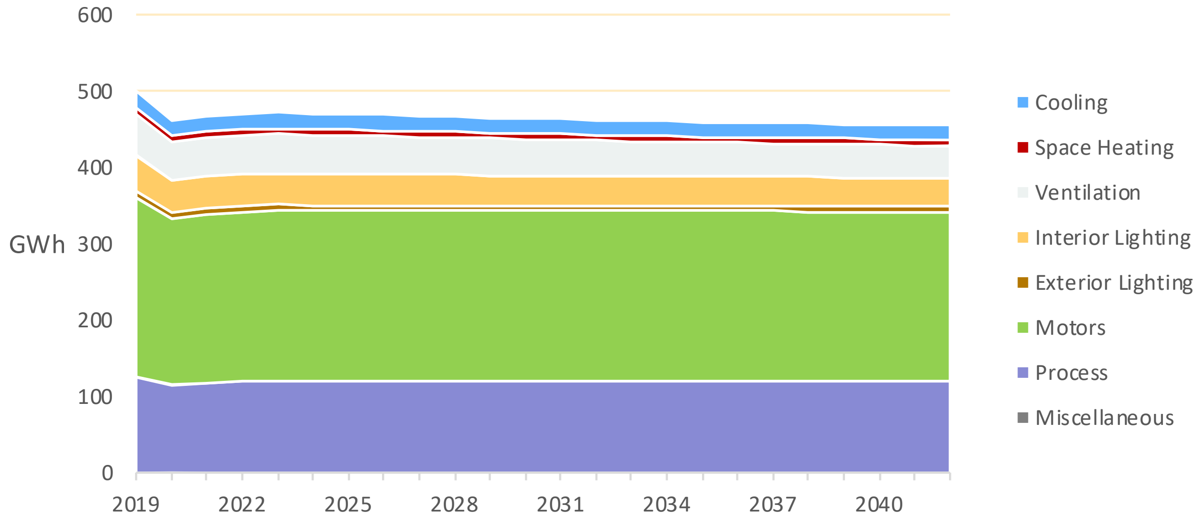
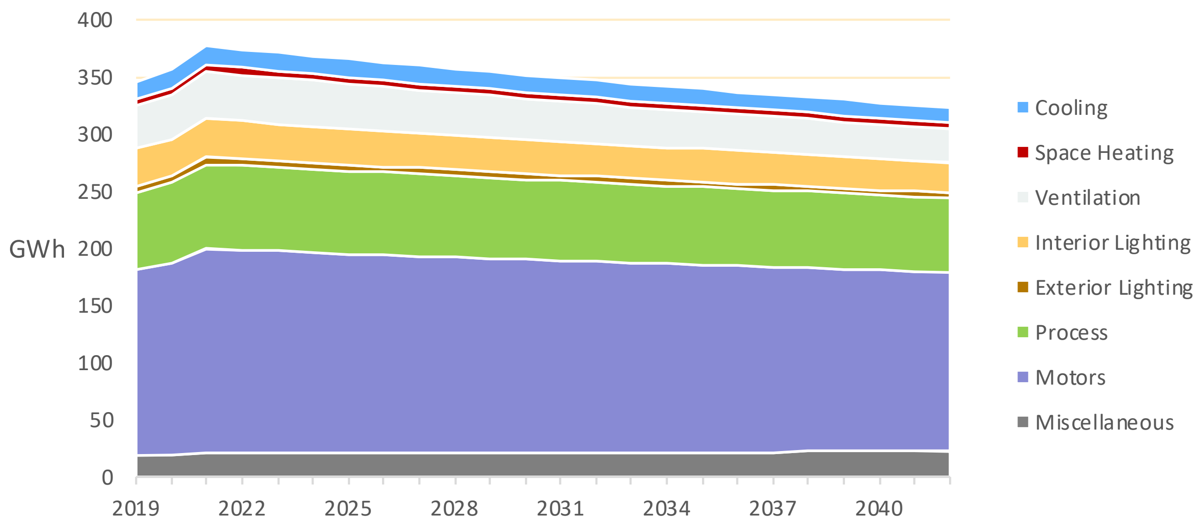


Figure 4-8 Industrial Baseline Projection by End Use (GWh), Idaho



Summary of Baseline Projections across Sectors and States

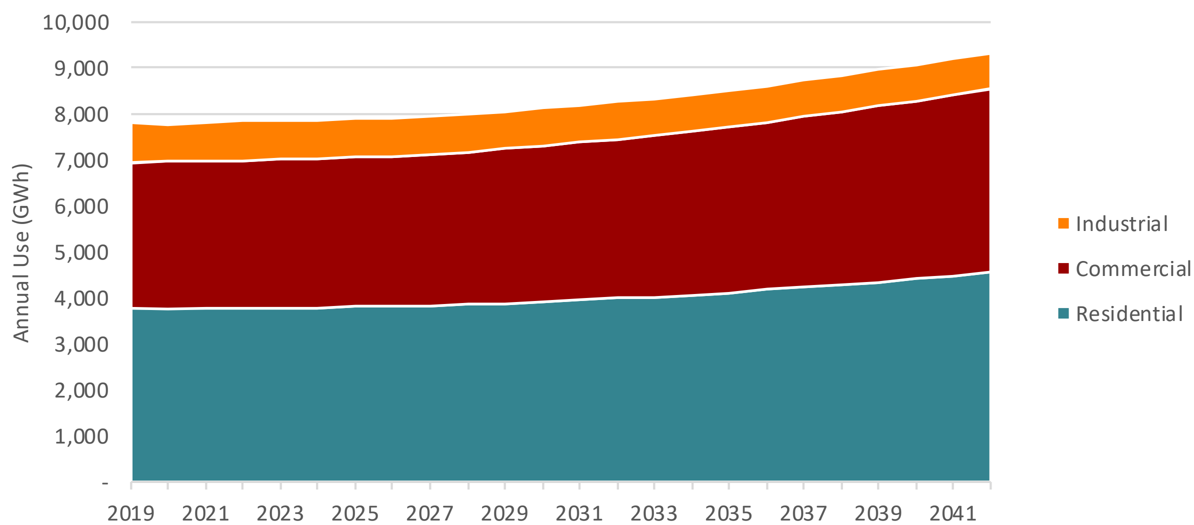
Annual Use

Table 4-7 and Figure 4-9 provide a summary of the baseline projection for annual use by sector for the entire Avista service territory. Overall, the projection shows steady growth in electricity use, driven primarily by customer growth forecasts.

Table 4-7 Baseline Projection Summary (GWh), WA and ID Combined

End Use	2019	2022	2023	2026	2031	2041	% Change ('19-'41)
Residential	3,775	3,774	3,785	3,820	3,953	4,489	19%
Commercial	3,173	3,223	3,234	3,273	3,427	3,924	24%
Industrial	846	845	843	831	812	780	-8%
Total	**7,794**	**7,842**	**7,863**	**7,925**	**8,192**	**9,193**	**18%**

Figure 4-9 Baseline Projection Summary (GWh), WA and ID Combined



5

CONSERVATION POTENTIAL

This section presents the conservation potential for Avista. This includes every measure that is considered in the measure list, regardless of delivery mechanism (program implementation, NEEA initiatives, or momentum savings).

We present the annual energy savings in GWh and aMW, as well as the winter peak demand savings in MW, for selected years. Year-by-year savings for annual energy and peak demand are available in the LoadMAP model, which was provided to Avista at the conclusion of the study.

This section begins a summary of annual energy savings across all three sectors. Then we provide details for each sector. Please note that all savings are provided at the customer meter.

Overall Summary of Energy Efficiency Potential

Summary of Annual Energy Savings

Table 5-1 (WA) and Table 5-2 (ID) summarize the EE savings in terms of annual energy use for all measures for two levels of potential relative to the baseline projection. Figure 5-1(WA) and Figure 5-2 (ID) displays the two levels of potential by year. Figure 5-3 (WA) and Figure 5-4 (ID) display the EE projections.

- **Technical Potential** reflects the adoption of all conservation measures regardless of cost-effectiveness. For Washington, first-year savings are 101 GWh, or 2.0% of the baseline projection. Cumulative savings in 2041 are 1,822 GWh, or 29.2% of the baseline. For Idaho, first-year savings are 58 GWh, or 2.2% of the baseline projection. Cumulative savings in 2041 are 948 GWh, or 32.1% of the baseline.
- **Technical Achievable Potential** modifies Technical Potential by accounting for customer adoption constraints. In Washington, first-year savings potential is 56 GWh, or 1.1% of the baseline. In 2041, cumulative technical achievable savings reach 1,309 GWh, or 21.0% of the baseline projection. This results in average annual savings of 1.0% of the baseline each year. Technical Achievable Potential is approximately 72% of Technical Potential in Washington throughout the forecast horizon. For Idaho, first year savings are 3 GWh or 1.2% of the baseline and by 2041 cumulative technical achievable savings reach 665 GWh, or 22.5% of the baseline. This results in average annual savings of 1% of the baseline each year. In Idaho, Technical Achievable Potential reflects 71% of Technical Potential throughout the forecast horizon.

Table 5-1 Summary of EE Potential (Annual Energy, GWh), Washington

	2022	2023	2024	2031	2041
Baseline projection (GWh)	5,196	5,212	5,229	5,479	6,243
Cumulative Savings (GWh)					
Achievable Technical Potential	56	121	194	868	1,309
Technical Potential	101	209	325	1,247	1,822
Cumulative Savings (aMW)					
Achievable Technical Potential	6	14	22	99	149
Technical Potential	12	24	37	142	208
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.1%	2.3%	3.7%	15.8%	21.0%
Technical Potential	2.0%	4.0%	6.2%	22.8%	29.2%

Table 5-2 Summary of EE Potential (Annual Energy, GWh), Idaho

	2022	2023	2024	2031	2041
Baseline projection (GWh)	2,646	2,650	2,653	2,713	2,951
Cumulative Savings (GWh)					
Achievable Technical Potential	33	70	110	448	665
Technical Potential	58	119	183	654	948
Cumulative Savings (aMW)					
Achievable Technical Potential	4	8	13	51	76
Technical Potential	7	14	21	75	108
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.2%	2.6%	4.1%	16.5%	22.5%
Technical Potential	2.2%	4.5%	6.9%	24.1%	32.1%

Figure 5-1 Summary of EE Potential as % of Baseline Projection (Annual Energy), Washington

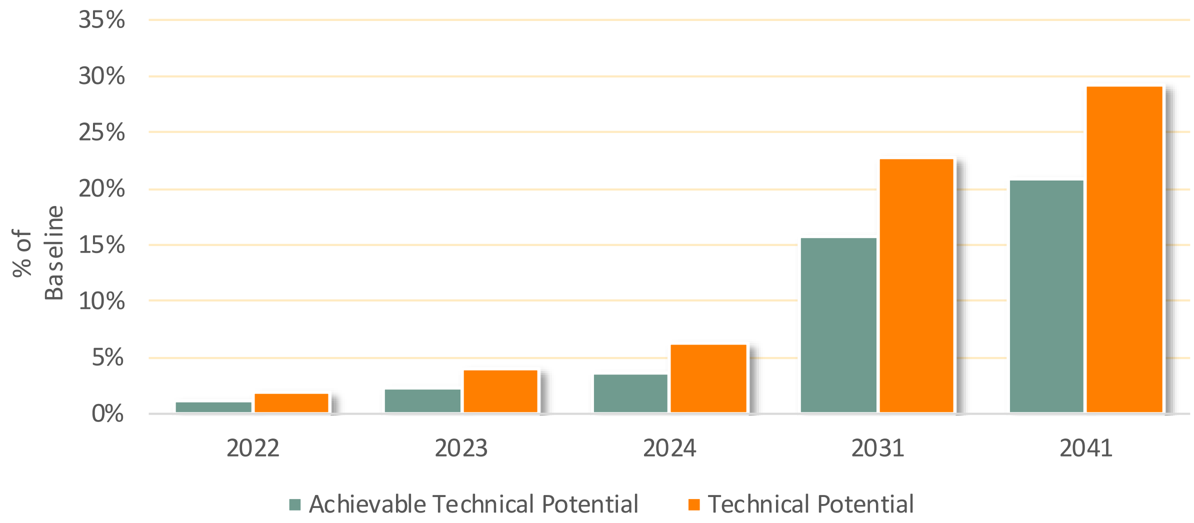


Figure 5-2 Summary of EE Potential as % of Baseline Projection (Annual Energy), Idaho

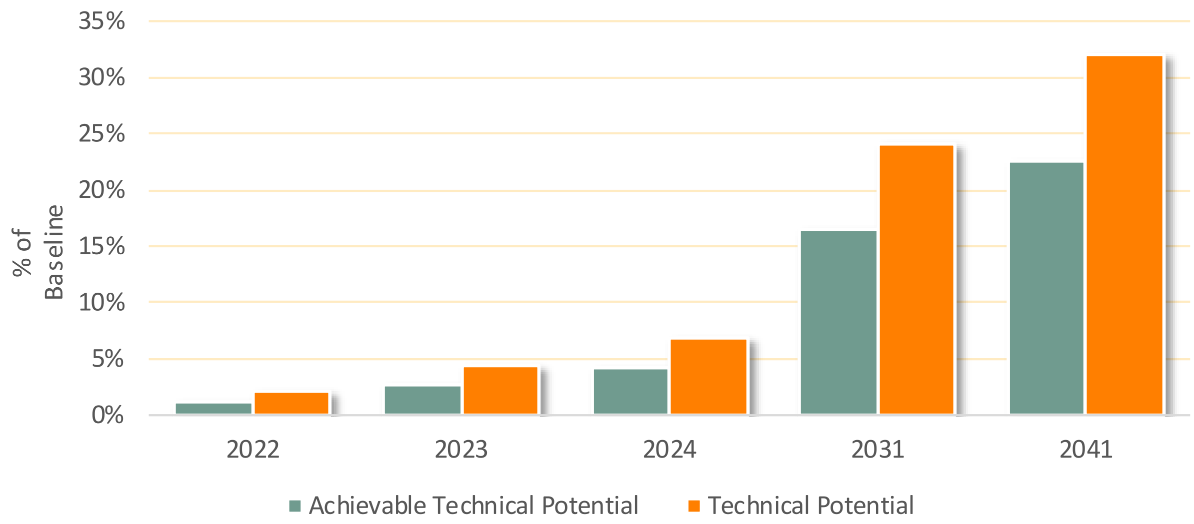


Figure 5-3 Baseline Projection and EE Forecast Summary (Annual Energy, GWh), Washington

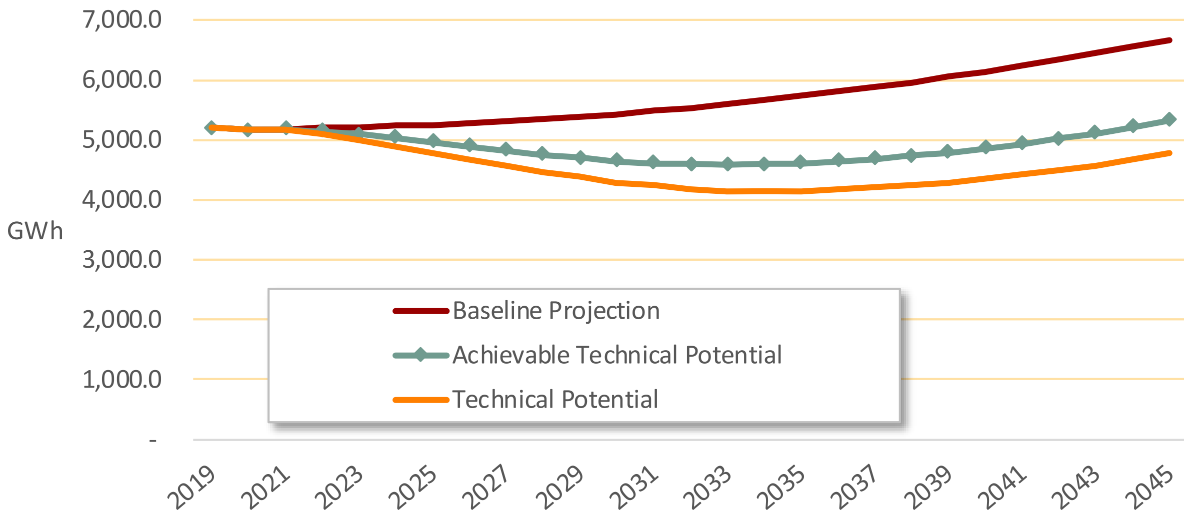
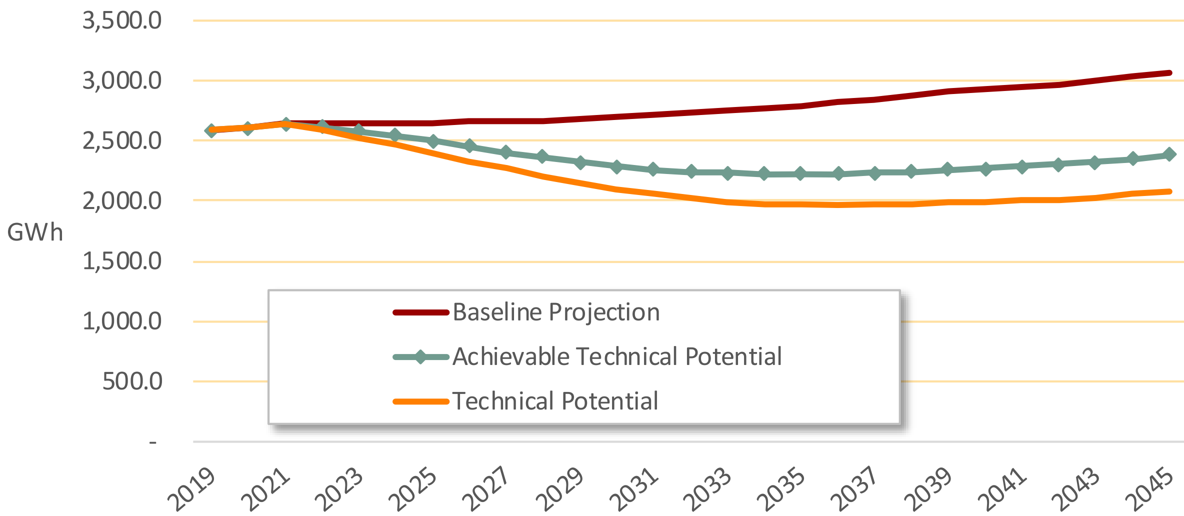


Figure 5-4 Baseline Projection and EE Forecast Summary (Annual Energy, GWh), Idaho



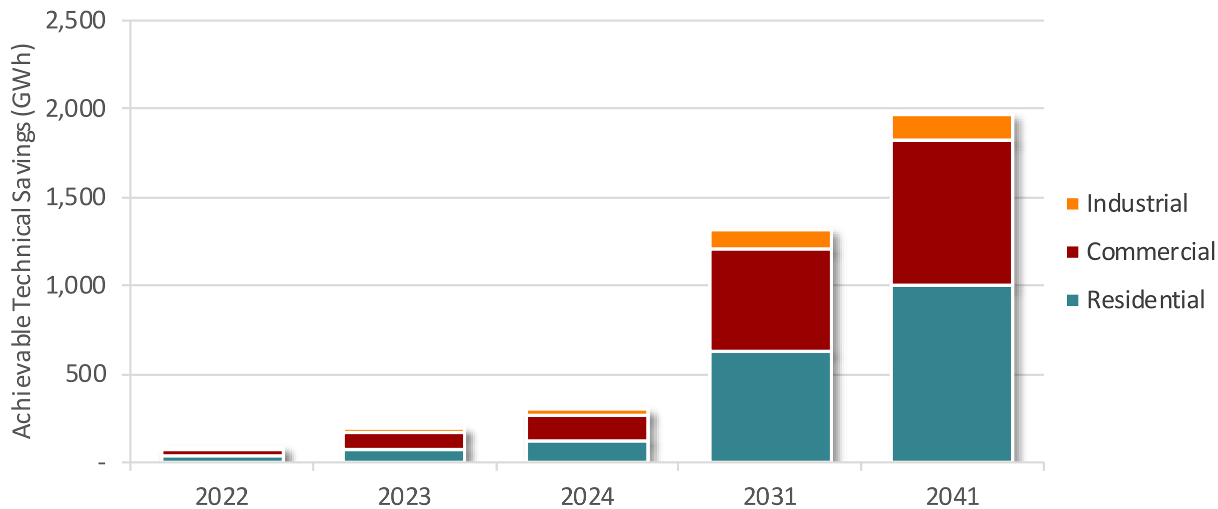
Summary of Conservation Potential by Sector

Table 5-3 and Figure 5-5 summarize the range of electric Technical Achievable Potential by sector, both states combined. The residential and commercial sectors contribute the most savings, with commercial lighting forming a strong early foundation, and later-blossoming residential potential from measures such as heat pump water heaters growing to surpass commercial savings by years 10-20.

Table 5-3 Technical Achievable Conservation Potential by Sector (Annual Use), WA and ID

	2022	2023	2024	2031	2041
Cumulative Savings (GWh)					
Residential	32	72	120	623	1,004
Commercial	46	97	152	583	819
Industrial	10	21	33	110	151
Total	**88**	**190**	**304**	**1,317**	**1,974**
Cumulative Savings (aMW)					
Residential	4	8	14	71	115
Commercial	5	11	17	67	94
Industrial	1	2	4	13	17
Total	**10**	**22**	**35**	**150**	**225**

Figure 5-5 Technical Achievable Conservation Potential by Sector (Annual Energy, GWh)



Residential Conservation Potential

Table 5-4 (WA) and Table 5-5 (ID) present estimates for measure-level conservation potential for the residential sector in terms of annual energy savings. Figure 5-6 (WA) and Figure 5-7 (ID) display the two levels of potential by year. For Washington, Technical Achievable Potential in 2022 is 20 GWh, or 0.8 % of the baseline projection. By 2041, cumulative technical achievable savings are 672 GWh, or 22.6% of the baseline projection. At this level, it represents over 66% of technical potential. For Idaho, 2022 technical achievable savings are 12 GWh or 1.0% of the baseline and by 2040 cumulative technical achievable savings reach 332 GWh, or 21.9% of the baseline. Technical Achievable Potential in Idaho in 2041 is 67% of technical potential.

Table 5-4 Residential Conservation Potential (Annual Energy), Washington

	2022	2023	2024	2031	2041
Baseline projection (GWh)	2,525	2,529	2,534	2,631	2,976
Cumulative Savings (GWh)					
Achievable Technical Potential	20	45	75	409	672
Technical Potential	49	103	162	655	1,005
Cumulative Savings (aMW)					
Achievable Technical Potential	2	5	9	47	77
Technical Potential	6	12	18	75	115
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	0.8%	1.8%	3.0%	15.6%	22.6%
Technical Potential	1.9%	4.1%	6.4%	24.9%	33.8%

Table 5-5 Residential Conservation Potential (Annual Energy), Idaho

	2022	2023	2024	2031	2041
Baseline projection (GWh)	1,250	1,256	1,262	1,322	1,513
Cumulative Savings (GWh)					
Achievable Technical Potential	12	27	45	214	332
Technical Potential	27	56	88	334	494
Cumulative Savings (aMW)					
Achievable Technical Potential	1	3	5	24	38
Technical Potential	3	6	10	38	56
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.0%	2.2%	3.5%	16.2%	21.9%
Technical Potential	2.1%	4.5%	6.9%	25.3%	32.6%

Figure 5-6 Residential Conservation Savings as a % of the Baseline Projection (Annual Energy), Washington

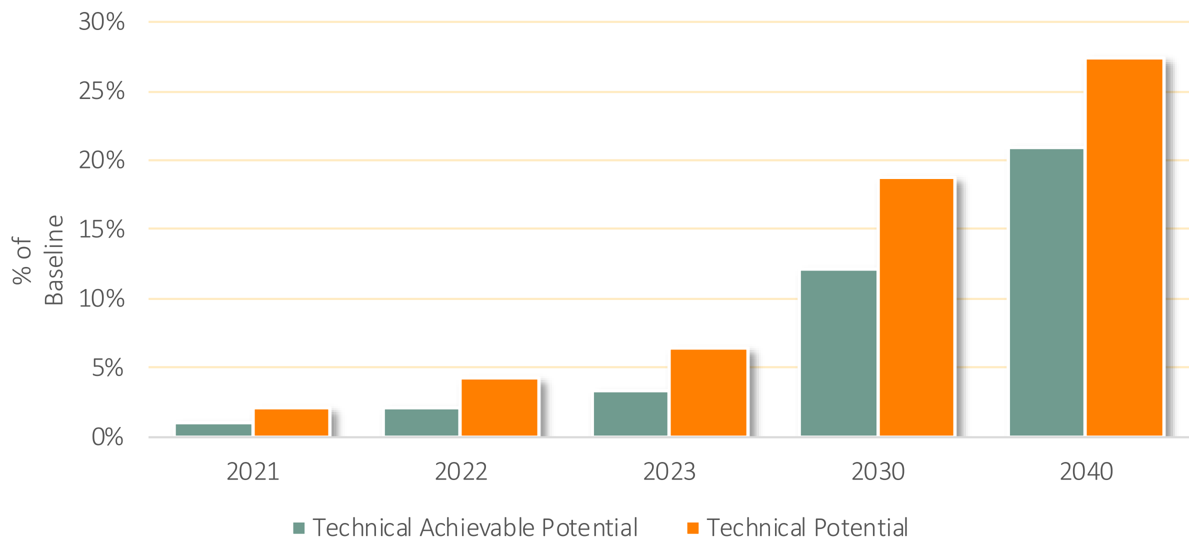
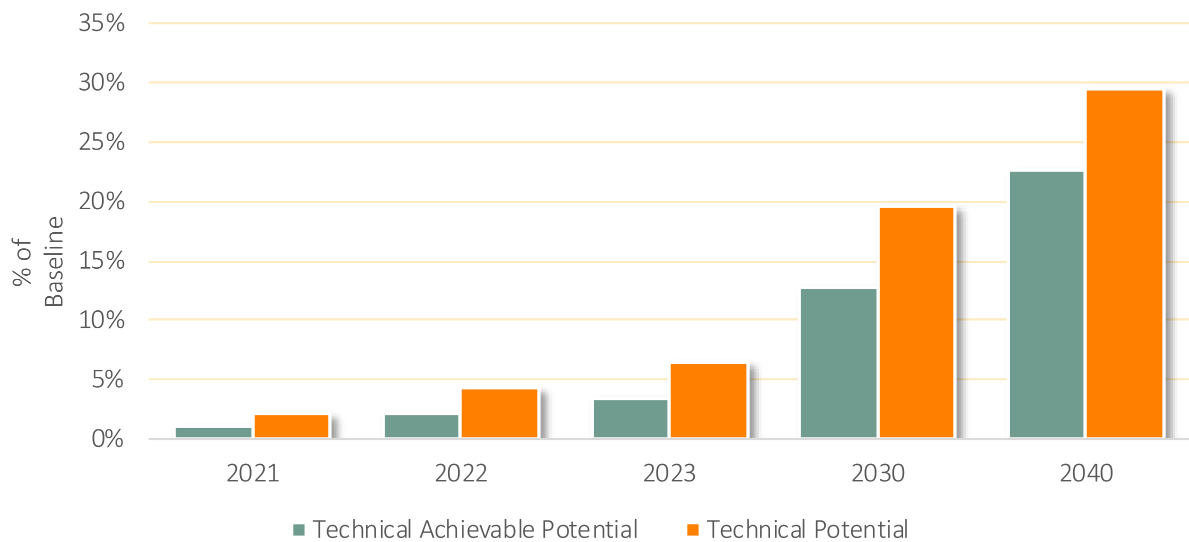


Figure 5-7 Residential Conservation Savings as a % of the Baseline Projection (Annual Energy), Idaho



Below, we present the top residential measures from the perspective of annual energy use. Table 5-6 identifies the top 20 residential measures from the perspective of cumulative technical achievable energy savings potential for Washington in 2023, the second year of potential. The top three measures include ENERGY STAR- Connected Thermostat, Ductless Mini Split Heat Pump (Zonal), and Home Energy Management System (HEMS). Note that technical achievable savings do not screen for cost effectiveness and some measures are expected to be screened out during the IRP process.

Table 5-6 Residential Top Measures in 2023 (Annual Energy, MWh), Washington

Rank	Residential Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	ENERGY STAR - Connected Thermostat	4,409	10%
2	Ductless Mini Split Heat Pump (Zonal)	4,280	10%
3	Home Energy Management System (HEMS)	3,428	8%
4	Windows - High Efficiency/ENERGY STAR	2,154	5%
5	Water Heater <= 55 Gal	2,016	5%
6	Insulation - Basement Sidewall Installation	1,826	4%
7	Insulation - Ducting	1,563	3%
8	Windows - Low-e Storm Addition	1,519	3%
9	Building Shell - Air Sealing (Infiltration Control)	1,228	3%
10	Ductless Mini Split Heat Pump with Optimized Controls (Ducted Forced Air)	1,128	3%
11	Connected Line-Voltage Thermostat	1,128	3%
12	Exempted Lighting	1,035	2%
13	Interior Lighting - Occupancy Sensors	1,004	2%
14	Exterior Lighting - Photovoltaic Installation	980	2%
15	Insulation - Floor Upgrade	898	2%
16	General Service Lighting	896	2%
17	Building Shell - Whole-Home Aerosol Sealing	840	2%
18	Insulation - Ceiling Upgrade	804	2%
19	Insulation - Wall Cavity Installation	770	2%
20	Windows - Cellular Shades	685	2%
	Total of Top 20 Measures	**32,591**	**73%**
	Total Cumulative Savings	**44,799**	**100%**

Figure 5-8 presents forecasts of cumulative energy savings for Washington. Space heating and water heating account for a substantial portion of the savings throughout the forecast horizon. Weatherization, ductless heat pumps, and heat pump water heaters account for a large portion of potential over the 20-year study period. LED lighting, while still present, is reduced in comparison to prior studies, as RTF market baseline assumptions and the Washington state lighting standard have moved a substantial amount of potential from those technologies into the realm of codes and market transformation.

Figure 5-8 Residential Technical Achievable Savings Forecast (Cumulative GWh), Washington

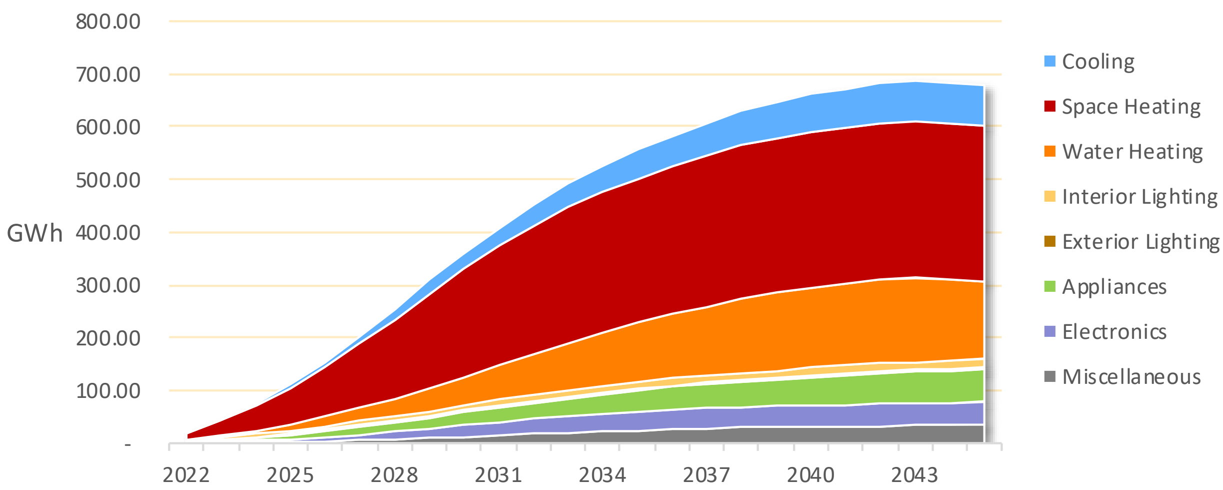


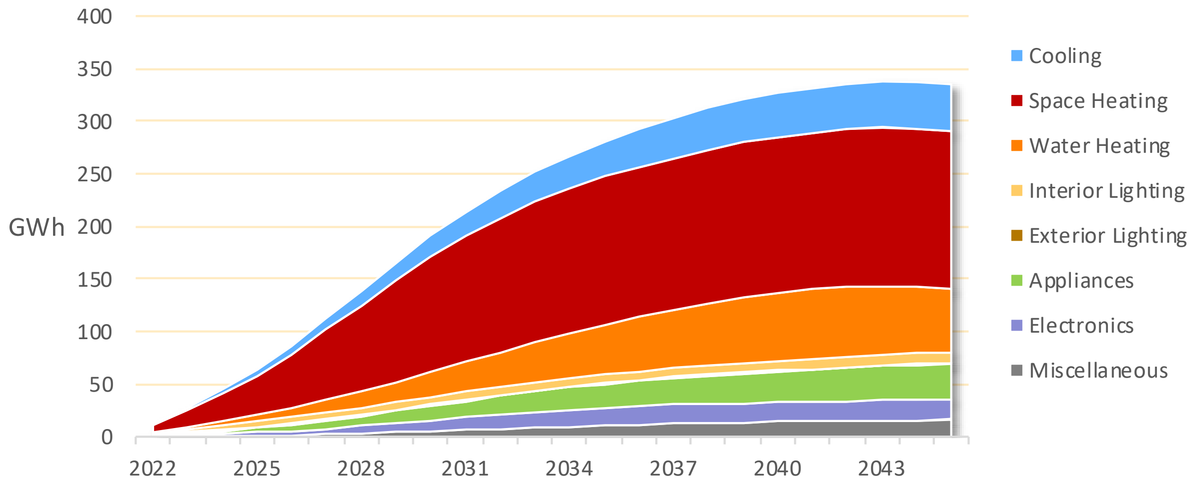
Table 5-7 shows the top residential measures for Idaho in 2023. The top three measures include high efficiency windows, Ductless Mini Split Heat Pump (Zonal), and LEDs in General Service Lighting. Since Idaho does not have the same state standard regarding lighting, LEDs for general service have a greater remaining market of potential captured in the CPA. in Note that technical achievable savings do not screen for cost effectiveness and some measures are expected to be screened out during the IRP process.

Table 5-7 Residential Top Measures in 2022 (Annual Energy, MWh), Idaho

Rank	Residential Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	Windows - High Efficiency/ENERGY STAR	3,654	13%
2	Ductless Mini Split Heat Pump (Zonal)	2,319	9%
3	General Service Lighting	2,302	8%
4	Home Energy Management System (HEMS)	1,547	6%
5	ENERGY STAR - Connected Thermostat	1,480	5%
6	Windows - Low-e Storm Addition	1,312	5%
7	Insulation - Basement Sidewall Installation	1,107	4%
8	Connected Line-Voltage Thermostat	689	3%
9	Building Shell - Air Sealing (Infiltration Control)	688	3%
10	Water Heater - Faucet Aerators	634	2%
11	Water Heater <= 55 Gal	630	2%
12	Exterior Lighting - Photovoltaic Installation	621	2%
13	Insulation - Ducting	580	2%
14	Insulation - Floor Upgrade	520	2%
15	Interior Lighting - Occupancy Sensors	452	2%
16	Insulation - Wall Cavity Installation	425	2%
17	Insulation - Wall Sheathing	383	1%
18	Insulation - Ceiling Upgrade	376	1%
19	Building Shell - Whole-Home Aerosol Sealing	369	1%
20	Ductless Mini Split Heat Pump with Optimized Controls	357	1%
	Total of Top 20 Measures	**20,445**	**75%**
	Total Cumulative Savings	**27,260**	**100%**

Figure 5-9 presents forecasts of cumulative energy savings for Idaho. Results are similar to Washington where the majority of the savings come from heating and water heating measures.

Figure 5-9 Residential Technical Achievable Savings Forecast (Cumulative GWh), Idaho



Commercial Conservation Potential

Table 5-8 (WA) and Table 5-9 (ID) present estimates for the two levels of conservation potential for the commercial sector from the perspective of annual energy savings and average MW.

Table 5-8 Commercial Conservation Potential (Annual Energy), WA

	2022	2023	2024	2031	2041
Baseline projection (GWh)	2,201	2,211	2,224	2,385	2,811
Cumulative Savings (GWh)					
Achievable Technical Potential	30	64	101	397	551
Technical Potential	44	90	139	514	712
Cumulative Savings (aMW)					
Achievable Technical Potential	3	7	12	45	63
Technical Potential	5	10	16	59	81
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.4%	2.9%	4.5%	16.6%	19.6%
Technical Potential	2.0%	4.1%	6.3%	21.5%	25.3%

Table 5-9 Commercial Conservation Potential (Annual Energy), Idaho

	2022	2023	2024	2031	2041
Baseline projection (GWh)	1,022	1,023	1,023	1,041	1,112
Cumulative Savings (GWh)					
Achievable Technical Potential	16	33	51	186	268
Technical Potential	25	50	76	260	375
Cumulative Savings (aMW)					
Achievable Technical Potential	2	4	6	21	31
Technical Potential	3	6	9	30	43
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.6%	3.2%	5.0%	17.9%	24.1%
Technical Potential	2.5%	4.9%	7.5%	25.0%	33.7%

Figure 5-10 (WA) and Figure 5-11 (ID) display the two levels of potential by year. For Washington, the first year of the projection, Technical Achievable Potential is 30 GWh, or 1.4% of the baseline projection. By 2041, technical achievable savings are 551 GWh, or 19.6% of the baseline projection. Throughout the forecast horizon, Technical Achievable Potential represents about 77% of technical potential. For Idaho, first year technical achievable savings are 16 GWh or 1.6% of the baseline and by 2041, cumulative technical

achievable savings reach 268 GWh, or 24.1% of the baseline. Throughout the forecast horizon, Technical Achievable Potential represents about 71% of technical potential in Idaho.

Figure 5-10 Commercial Conservation Savings (Energy), Washington

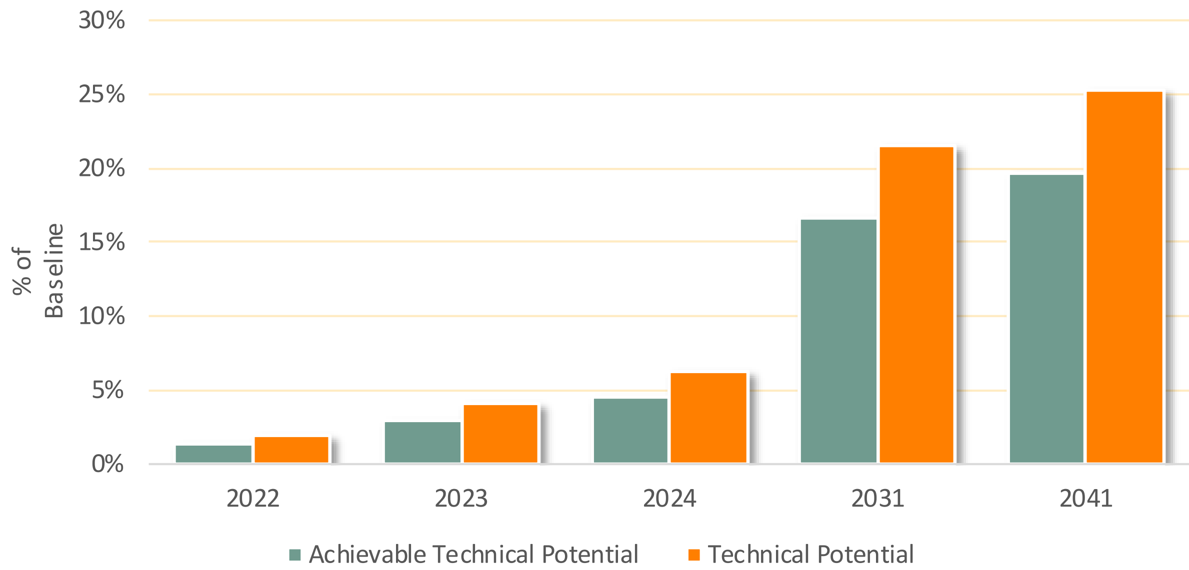
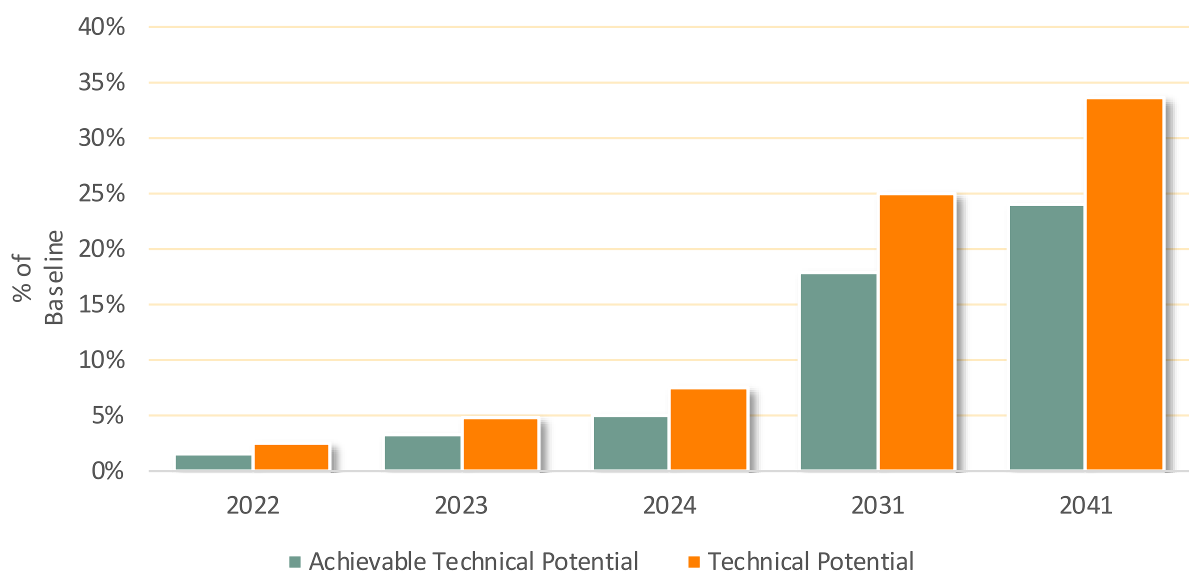


Figure 5-11 Commercial Conservation Savings (Energy), Idaho



Below, we present the top commercial measures from the perspective of annual energy use.

Table 5-10 (WA) and Table 5-11 (ID) identify the top 20 commercial-sector measures from the perspective of annual energy savings in 2019. In both states, lighting applications make up three out of the top five measures. Although the market has seen significant penetration of LEDs in some applications, newer systems – particularly those with built-in occupancy sensors or other controls – still represent significant savings opportunities.

Figure 5-12 (WA) and Figure 5-13 (ID) present forecasts of cumulative energy savings by end use. Lighting savings from interior and exterior applications account for a substantial portion of the savings throughout the forecast horizon, due in part to revised turnover assumptions for C&I lighting consistent with RTF assumptions.

Table 5-5-10 Commercial Top Measures in 2019 (Annual Energy, MWh), Washington

Rank	Commercial Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	Retrocommissioning	6,538	10%
2	Linear Lighting	5,887	9%
3	Strategic Energy Management	4,771	7%
4	Space Heating - Heat Recovery Ventilator	2,401	4%
5	High-Bay Lighting	2,306	4%
6	General Service Lighting	2,010	3%
7	Chiller - Variable Flow Chilled Water Pump	1,876	3%
8	Exterior Lighting - Photovoltaic Installation	1,857	3%
9	HVAC - Dedicated Outdoor Air System (DOAS)	1,679	3%
10	Interior Lighting - Embedded Fixture Controls	1,568	2%
11	Refrigeration - Evaporative Condenser	1,505	2%
12	Ventilation - Permanent Magnet Synchronous Fan Motor	1,379	2%
13	Thermostat - Connected	1,364	2%
14	Area Lighting	1,317	2%
15	Ventilation - Variable Speed Control	1,084	2%
16	Refrigeration - Variable Speed Compressor	982	2%
17	Ventilation - ECM on VAV Boxes	970	2%
18	RTU - Evaporative Precooler	958	1%
19	HVAC - Economizer Maintenance and Repair	876	1%
20	Water Heater - Solar System	754	1%
	Total of Top 20 Measures	**42,082**	**66%**
	Total Cumulative Savings	**64,043**	**100%**

Figure 5-12 Commercial Technical Achievable Savings Forecast (Cumulative GWh), Washington

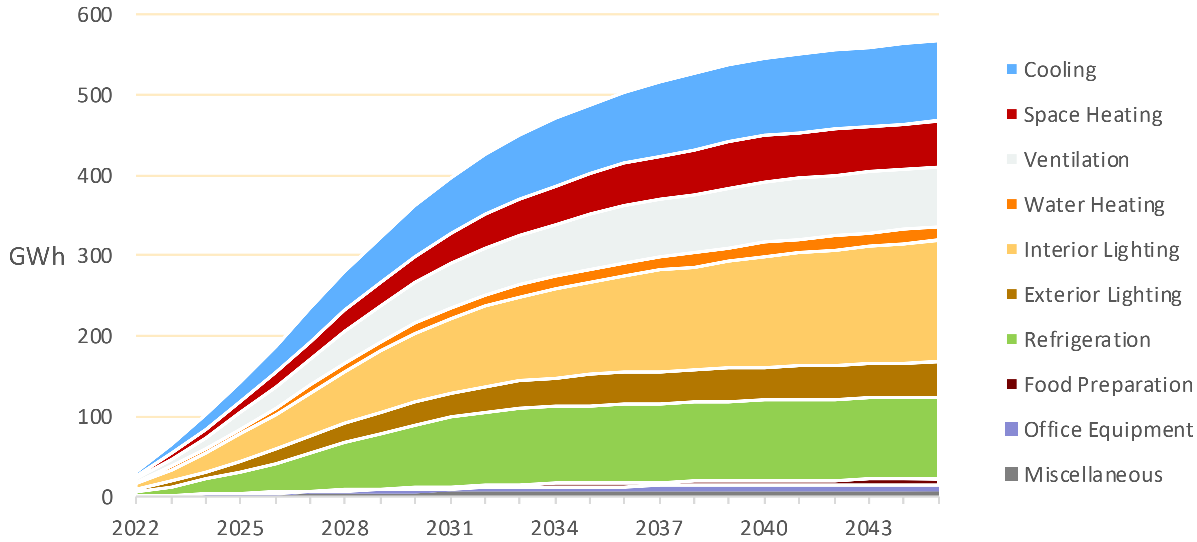
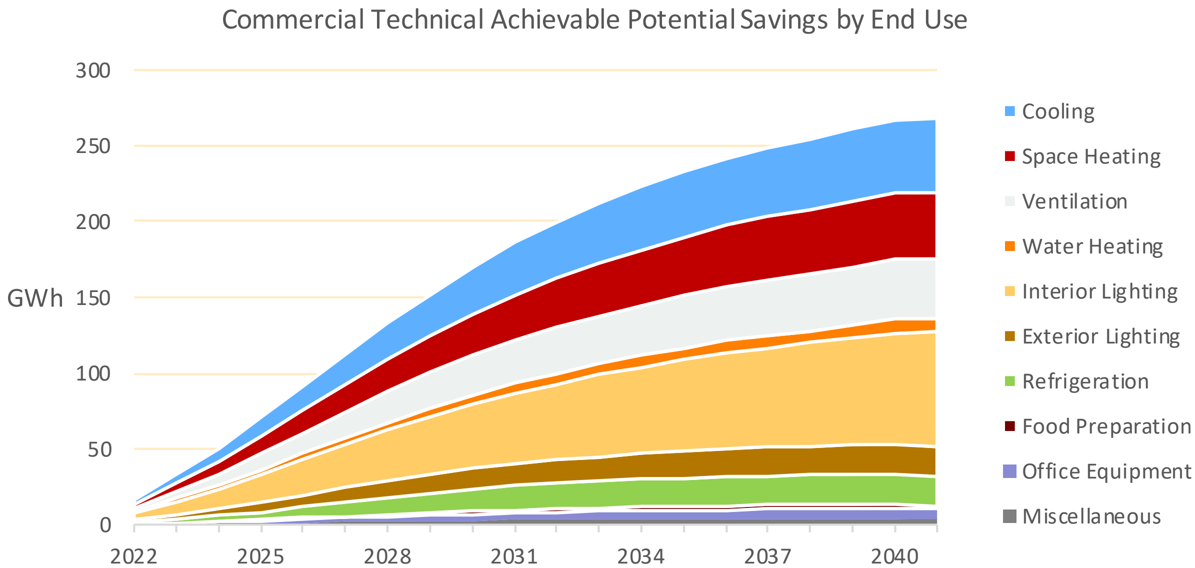


Table 5-11 Commercial Top Measures in 2023 (Annual Energy, MWh), Idaho

Rank	Commercial Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	Linear Lighting	3,251	10%
2	Retrocommissioning	2,780	8%
3	Space Heating - Heat Recovery Ventilator	2,727	8%
4	Strategic Energy Management	2,276	7%
5	High-Bay Lighting	1,817	6%
6	HVAC - Dedicated Outdoor Air System (DOAS)	1,375	4%
7	General Service Lighting	1,171	4%
8	Ductless Mini Split Heat Pump	1,131	3%
9	Chiller - Variable Flow Chilled Water Pump	1,048	3%
10	Exterior Lighting - Photovoltaic Installation	1,016	3%
11	Interior Lighting - Embedded Fixture Controls	902	3%
12	Area Lighting	882	3%
13	Thermostat - Connected	801	2%
14	Ventilation - Permanent Magnet Synchronous Fan Motor	636	2%
15	Ventilation - Variable Speed Control	508	2%
16	Exterior Lighting - Enhanced Controls	477	1%
17	Office Equipment - Advanced Power Strips	473	1%
18	HVAC - Economizer Maintenance and Repair	470	1%
19	Ventilation - ECM on VAV Boxes	460	1%
20	RTU - Evaporative Precooler	439	1%
	Total of Top 20 Measures	**24,638**	**75%**
	Total Cumulative Savings	**32,778**	**100%**

Figure 5-13 Commercial Technical Achievable Savings Forecast (Cumulative GWh), Idaho



Industrial Conservation Potential

Table 5-12 (WA) and Table 5-13 (ID) present potential estimates at the measure level for the industrial sector, from the perspective of annual energy savings. Figure 5-14 (WA) and Figure 5-15 (ID) display the two levels of potential by year. For Washington, technical achievable savings in the first year, 2022, are 6 GWh, or 1.2% of the baseline projection. In 2041, savings reach 86 GWh, or 18.8% of the baseline projection. For Idaho, technical achievable savings in the first year, 2022, are 4 GWh, or 1.2% of the baseline projection. In 2041, savings reach 65 GWh, or 20.0% of the baseline projection.

Table 5-12 Industrial Conservation Potential (Annual Energy), WA

	2022	2023	2024	2031	2041
Baseline projection (GWh)	471	472	471	463	455
Cumulative Savings (GWh)					
Achievable Technical Potential	6	12	18	62	86
Technical Potential	8	17	25	78	105
Cumulative Savings (aMW)					
Achievable Technical Potential	1	1	2	7	10
Technical Potential	1	2	3	9	12
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.2%	2.5%	3.8%	13.4%	18.8%
Technical Potential	1.7%	3.5%	5.2%	16.8%	23.1%

Table 5-13 Industrial Conservation Potential (Annual Energy), Idaho

	2022	2023	2024	2031	2041
Baseline projection (GWh)	374	371	368	349	325
Cumulative Savings (GWh)					
Achievable Technical Potential	4	10	14	49	65
Technical Potential	6	13	19	60	79
Cumulative Savings (aMW)					
Achievable Technical Potential	1	1	2	6	7
Technical Potential	1	1	2	7	9
Cumulative Savings as a % of Baseline					
Achievable Technical Potential	1.2%	2.6%	3.9%	13.9%	20.0%
Technical Potential	1.6%	3.4%	5.2%	17.2%	24.3%

Figure 5-14 Industrial Conservation Potential as a % of the Baseline Projection (Annual Energy), Washington

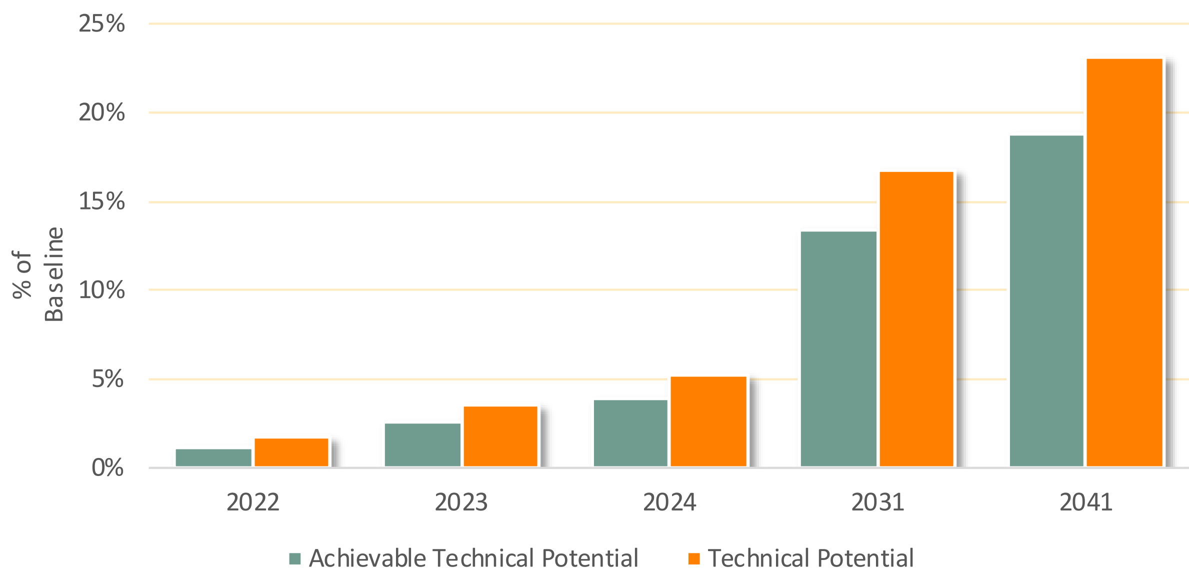
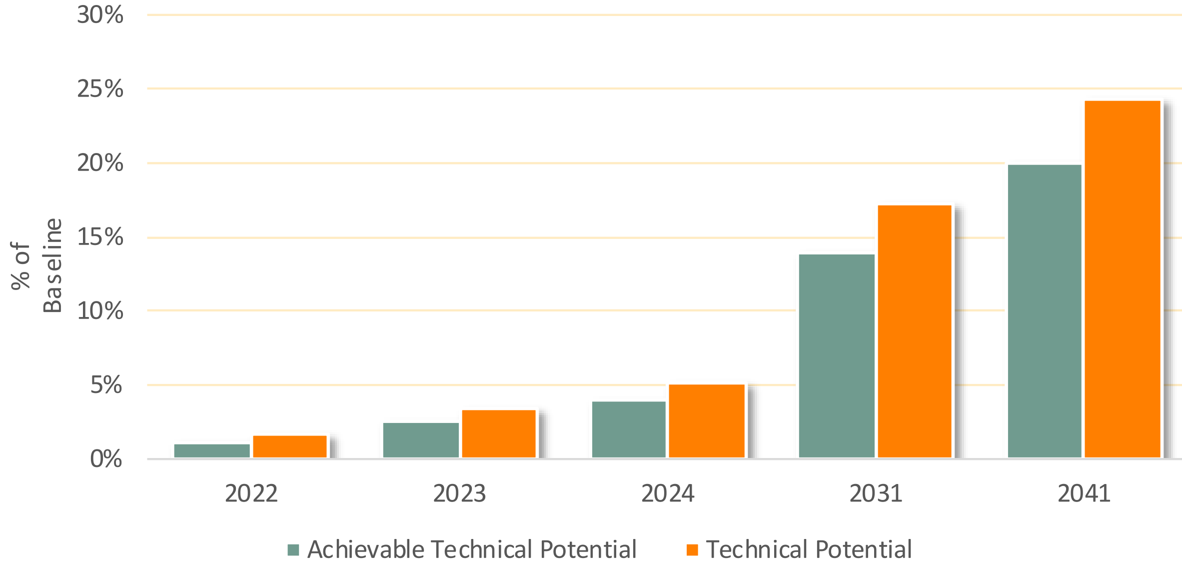


Figure 5-15 Industrial Conservation Potential as a % of the Baseline Projection (Annual Energy), Idaho



Below, we present the top industrial measures from the perspective of annual energy use.

Table 5-14 and Table 5-15 identify the top 20 industrial measures from the perspective of annual energy savings in 2020. For both states, the top measure is High-Bay Lighting. The measure with the second highest savings is Interior Lighting- Embedded Fixture Controls, and retrocomissioning rounds out the top three in both states.

Figure 5-16 (WA) and Figure 5-17 (ID) present forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Various motor savings and lighting make up the majority of savings potential in the study horizon.

Table 5-14 Industrial Top Measures in 2023 (Annual Energy, GWh), Washington

Rank	Industriall Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	High-Bay Lighting	3,542	30%
2	Interior Lighting - Embedded Fixture Controls	862	7%
3	Retrocommissioning	740	6%
4	Fan System - Equipment Upgrade	656	5%
5	Strategic Energy Management	613	5%
6	Fan System - Flow Optimization	550	5%
7	Compressed Air - Leak Management Program	379	3%
8	Material Handling - Variable Speed Drive	378	3%
9	Pumping System - System Optimization	342	3%
10	Interior Lighting - Networked Fixture Controls	303	3%
11	Interior Fluorescent - Delamp and Install Reflectors	252	2%
12	Compressed Air - End Use Optimization	246	2%
13	LED Lighting for Indoor Agriculture	236	2%
14	Pumping System - Variable Speed Drive	225	2%
15	Fan System - Variable Speed Drive	215	2%
16	Exterior Lighting - Photovoltaic Installation	205	2%
17	Interior Lighting - Skylights	193	2%
18	Ventilation	179	1%
19	Pumping System - Equipment Upgrade	171	1%
20	Advanced Refrigeration Controls	166	1%
	Total of Top 20 Measures	**10,454**	**87%**
	Total Cumulative Savings	**11,959**	**100%**

Figure 5-16 Industrial Technical Achievable Savings Forecast (Cumulative GWh), Washington

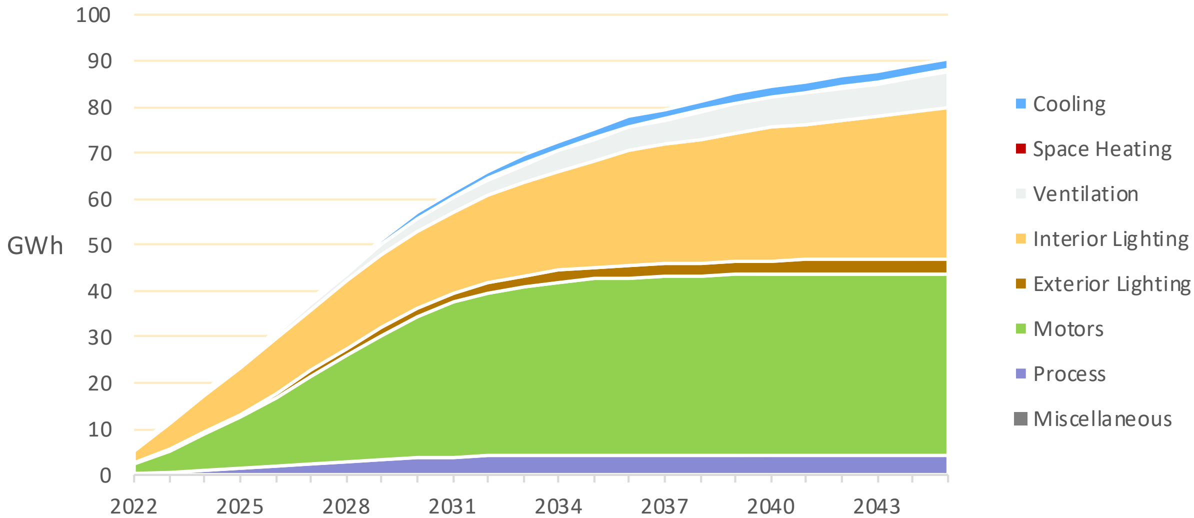
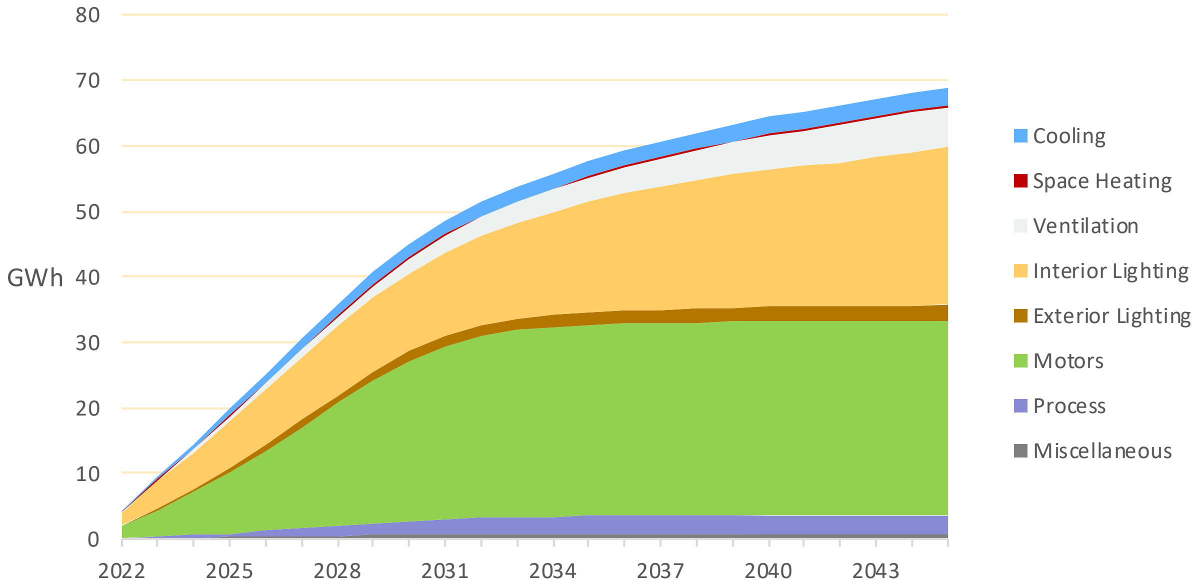


Table 5-15 Industrial Top Measures in 2019 (Annual Energy, GWh), Idaho

Rank	Industrial Measure	2023 Cumulative Energy Savings (MWh)	% of Total
1	High-Bay Lighting	2,514	26%
2	Interior Lighting - Embedded Fixture Controls	613	6%
3	Retrocommissioning	550	6%
4	Fan System - Equipment Upgrade	518	5%
5	Strategic Energy Management	485	5%
6	Fan System - Flow Optimization	435	5%
7	Compressed Air - Equipment Upgrade	396	4%
8	Compressed Air - Leak Management Program	299	3%
9	Material Handling - Variable Speed Drive	299	3%
10	Pumping System - System Optimization	270	3%
11	Destratification Fans (HVLS)	241	3%
12	Interior Lighting - Networked Fixture Controls	215	2%
13	Interior Fluorescent - Delamp and Install Reflectors	199	2%
14	Compressed Air - End Use Optimization	194	2%
15	LED Lighting for Indoor Agriculture	184	2%
16	Pumping System - Variable Speed Drive	178	2%
17	Fan System - Variable Speed Drive	170	2%
18	Exterior Lighting - Photovoltaic Installation	161	2%
19	Pumping System - Equipment Upgrade	135	1%
20	Interior Lighting - Skylights	126	1%
	Total of Top 20 Measures	**8,184**	**86%**
	Total Cumulative Savings	**9,510**	**100%**

Figure 5-17 Industrial Technical Achievable Savings Forecast (Annual Energy, GWh), Idaho



6

DEMAND RESPONSE POTENTIAL

In 2014, AEG and The Brattle Group performed an assessment of winter demand response potential for Avista's commercial and industrial (C&I) sectors. As part of this conservation potential assessment, Avista asked AEG to update the DR analysis for C&I sectors in Washington and Idaho. In 2016, AEG provided an update to the 2014 assessment. For the 2019 study, Avista asked that AEG include the demand response potential for their residential sector and since Avista is a dual-peaking utility, AEG was asked to provide summer demand response potential as well. This year for the 2020 study, to achieve a more accurate representation of ancillary services, viable programs were evaluated on an individual basis for ancillary savings potential.

The updated analysis provides demand response potential and cost estimates for the 24-year planning horizon of 2022-2045 to inform the development of Avista's 2021 Integrated Resource Plan (IRP). It primarily seeks to develop reliable estimates of the magnitude, timing, and costs of DR resources likely available to Avista over the 24-year planning horizon. The analysis focuses on resources assumed achievable during the planning horizon, recognizing known market dynamics that may hinder resource acquisition. DR analysis results will also be incorporated into subsequent DR planning and program development efforts.

This section describes our analysis approach and the data sources used to develop potential and cost estimates. The following three steps broadly outline our analysis approach:

1. Segment residential service, general service, large general service, and extra-large general service customers for DR analysis and develop market characteristics (customer count and coincident peak demand values) by segment for the base year and planning period.
2. Identify and describe the relevant DR programs and develop assumptions on key program parameters for potential and cost analysis.
3. Assess achievable potential by DR program for the 2022-2045 planning period and estimate program budgets and levelized costs.

Market Characterization

The first step in the DR analysis was to segment customers by service class and develop characteristics for each segment. The two relevant characteristics for DR potential analysis are the number of eligible customers in each market segment and their coincident peak demand.

Market segmentation

Like the 2014, 2016, and 2019 studies, we used Avista's rate schedules as the basis for customer segmentation by state and customer class. Table 6-1 summarizes the market segmentation we developed for this study.

Table 6-1 Market Segmentation

Market Dimensions	Segmentation Variable	Description
1	State	Idaho Washington
2	Customer Class	By rate schedule: Residential Service **General Service**: Rate Schedule 11 Large General Service: Rate Schedule 21 Extra Large General Service: Rate Schedule 25[10]

We excluded Avista's two largest industrial customers from our analysis because they are so large and unique that a segment-based modeling approach is not appropriate. To accurately estimate demand reduction potential for these customers, we would need to develop a detailed understanding of their industrial processes and associated possibilities for load reduction. We would also need to develop specific DR potential estimates for each customer. Avista may wish to engage with these large customers directly to gauge interest in participating in DR programs.

Customer Counts by Segment

Once the customer segments were defined, we developed customer counts and coincident peak demand values for the three C&I segments. We developed these estimates separately by state for Washington and Idaho. We considered 2019 as the base year for the study, since this is the most recent year with a full 12 months of available customer data. This also coincides with the base year used for the CPA study. The forecast years are 2022 to 2045.

Avista provided actual customer counts by rate schedule for Washington and Idaho over the 2016-2019 timeframe and forecasted customer counts over the 2020-2025 period. We used this data to calculate the growth rate across the final two years of the forecast. We then applied these growth rates to develop customer projections over the rest of the study timeframe, 2026-2045. The average annual growth rate for all sectors is 1.1%. Table 6-2 below shows the number of customers by state and customer class for the base year and selected future years.

Table 6-2 Baseline C&I Customer Forecast by State and Customer Class

Customer Class	2022	2025	2035	2045
Washington				
Residential Service	234,948	241,598	264,568	289,722
General Service	23,328	24,029	26,470	29,159
Large General Service	1,847	1,840	1,822	1,808
Extra Large General Service	22	22	22	22
Total	**260,146**	**267,489**	**292,881**	**320,712**

[10] Excluding the two largest Schedule 25 and Schedule 25P customers.

Customer Class	2022	2025	2035	2045
Idaho				
Residential Service	120,797	125,479	141,680	159,973
General Service	16,897	17,505	19,692	22,158
Large General Service	1,012	1,007	992	982
Extra Large General Service	11	11	11	11
Total	**138,717**	**144,002**	**162,376**	**183,124**

Forecasts of Winter and Summer Peak Demand

System Peak Demand

Avista provided the 2019 system winter and summer peak values as well as annual energy forecasts through 2025. AEG used the growth rate across the final two forecasted years by state and sector to forecast annual peak demands through 2045, Table 6-3 shows the winter and summer system peaks for the base year and selected futures years. These peaks exclude the demand for Avista's largest industrial customers. The winter and summer system peaks are each expected to increase around 10% between 2022-2045.

Table 6-3 Baseline System Winter Peak Forecast (MW @Meter) [11]

Peak Demand	2022	2025	2035	2045
Winter System Peak	1,331	1,349	1,403	1,444
Summer System Peak	1,369	1,389	1,446	1,508

Coincident Peak Demand by Segment

To develop the coincident peak forecast for each segment, we started with electricity sales by customer class. Avista provided actual electricity sales for the years 2016-2019 and forecasted electricity sales by rate schedule for the years 2020 through 2025. For the remaining years of the forecast, 2026 through 2045, we projected electricity sales using the growth rate from the last two years of each forecast timeframe.

Next, we relied on electricity sales and coincident peak demand values for 2010 provided in the 2010 load research study conducted by Avista to calculate the load factors for Residential Service, General Service, Large General Service, and Extra Large General Service customers for Washington and Idaho. We then applied the load factors to the 2019 electricity sales data to derive coincident peak demand estimates for the four segments. Table 6-4 and Table 6-5 below show the load factors and coincident peak values for the base year and selected future years.

[11] The system peak forecast shown here is the net native load forecast from data provided by Avista, excluding the two largest industrial loads.

Table 6-4 Winter Load Factors and Baseline Coincident Peak Forecast by Segment (MW @Meter)

Customer Class	Load Factor	2022	2025	2035	2045
Washington					
Residential	0.63	473	481	502	522
General Service	0.60	82	85	93	103
Large General Service	0.60	185	184	182	180
Extra Large General Service	0.68	83	83	83	84
Total		**823**	**834**	**861**	**889**
Idaho					
Residential	0.65	226	232	252	274
General Service	0.66	65	67	75	85
Large General Service	0.66	91	90	87	85
Extra Large General Service	0.60	49	49	47	45
Total		**431**	**437**	**461**	**489**

Table 6-5 Summer Load Factors and Baseline Coincident Peak Forecast by Segment (MW @Meter)

Customer Class	Load Factor	2022	2025	2035	2045
Washington					
Residential	0.50	509	518	540	562
General Service	0.51	83	85	94	103
Large General Service	0.51	186	185	183	181
Extra Large General Service	0.65	74	74	75	75
Total		**852**	**863**	**892**	**922**
Idaho					
Residential	0.53	237	243	264	287
General Service	0.57	64	66	75	84
Large General Service	0.57	90	89	86	84
Extra Large General Service	0.53	48	47	45	44
Total		**438**	**445**	**470**	**499**

System and Coincident Peak Forecasts by State

The next step in market characterization is to define the estimated peak load forecast for the study timeframe. This is done at the Avista system level, and also by state. We used Avista's peak demand data to develop the individual state contribution to the estimated coincident peak values. These represent a state's projected demand at the time of the system peak for both summer and winter.

Figure 6-1 shows the statewide contribution to the estimated system coincident summer peak, developed based on load forecast data provided by Avista. In 2022, system peak load for the summer is 1,369 MW at the grid or generator level. Washington contributes 66% of summer system peak while Idaho contributes 34%. Summer coincident peak load is expected to grow by an average of 0.42% annually from 2022-2044.

Figure 6-1 Contribution to Estimated System Coincident Peak Forecast by State (Summer)

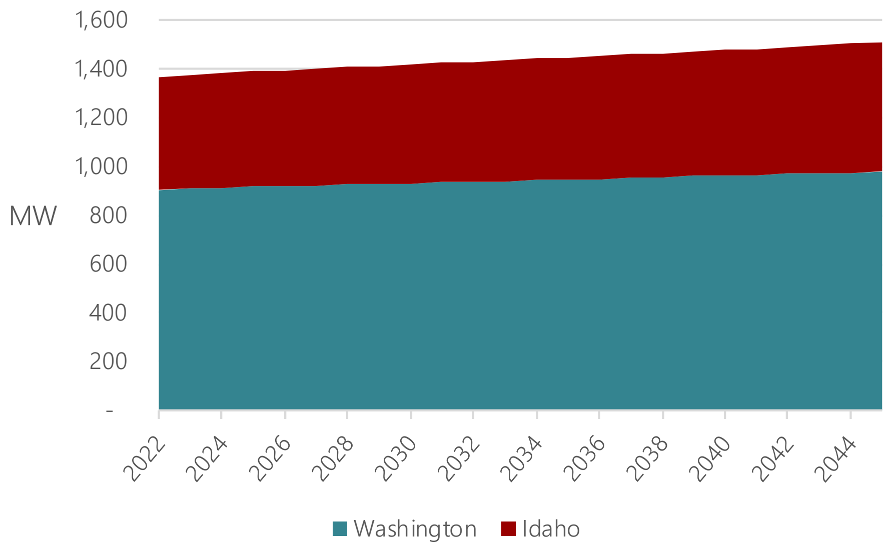
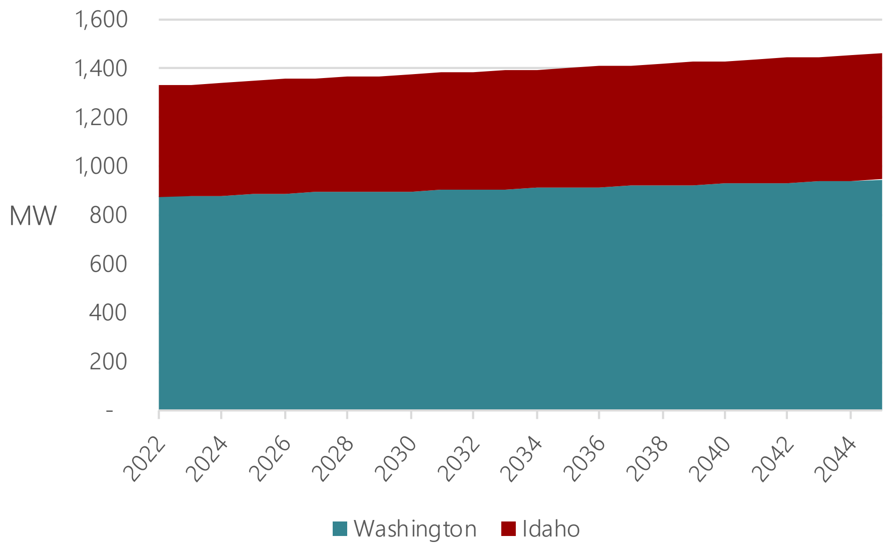


Figure 6-2 shows the jurisdictional contribution to the estimated system coincident winter peak forecast, developed based on load forecast data provided by Avista. In 2022, system peak load for the winter (a typical December weekday at 6:00 pm) is 1,331 MW at the grid or generator level. The winter system peak is about 3% lower than the summer peak. Washington contributes 66% of winter system peak while Idaho contributes 34%. Over the study period, winter coincident peak load is expected to grow by an average of 0.41% annually.

Figure 6-2 Contribution to Estimated System Coincident Peak Forecast by State (Winter)



Equipment End Use Saturation

Another key component of market characterization for DR analysis is end use saturation data. This is required to further segment the market and identify eligible customers for direct control of different equipment options. The relevant space heating equipment for DR analysis are electric furnaces and air-source heat pumps. We obtained C&I saturation data from the CPA study, which had updated figures from the 2019 NEEA Commercial Building Stock Assessment (CBSA). We obtained Residential saturation data from the 2016 NEEA Residential Building Stock Assessment (RBSA). Table 6-6 and Table 6-7 below show saturation estimates by state and customer class for Washington and Idaho respectively. We assume slight growth trends in Central AC, Space Heating, and Electric Vehicle saturations through 2040. For AMI, Avista began their rollout in Washington in 2019 and expects to complete it by the end of 2020. Currently Avista has 99.5% of their rollout complete in their electric only service areas in Washington. In Idaho, the AMI rollout is projected to begin in 2022 and be complete by 2024.

Table 6-6 2019 End Use Saturations by Customer Class, Washington

End Use Saturation by Equipment Type	Residential	C&I
Space Heating Saturation		
Air-Source Heat Pump	40.8%	14.2%
Total (Applicable for DR Analysis)	40.8%	14.2%
Water Heating Saturation		
CTA-2045 Water Heater	0.0%	0.0%
Electric Vehicle Saturation		
All equipment	0.8%	-
Central AC Saturation		
All Equipment	27.8%	27.8%
AMI Saturation		
All Equipment	2.0%	2.0%
Appliance Saturation		
All Equipment	100.0%	-

Table 6-7 2019 End Use Saturation by Customer Class, Idaho

End Use Saturation by Equipment Type	Residential	C&I
Space Heating Saturation		
Air-Source Heat Pump	40.8%	14.2%
Total (Applicable for DR Analysis)	40.8%	14.2%
Water Heating Saturation		
Electric Resistance Water Heater	52.2%	60.1%
Electric Vehicle Saturation		
All equipment	0.8%	-
Central AC Saturation		
All Equipment	27.8%	27.8%
AMI Saturation		
All Equipment	0.0%	0.0%
Appliance Saturation		
All Equipment	100.0%	-

DSM Program Options

The next step in the analysis is to characterize the available DSM options for the Avista territory. We considered the characteristics and applicability of a comprehensive list of options available in the DSM marketplace today as well as those projected into the 24-year study time horizon. We included for quantitative analysis those options which have been deployed at scale such that reliable estimates exist for cost, lifetime, and performance. Each selected option is described briefly below.

Program Descriptions

Direct Load Control of Central Air Conditioners

The DLC Central AC program targets Avista's Residential and General Service customers in Washington and Idaho. This program directly controls Central AC load in summer through a load control switch placed on a customer's AC unit. During events, the AC units will be cycled on and off. Participation in the program is expected to be shared with the Smart Thermostat- Cooling Program in the integrated scenario since the programs are similar. However, if only one program is rolled out of the two, then participation would be expected to double for the program implemented. In the fully integrated case, we assume it would take three full time employees to manage all the DLC programs (five total).

Direct Load Control of Domestic Hot Water Heaters

The DLC Domestic Hot Water Heater program targets Avista's Residential and General Service customers in Idaho. This program directly controls water heating load throughout the year for these customers through a load control switch. Water heaters would be completely turned off during the DR event period. The event period is assumed to be 50 hours during the summer months and another 50 hours during winter months. Water heaters of all sizes are eligible for control. We assume a $160 cost to Avista for each switch, a $200 installation fee, and a permit and license cost of $100 for residential participants ($125 for general service participants).

CTA-2045 Hot Water Heaters

The CTA-2045 Hot Water Heater program targets Avista's Residential and General Service customers in Washington. These water heaters contain a communicating module interface and can seamlessly fit into a DR program as these become more prevalant in the Avista territory. Idaho is not mandating this equipment yet and therefore this program is only modeled for Washington. Water heaters would be completely turned off during the DR event period. The event period is assumed to be 75 hours during the summer months and another 75 hours during winter months. Water heaters of all sizes are eligible for control. We assume a $150 cost to Avista for each module as well as an additional provisioning cost of $100 for each customer (since only 20% of customers will need help provisioning, so we assume a $20 average provisioning cost.)

Smart Thermostats DLC Heating/Cooling

This program uses the two-way communicating ability of smart thermostats to cycle them on and off during events. The Smart Thermostat program targets Avista's Residential and General Service customers in Washington and Idaho. We assume this will be a Bring your own Thermostat program (BYOT) and therefore assume no installation costs to Avista. Since the cooling and heating programs are quite different as far as impact assumptions and participation rates, we modeled them separately. As mentioned in the DLC Central AC program description, participation in the DLC Smart Thermostat Cooling program is expected to be split between the two programs in the integrated scenario.

Smart Appliances DLC

The Smart Appliances DLC program uses a Wi-Fi hub to connect smart Wi-Fi enabled appliances such as washers, dryers, refrigerators, and water heaters. During events throughout the year, the smart appliances will be cycled on and off. The Smart Appliances DLC program targets Avista's Residential and General Service customers in Washington and Idaho. We assume a low steady-state participation rate of 5% for this program.

Third Party Contracts

Third Party Contracts are assumed to be available for General Service, Large General Service, and Extra Large General Service customers year-round. For the Large and Extra Large General Service customers, we assume they will engage in firm curtailment. Under this program option, it is assumed that participating customers will agree to reduce demand by a specific amount or curtail their consumption to a predefined level at the time of an event. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year). Customers are paid to be on call even though actual load curtailments may not occur. The amount of the capacity payment typically varies with the load commitment level. In addition to the fixed capacity payment, participants typically receive a payment for energy reduction during events. Because it is a firm, contractual arrangement for a specific level of load reduction, enrolled loads represent a firm resource and can be counted toward installed capacity requirements. Penalties may be assessed for under-performance or non-performance. Events may be called on a day-of or day-ahead basis as conditions warrant.

This option is typically delivered by load aggregators and is most attractive for customers with maximum demand greater than 200 kW and flexibility in their operations. Industry experience indicates that aggregation of customers with smaller sized loads is less attractive financially due to lower economies of scale. In addition, customers with 24x7 operations, continuous processes, or with obligations to continue providing service (such as schools and hospitals) are not often good candidates for this option.

For the general service customers, we simulate a demand buyback program. In a demand buyback program, customers volunteer to reduce what they can on a day-ahead or day-of basis during a predefined event window. Customers then receive an energy payment based on their performance during the events.

Electric Vehicle DLC Smart Chargers

DLC Smart Chargers for Electric Vehicles can be switched off during on-peak hours throughout the year to offset demand to off-peak hours. Avista currently has an Electric Vehicle Supply Equipment (EVSE) pilot program in place for residential, commercial electric vehicle fleets, and workplace charging locations. In 2018, we based our assumptions off of the EVSE pilot results. However, this year Avista revised several program assumptions internally and AEG used those numbers for the study. The program start year was updated to 2024 to reflect technology rollout, the peak reduction was increased, annual O&M Costs were lowered, the Cost of Equipment was lowered, and the annual incentive costs were removed in lieu of a rebate or the utility providing a rate-based charger to participate in the program.

Time-of-Use Pricing

The Time-of-Use (TOU) pricing rate is a standard rate structure where rates are lower during off-peak hours and higher during peak hours during the day incentivizing participants to shift energy use to periods of lower grid stress. For the TOU rate, there are no events called and the structure does not change during the year. Therefore, it is a good default rate for customers that still offers some load shifting potential. We assume two scenarios for the TOU rate. An opt-in rate where participants will have to choose to go on the rate and an opt-out rate where participants will automatically be placed on the TOU rate and will need to request a rate change if required. We assume this rate will be available to all service classes.

Variable Peak Pricing

The Variable Peak Pricing (VPP) rate is composed of significantly higher prices during relatively short critical peak periods on event days to encourage customers to reduce their usage. VPP is usually offered in conjunction with a time-of-use rate, which implies at least three time periods: critical peak, on-peak and off-peak. The customer incentive is a more heavily discounted rate during off-peak hours throughout the year (relative a standard TOU rate). Event days are dispatched on relatively short notice (day ahead or day of) typically for a limited number of days during the year. Over time, event-trigger criteria become well-established so that customers can expect events based on hot weather or other factors. Events can also be called during times of system contingencies or emergencies. We assume that this rate will be offered to all service classes

Ancillary Services

Ancillary Services refer to functions that help grid operators maintain a reliable electricity system. Ancillary services maintain the proper flow and direction of electricity, address imbalances between supply and demand, and help the system recover after a power system event. In systems with significant variable renewable energy penetration, additional ancillary services may be required to manage increased variability and uncertainty. We assume ancillary services demand response capabilities can be available in all sectors. This year we modeled individual ancillary programs based on several parent programs: Smart Thermostats- Heating/Cooling, DLC Water Heating, CTA-2045 Water Heating, Electric Vehicle Charging, and Battery Energy Storage.

Thermal Energy Storage

Ice Energy Storage, a type of thermal energy storage, is an emerging technology that is being explored in many peak-shifting applications across the country. This technology involves cooling and freezing water in a storage container so that the energy can be used at a later time for space cooling. More specifically, the freezing water takes advantage of the large amount of latent energy associated with the phase change between ice and liquid water, which will absorb or release a large amount of thermal energy while maintaining a constant temperature at the freezing (or melting) point. An ice energy storage unit turns water into ice during off-peak times when price and demand for electricity is low, typically night time. During the day, at peak times, the stored ice is melted to meet all or some of the building's cooling requirements, allowing air conditioners to operate at reduced loads.

Ice energy storage is primarily being used in non-residential buildings and applications, as modeled in this analysis, but may see expansion in the future to encompass smaller, residential systems as well as emerging grid services for peak shaving and renewable integration. Since the ice energy storage is used for space cooling, we assume this program would be available during the summer months only.

Battery Energy Storage

This program provides the ability to shift peak loads using stored electrochemical energy. Currently the main battery storage equipment uses Lithium-Ion Batteries. They are the most cost-effective battery type on the market today. We assume the battery energy storage option will be available for all service classes with the size and cost of the battery varying depending upon the level of demand of the building.

Behavioral

Behavioral DR is structured like traditional demand response interventions, but it does not rely on enabling technologies nor does it offer financial incentives to participants. Participants are notified of an event and simply asked to reduce their consumption during the event window. Generally, notification occurs the day prior to the event and are deployed utilizing a phone call, email, or text message. The next day, customers may receive post-event feedback that includes personalized results and encouragement.

For this analysis, we assumed the Behavioral DR program would be offered as part of a Home Energy Reports program in a typical opt-out scenario. As such, we assume this program would be offered to residential customers only. Avista does not currently have a Home Energy Report program in place. Therefore, the Behavioral program is expected to bear the full cost of the program implementation.

Program Assumptions and Characteristics

Table 6-8 lists the DSM options considered in the study, including the eligible sectors, the mechanism for deployment and the expected annual event hours (summer and winter hours combined if both seasons are considered). The 2018 study revised the 2016 study by adding Space Heating as an additional option, however Avista ultimately decided the Smart Thermostat DLC Heating program would be sufficient for DLC space heating options. For cooling, both Central AC DLC and Smart Thermostats DLC were considered as options. 2018 was also the first year that the CTA-2045 Water Heaters were considered as an option. In 2020, several other changes were made to provide a more realistic forecast of DR potential. Since CTA-2045 Water Heaters are only being mandated in Washington, we used a DLC Water Heating program for Idaho instead. Real Time Pricing was removed as a rate option as it is becoming more of a rarely implemented program. In addition, ancillary services were broken out this year as subsets of viable parent programs to capture a more accurate depiction of their potential savings.

Table 6-8 Class 1 DSM Products Assessed in the Study

DSM Option	Eligible Sectors	Mechanism	Annual Event Hours
DLC of central air conditioners	Residential, General Service	Direct load control switch installed on customer's equipment.	100
DLC of domestic hot water heaters (DHW)	Residential, General Service	Direct load control switch installed on customer's equipment.	100
CTA-2045 hot water heaters	Residential, General Service	Communicating module installed on water heater	150
Smart Thermostats DLC Heating	Residential, General Service	Internet-enabled control of thermostat set points	36
Smart Thermostats DLC Cooling	Residential, General Service	Internet-enabled control of thermostat set points	36
Smart Appliances DLC	Residential, General Service	Internet-enabled control of operational cycles of white goods appliances	1056
Thermal Energy Storage	General Service, Large General Service, Extra Large General Service	Peak shifting of space cooling loads using stored ice	72
Third Party Contracts	General Service, Large General Service, Extra Large General Service	Customers enact their customized, mandatory curtailment plan. Penalties apply for non-performance.	60
Electric Vehicle DLC Smart Chargers	Residential	Automated, level 2 EV chargers that postpone or curtail charging during peak hours.	1056
Time-of-Use Pricing	All Sectors	Higher rate for a particular block of hours that occurs every day. Requires either on/off peak meters or AMI technology.	1056
Variable Peak Pricing	All Sectors	Much higher rate for a particular block of hours that occurs only on event days. Requires AMI technology.	80
Ancillary Services	All Sectors	Automated control of various building management systems or end-uses through one of the mechanisms already described	varies by program
Thermal Energy Storage	General Service, Large General Service, Extra Large General Service	Peak shifting of primarily space cooling or heating loads using a thermal storage medium such as water or ice	72
Battery Energy Storage	All Sectors	Peak shifting of loads using stored electrochemical energy	72
Behavioral	Residential	Voluntary DR reductions in response to behavioral messaging. Example programs exist in CA and other states. Requires AMI technology.	80

The description of options below includes the key assumptions used for potential and levelized cost calculations. The development of these assumptions is based on findings from research and review of available information on the topic, including national program survey databases, evaluation studies, program reports, regulatory filings. The key parameters required to estimate potential for a DSM program are participation rate, per participant load reduction and program costs. We have described below our assumptions of these parameters.

Participation Rate Assumptions

Table 6-9 below shows the steady-state participation rate assumptions for each DSM option as well as the basis for the assumptions. As previously mentioned, the participation for space cooling is split between DLC Central AC and Smart Thermostat options.

Table 6-9 DSM Steady-State Participation Rates (% of eligible customers)

DSM Option	Residential Service	General Service	Large General Service	Extra Large General Service	Basis for Assumption
Direct Load Control (DLC) of central air conditioners	10%	10%	-	-	NWPC DLC Switch cooling assumption
DLC of domestic hot water heaters (DHW)	15%	5%	-	-	Industry Experience- Brattle Study
Smart Thermostats DLC Heating	5%	3%	-	-	Agreed Upon Estimate with Avista
CTA-2045 hot water heaters	50%	50%	-	-	NWPC Grid Interactive Water Heater Assumptions
Smart Thermostats DLC Cooling	20%	20%	-	-	NWPC Smart Thermostat cooling assumption (See DLC Central AC)
Smart Appliances DLC	5%	5%	-	-	2017 ISACA IT Risk Reward Barometer – US Consumer Results, October 2017
Third Party Contracts	-	15%	22%	21%	Industry Experience
Electric Vehicle DLC Smart Chargers	25%	-	-	-	NWPC Electric Resistance Grid-Ready Summer/Winter Participation
Time-of-Use Pricing Opt-in	13%	13%	13%	13%	Best estimate based on industry experience; Winter impacts ½ of summer impacts
Time-of-Use Pricing Opt-out	74%	74%	74%	74%	
Variable Peak Pricing	25%	25%	25%	25%	OG&E 2019 Smart Hours Study

Thermal Energy Storage	-	0.5%	1.5%	1.5%	Industry Experience
Battery Energy Storage	0.5%	0.5%	0.5%	0.5%	Industry Experience
Behavioral	20%	-	-	-	PG&E rollout with six waves (2017)

Load Reduction Assumptions

Table 6-10 presents the per participant load reductions for each DSM option and explains the basis for these assumptions. The load reductions are shown on a kW basis for technology-based options and a percent load reduction otherwise.

Table 6-10 DSM Per Participant Impact Assumptions

DSM Option	Residential	General Service	Large General Service	Extra Large General Service	Basis for Assumption
Direct Load Control (DLC) of central air conditioners	0.5 kW	1.25 kW	-	-	NWPC DLC Switch cooling assumption was close to 1.0 kW reduced to adjust for Avista proposed cycling strategy,
DLC of domestic hot water heating (DHW)	0.50 kW	1.26 kW	-	-	NWPC Electric Resistance Switch Summer Impact, General Service is 2.52x that of Residential based on DLC Central AC Residential to C&I ratio
CTA-2045 Water Heating	0.50 kW	1.26 kW	-	-	NWPC Electric Resistance Grid-Ready Summer/Winter Impact, General Service is 2.52x that of Residential based on DLC Central AC Residential to C&I ratio
Smart Thermostats DLC Heating	1.09 kW	1.35 kW	-	-	NWPC Smart thermostat heating assumption (east)
Smart Thermostats DLC Cooling	0.50 kW	1.25 kW	-	-	NWPC DLC Switch cooling assumption was close to 1.0 kW reduced to adjust for Avista proposed cycling strategy
Smart Appliances DLC	0.14 kW	0.14 kW	-	-	Ghatikar, Rish. Demand Response Automation in Appliance and Equipment. Lawrence Berkley National Laboratory, 2017.
Third Party Contracts	-	10%	21%	21%	Impact Estimates from Aggregator Programs in California (Source: 2012 Statewide Load Impact Evaluation of California Aggregator Demand Response Programs Volume 1: Ex post and Ex ante Load Impacts; Christensen Associates Energy Consulting; April 1, 2013).
Electric Vehicle DLC Smart Chargers	0.50 kW	-	-	-	Avista EVSE DR Pilot Program and other Avista research
Time-of-Use Pricing Opt-in	5.7%	0.2%	2.6%	3.1%	Best estimate based on industry experience; Winter impacts ½ of summer impacts
Time-of-Use Pricing Opt-out	3.4%	0.2%	2.6%	3.1%	
Variable Peak Pricing	10%	4%	4%	4%	OG&E 2019 Smart Hours Study; Summer Impacts Shown (Winter impacts ¾ summer)

DSM Option	Residential	General Service	Large General Service	Extra Large General Service	Basis for Assumption
Thermal Energy Storage		1.68 kW	8.4 kW	8.4 kW	Ice Bear Tech Specifications, https://www.ice-energy.com/wp-content/uploads/2016/03/ICE-BEAR-30-Product-Sheet.pdf
Battery Energy Storage	2 kW	2 kW	15 kW	15 kW	Typical Battery size per segment
Behavioral	2%	-	-	-	Opower documentation for BDR with Consumers and Detroit Energy

Program Costs

Table 6-11 *shows the annual marketing, recruitment, incentives, and program development costs associated with each DSM option.*

Table 6-12 presents itemized cost assumptions for the DSM Options and the basis for the assumptions for the state of Washington. Table 6-11 shows the annual O&M costs per participant and per MW (Third Party Contracts only) and the Cost of Equipment and installation per participant and per kW (Thermal Energy Storage only).

Table 6-11 DSM Program Operations Maintenance, and Equipment Costs (Washington)

DSM Option	Annual O&M Cost Per Participant	Annual O&M Cost per MW	Cost of Equip + Install Per Participant	Cost of Equip + Install per kW
DLC Central AC	$13.00		$260.00	$0.00
DLC Water Heating	$23.63		$472.50	$0.00
CTA-2045 Water Heating	$0.00		$170.00	$0.00
DLC Smart Thermostats – Heating	$44.00		$0.00	$0.00
DLC Smart Thermostats - Cooling	$44.00		$0.00	$0.00
DLC Smart Appliances	$0.00		$300.00	$0.00
Third Party Contracts	$0.00	$80,000.00	$0.00	$0.00
DLC Electric Vehicle Charging	$11.00		$1,200.00	$0.00
Time-of-Use Opt-in	$0.00		$0.00	$0.00
Time-of-Use Opt-out	$0.00		$0.00	$0.00
Variable Peak Pricing Rates	$0.00		$0.00	$0.00
Thermal Energy Storage	$308.00		$0.00	$6,160.00
Battery Energy Storage	$0.00		$27,897.60	$0.00
Behavioral	$3.25		$0.00	$0.00

Table 6-12 shows the annual marketing, recruitment, incentives, and program development costs associated with each DSM option.

Table 6-12 Marketing, Recruitment, Incentive, and Development Costs (Washington)

DSM Option	Annual Marketing/Recruitment Cost Per Participant	Annual Incentive Per Participant	Program Development Cost
DLC Central AC	$67.50	$29.00	$23,863.32
CTA-2045 Water Heating	$67.50	$24.00	$75,000.00
DLC Smart Thermostats - Heating	$67.50	$20.00	$23,963.15
DLC Smart Thermostats - Cooling	$67.50	$20.00	$23,863.32
DLC Smart Appliances	$50.00	$0.00	$24,084.70
Third Party Contracts	$0.00	$0.00	$0.00
DLC Electric Vehicle Charging	$50.00	$24.00	$49,135.60
Time-of-Use Opt-in	$57.50	$0.00	$12,315.14
Time-of-Use Opt-out	$57.50	$0.00	$12,281.26
Variable Peak Pricing Rates	$175.00	$0.00	$12,222.26
Thermal Energy Storage	$100.00	$0.00	$14,994.78
Battery Energy Storage	$25.00	$0.00	$8,017.36
Behavioral	$0.00	$0.00	$66,055.68

Table 6-13 and Table 6-14 present the equivalent cost tables for the state of Idaho.

Table 6-13 DSM Program Operations Maintenance, and Equipment Costs (Idaho)

DSM Option	Annual O&M Cost Per Participant	Annual O&M Cost per MW	Cost of Equip + Install Per Participant	Cost of Equip + Install per kW
DLC Central AC	$13.00		$260.00	$0.00
DLC Water Heating	$23.63		$472.50	$0.00
DLC Smart Thermostats – Heating	$44.00		$0.00	$0.00
DLC Smart Thermostats - Cooling	$44.00		$0.00	$0.00
DLC Smart Appliances	$0.00		$300.00	$0.00
Third Party Contracts	$0.00	$80,000.00	$0.00	$0.00
DLC Electric Vehicle Charging	$11.00		$1,200.00	$0.00
Time-of-Use Opt-in	$0.00		$0.00	$0.00
Time-of-Use Opt-out	$0.00		$0.00	$0.00
Variable Peak Pricing Rates	$0.00		$0.00	$0.00
Thermal Energy Storage	$308.00		$0.00	$6,160.00

Battery Energy Storage	$0.00	$27,897.60	$0.00
Behavioral	$3.25	$0.00	$0.00

Table 6-14 Marketing, Recruitment, Incentive, and Development Costs (Idaho)

DSM Option	Annual Marketing/Recruitment Cost Per Participant	Annual Incentive Per Participant	Program Development Cost
DLC Central AC	$67.50	$29.00	$13,636.68
DLC Water Heating	$67.50	$24.00	$13,371.11
DLC Smart Thermostats - Heating	$67.50	$20.00	$13,536.85
DLC Smart Thermostats - Cooling	$67.50	$20.00	$13,636.68
DLC Smart Appliances	$50.00	$0.00	$13,415.30
Third Party Contracts	$0.00	$0.00	$0.00
DLC Electric Vehicle Charging	$50.00	$24.00	$25,864.40
Time-of-Use Opt-in	$69.00	$0.00	$6,434.86
Time-of-Use Opt-out	$69.00	$0.00	$6,468.74
Variable Peak Pricing Rates	$175.00	$0.00	$6,527.74
Thermal Energy Storage	$100.00	$0.00	$10,005.22
Battery Energy Storage	$25.00	$0.00	$4,482.64
Behavioral	$0.00	$0.00	$33,944.32

Other Cross-cutting Assumptions

In addition to the above program-specific assumptions, there are three that affect all programs:

- **Discount rate.** We used a nominal discount rate of 5.21% to calculate the net present value (NPV) of costs over the useful life of each DR program. All cost results are shown in nominal dollars.
- **Line losses.** Avista provided a line loss factor of 6.16% to convert estimated demand savings at the customer meter level to demand savings at the generator level. In the next section, we report our analysis results at the generator level.
- **Shifting and Saving.** Each program varies in the way energy is shifted or saved throughout the day. For example, customers on the DLC Central AC program are likely to pre-cool their homes prior to the event and turn their AC units back on after the event (snapback effect). The results in this report only show the savings during the event window and not before and after the event. However, shifting and savings assumptions were provided to Avista for each program to inform the IRP results.

DR Potential and Cost Estimates

This section presents analysis results on demand savings and cost estimates for DR programs. We developed savings estimates in two ways:

- First, we present the integrated results. If Avista offers more than one program, then the potential for double counting exists. To address this possibility, we created a participation hierarchy to define the order in which the programs are taken by customers. Then we computed the savings and costs under this scenario. For this study, we assumed a customer would not be on both a Central AC program and a Smart Thermostat program and would only be on a thermal energy storage program or battery energy storage program. The hierarchy of pricing rates is as follows: Time-of-Use, Variable Peak Pricing, and Real Time Pricing.
- At the very end of this section, we present high-level standalone results in 2045 without considering the integrated effects that occur if more than one DR option is offered to Avista customers. Standalone results represent an upper bound for each program individually and should not be added together as that would overstate the overall system level potential.

All potential results presented in this section represent capacity savings in terms of equivalent generation capacity.

Integrated Potential Results

The following sections separate out the integrated potential results for winter and summer for the Time-of-Use Opt-in and Time-of-Use Opt-out scenarios.

Winter TOU Opt-in Scenario

Figure 6-3 and Table 6-15 show the total winter demand savings from individual DR options for selected years of the analysis. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- The highest potential option is CTA-2045 WH which is expected to reach a savings potential of 48.9 MW by 2045.
- The next three biggest potential options in winter include DLC Electric Vehicle Charging (30.2 MW in 2045), Third Part Contracts (21.9 MW), and Variable Peak Pricing Rates (12.0 MW)
- Since most of the participants are likely to be on the VPP pricing rate in the TOU Opt-in scenario, the TOU potential (4.1 MW in 2045) is significantly lower than in the Opt-out case (17.8 MW).
- The total potential savings in the winter TOU Opt-in scenario are expected to increase from 9.3 MW in 2022 to 144.3 MW by 2045. The respective increase in the percentage of system peak goes from 0.7% in 2022 to 10.0% by 2045.

Figure 6-3 Summary of Potential Analysis for Avista (TOU Opt-In Winter Peak MW @Generator)

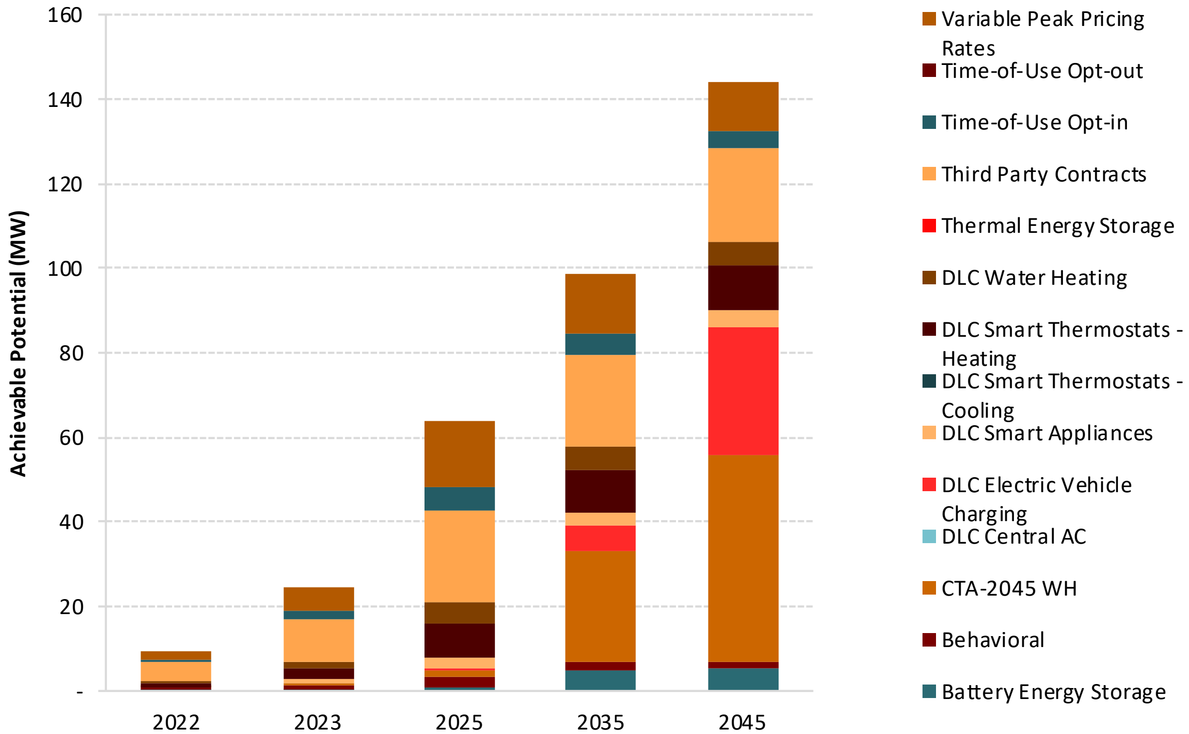


Table 6-15 Achievable DR Potential by Option (TOU Opt-In Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,444**
Market Potential (MW)	**9.3**	**24.6**	**63.9**	**98.8**	**144.3**
Market Potential (% of baseline)	**0.7%**	**1.8%**	**4.7%**	**7.0%**	**10.0%**
Potential Forecast	**1,321**	**1,312**	**1,285**	**1,304**	**1,300**
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.2	2.5	2.0	1.6
CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.9	2.6	8.0	9.8	10.9
DLC Water Heating	0.5	1.6	4.9	5.5	5.5
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	4.6	10.0	21.9	21.8	21.9
Time-of-Use Opt-in	0.5	1.8	5.3	4.9	4.1

Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	1.8	5.9	15.9	14.5	12.0
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.38%
Behavioral	0.04%	0.09%	0.18%	0.14%	0.11%
CTA-2045 WH	0.00%	0.02%	0.12%	1.88%	3.38%
DLC Central AC					
DLC Electric Vehicle Charging			0.02%	0.40%	2.09%
DLC Smart Appliances	0.02%	0.07%	0.20%	0.24%	0.26%
DLC Smart Thermostats - Cooling					
DLC Smart Thermostats - Heating	0.06%	0.19%	0.59%	0.70%	0.75%
DLC Water Heating	0.04%	0.12%	0.37%	0.39%	0.38%
Thermal Energy Storage					
Third Party Contracts	0.34%	0.75%	1.62%	1.56%	1.52%
Time-of-Use Opt-in	0.04%	0.13%	0.39%	0.35%	0.28%
Time-of-Use Opt-out					
Variable Peak Pricing Rates	0.14%	0.44%	1.18%	1.03%	0.83%

Table 6-16 and Table 6-17 show demand savings by individual DR option for the states of Washington and Idaho separately. Using the available DSM options, Washington is projected to save 105.27 MW (7.2% of winter system peak demand) by 2045 while Idaho is projected to save 39.03 MW (2.67% of winter system peak demand) by 2045.

Table 6-16 Achievable DR Potential by Option for Washington (TOU Opt-In Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	1,331	1,337	1,349	1,403	1,463
Market Potential (MW)	6.91	16.53	39.46	69.22	105.27
Market Potential (% of System Peak)	0.5%	1.2%	2.9%	4.9%	7.2%
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.49	0.94	1.69	1.21	0.82
CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.57	1.71	5.23	6.37	6.97
DLC Water Heating	-	-	-	-	-
Thermal Energy Storage	-	-	-	-	-

Third Party Contracts	3.55	7.10	14.20	14.23	14.31
Time-of-Use Opt-in	0.46	1.34	3.57	3.07	2.32
Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	1.54	4.36	10.66	8.96	6.63

Table 6-17 Achievable DR Potential by Option for Idaho (TOU Opt-In Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,463**
Market Potential (MW)	**2.43**	**8.09**	**24.43**	**29.63**	**39.03**
Market Potential (% of System Peak)	**0.18%**	**0.61%**	**1.81%**	**2.11%**	**2.67%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.30	0.79	0.76	0.74
CTA-2045 WH	-	-	-	-	-
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.29	0.89	2.74	3.44	3.89
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	1.02	2.93	7.69	7.60	7.58
Time-of-Use Opt-in	0.09	0.45	1.72	1.84	1.79
Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	0.29	1.50	5.25	5.55	5.39

Cost Results

Table 6-18 presents the levelized costs per kW of equivalent generation capacity over 2022-2031 for both Washington and Idaho as well as the system weighted average levelized costs across both states. In addition, we show the 2031 savings potential from DR options for reference purposes.

Key findings include:

- The Third Party Contracts option delivers the highest savings in 2031 at approximately $75.26/kW-year cost. Capacity-based and energy-based payments to the third-party constitutes the major cost component for this option. All O&M and administrative costs are expected to be incurred by the representative third party contractor.

- The Variable Peak Pricing option has lowest levelized cost among all the DR options. It delivers 16.14 MW of savings in 2031 at $39.34/kW-year system wide. Enabling technology purchase and installation costs for enhancing customer response is a large part of CPP deployment costs.

Table 6-18 DR Program Costs and Potential (TOU Opt-In Winter)

DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Winter Potential MW in Year 2031
Battery Energy Storage	$833.17	$849.86	$839.87	2.81
Behavioral	$158.42	$172.77	$161.07	2.26
CTA-2045 WH	$174.13		$174.13	17.36
DLC Central AC				-
DLC Electric Vehicle Charging	$449.91	$452.04	$450.67	2.85
DLC Smart Appliances	$398.04	$401.96	$399.70	3.21
DLC Smart Thermostats - Cooling				-
DLC Smart Thermostats - Heating	$76.79	$77.74	$77.19	9.42
DLC Water Heating		$239.74	$239.74	5.48
Thermal Energy Storage				-
Third Party Contracts	$75.36	$75.07	$75.26	21.83
Time-of-Use Opt-in	$78.12	$97.73	$84.82	5.46
Time-of-Use Opt-out				-
Variable Peak Pricing Rates	$38.26	$40.90	$39.34	16.14

Winter TOU Opt-out Scenario

Figure 6-4 and Table 6-19 show the total winter demand savings from individual DR options for selected years of the analysis. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- Once again the largest potential is in CTA-2045 WH, at 48.9 MW by 2045.
- After CTA-2045 WH, the next three biggest potential options in winter include DLC Electric Vehicle Charging (30.2 MW in 2045), Third Party Contracts (21.9 MW), and TOU (17.8 MW).
- In the TOU opt-out scenario, customers are placed on the Time-of-Use rate by default and will need to go through an added step to switch rates. Therefore, the majority of savings among the rates are concentrated in TOU which is expected to reach 17.8 MW by 2045.
- In the Opt-out scenario, most of the participants are likely to be on the TOU pricing rate and we see a much lower savings potential for the VPP rate (4.0 MW by 2045).

- The total potential savings in the winter TOU Opt-out scenario are expected to increase from 36.4 MW in 2022 to 150.1 MW by 2045. The respective increase in the percentage of system peak increases from 2.7% in 2022 to 10.4% by 2045.

Figure 6-4 Summary of Winter Potential Analysis for Avista (TOU Opt-Out MW @Generator)

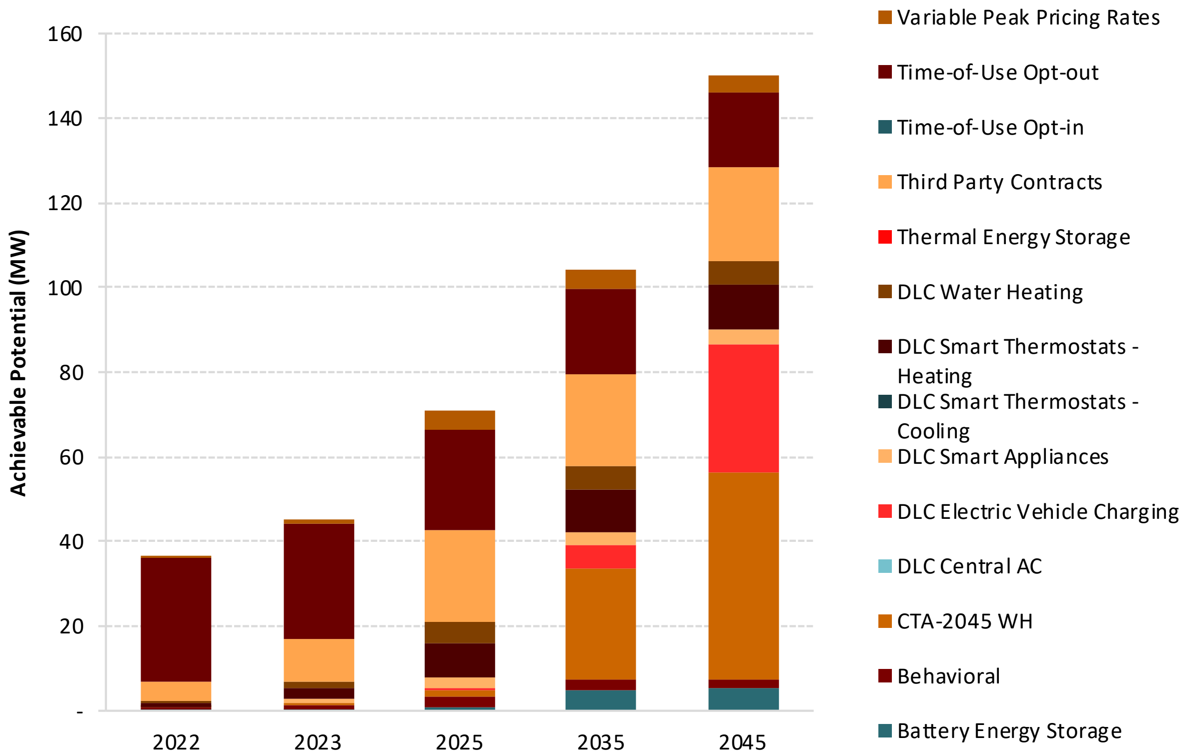


Table 6-19 Achievable DR Potential by Option – TOU Opt-Out (Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	1,331	1,337	1,349	1,403	1,444
Market Potential (MW)	36.4	45.3	71.1	104.5	150.1
Market Potential (% of baseline)	2.7%	3.4%	5.3%	7.4%	10.4%
Potential Forecast	1,294	1,291	1,278	1,299	1,294
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.3	2.5	2.1	1.7
CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7

DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.9	2.6	8.0	9.8	10.9
DLC Water Heating	0.5	1.6	4.9	5.5	5.5
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	4.6	10.0	21.9	21.8	21.9
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	29.3	27.0	23.7	20.3	17.8
Variable Peak Pricing Rates	0.2	1.3	4.6	4.7	4.0
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.38%
Behavioral	0.04%	0.09%	0.19%	0.15%	0.12%
CTA-2045 WH	0.00%	0.02%	0.12%	1.88%	3.38%
DLC Central AC					
DLC Electric Vehicle Charging			0.02%	0.40%	2.09%
DLC Smart Appliances	0.02%	0.07%	0.20%	0.24%	0.26%
DLC Smart Thermostats - Cooling					
DLC Smart Thermostats - Heating	0.06%	0.19%	0.59%	0.70%	0.75%
DLC Water Heating	0.04%	0.12%	0.37%	0.39%	0.38%
Thermal Energy Storage					
Third Party Contracts	0.34%	0.75%	1.62%	1.56%	1.52%
Time-of-Use Opt-in					
Time-of-Use Opt-out	2.20%	2.02%	1.76%	1.44%	1.23%
Variable Peak Pricing Rates	0.01%	0.10%	0.34%	0.33%	0.28%

Table 6-20 and Table 6-21 show demand savings by individual DR option for the states of Washington and Idaho separately.

Table 6-20 Achievable DR Potential by Option for Washington - TOU Opt-Out (MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,463**
Market Potential (MW)	**29.20**	**31.62**	**44.49**	**73.31**	**109.61**
Market Potential (% of System Peak)	**2.2%**	**2.4%**	**3.3%**	**5.2%**	**7.5%**
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.49	0.95	1.75	1.34	0.99

CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.57	1.71	5.23	6.37	6.97
DLC Water Heating	-	-	-	-	-
Thermal Energy Storage	-	-	-	-	-
Time-of-Use Opt-out	24.29	20.07	16.07	13.05	10.79
Variable Peak Pricing Rates	0.02	0.71	3.13	2.95	2.32

Table 6-21 Achievable DR Potential by Option for Idaho – TOU Opt-Out (MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,463**
Market Potential (MW)	**7.22**	**13.71**	**26.58**	**31.14**	**40.49**
Market Potential (% of System Peak)	**0.54%**	**1.03%**	**1.97%**	**2.22%**	**2.77%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.30	0.79	0.76	0.74
CTA-2045 WH	-	-	-	-	-
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.29	0.89	2.74	3.44	3.89
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	-	-	-	-	-
Time-of-Use Opt-out	5.00	6.93	7.62	7.20	6.99
Variable Peak Pricing Rates	0.16	0.64	1.49	1.70	1.66

Cost Results

Table 6-22 presents the levelized costs per kW of equivalent generation capacity over 2022-2031 for both Washington and Idaho as well as the system weighted average levelized costs across both states. In addition, we show the 2031 savings potential from DR options for reference purposes.

Key findings include:

- The Third Party Contracts option delivers the highest savings potential of 21.83 MW in 2031 at approximately $75.26/kW-year cost. Capacity-based and energy-based payments to the third-party constitutes the major cost component for this option. All O&M and administrative costs are expected to be incurred by the representative third party contractor.
- The TOU Opt-out option has the second highest potential to contribute 21.34 MW of savings in 2031 at approximately $99.84/kW-year
- The Variable Peak Pricing option has lowest levelized cost among all the DR options. It delivers 4.95 MW of savings in 2031 at $59.11/kW-year system wide. Enabling technology purchase and installation costs for enhancing customer response is a large part of VPP deployment costs.

Table 6-22 DR Program Costs and Potential – TOU Opt Out Winter

DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Winter Potential MW in Year 2031
Battery Energy Storage	$833.17	$849.86	$839.87	2.81
Behavioral	$154.99	$172.77	$172.77	2.26
CTA-2045 WH	$174.13		$174.13	17.36
DLC Central AC				-
DLC Electric Vehicle Charging	$449.91	$452.04	$450.67	2.85
DLC Smart Appliances	$398.04	$401.96	$399.70	3.21
DLC Smart Thermostats - Cooling				-
DLC Smart Thermostats - Heating	$76.79	$77.74	$77.19	9.42
DLC Water Heating		$239.74	$239.74	5.48
Thermal Energy Storage				-
Third Party Contracts	$75.36	$75.07	$75.26	21.83
Time-of-Use Opt-in				-
Time-of-Use Opt-out	$97.99	$103.41	$99.84	21.34
Variable Peak Pricing Rates	$58.72	$59.77	$59.11	4.95

Summer TOU Opt-in Scenario

Figure 6-5 and Table 6-23 show the total summer demand savings from individual DR options for selected years of the analysis. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- The highest potential option is DLC Smart Thermostats, which is expected to reach savings potential of 61 MW by 2045.

- The next two biggest potential options in summer include CTA-2045 WH (48.9 MW in 2045), DLC Electric Vehicle Charging (30.2 MW), and DLC Central AC (24.5 MW).
- Two Space cooling options- DLC Smart Thermostat and DLC Central AC – are expected to contribute a combined 85.5 MW by 2045.
- Total potential savings in the summer TOU Opt-in scenario are expected to increase from 11.3 MW in 2022 to 232 MW by 2045. The respective increase in the percentage of system peak increases from 0.8% in 2022 to 15.4% by 2045.

Figure 6-5 Summary of Summer Potential by Option (TOU Opt-In MW @Generator)

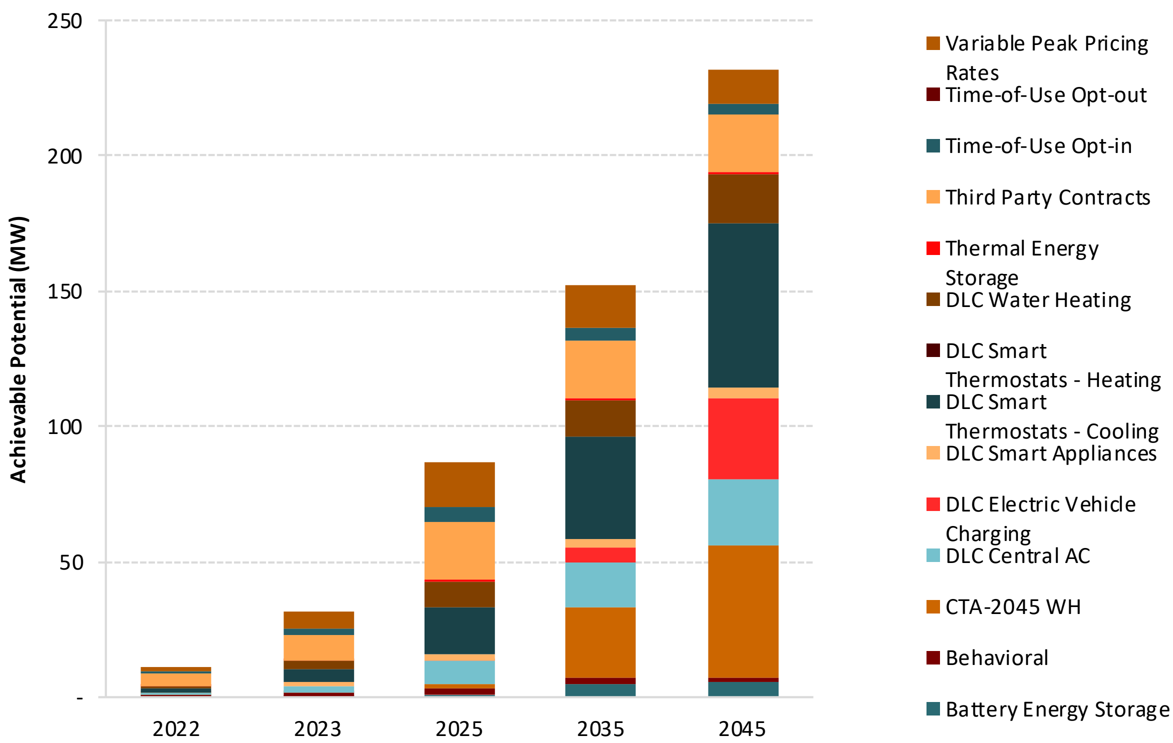


Table 6-23 Achievable DR Potential by Option TOU Opt-In (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**11.3**	**31.3**	**86.8**	**151.9**	**232.0**
Market Potential (% of baseline)	**0.8%**	**2.3%**	**6.3%**	**10.5%**	**15.4%**
Potential Forecast	**1,358**	**1,344**	**1,302**	**1,294**	**1,276**
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.3	2.6	2.1	1.7

CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
DLC Central AC	0.8	2.5	8.1	16.2	24.5
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7
DLC Smart Thermostats - Cooling	1.6	5.1	17.4	37.4	61.0
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	1.0	2.9	9.1	13.7	17.8
Thermal Energy Storage	0.1	0.2	0.6	0.7	0.6
Third Party Contracts	4.5	9.8	21.4	21.3	21.4
Time-of-Use Opt-in	0.6	1.9	5.5	5.1	4.3
Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	1.9	6.1	16.7	15.1	12.5
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.38%
Behavioral	0.04%	0.09%	0.18%	0.14%	0.11%
CTA-2045 WH	0.00%	0.02%	0.12%	1.82%	3.24%
DLC Central AC	0.06%	0.18%	0.58%	1.12%	1.62%
DLC Electric Vehicle Charging			0.02%	0.39%	2.00%
DLC Smart Appliances	0.02%	0.06%	0.20%	0.23%	0.25%
DLC Smart Thermostats - Cooling	0.12%	0.37%	1.25%	2.58%	4.04%
DLC Smart Thermostats - Heating					
DLC Water Heating	0.07%	0.21%	0.65%	0.95%	1.18%
Thermal Energy Storage	0.00%	0.01%	0.05%	0.05%	0.04%
Third Party Contracts	0.33%	0.71%	1.54%	1.48%	1.42%
Time-of-Use Opt-in	0.04%	0.14%	0.40%	0.35%	0.28%
Time-of-Use Opt-out					
Variable Peak Pricing Rates	0.14%	0.45%	1.20%	1.05%	0.83%

Table 6-24 and Table 6-25 show demand savings by individual DR option for the states of Washington and Idaho separately.

Table 6-24 Achievable DR Potential by Option for Washington TOU Opt-In (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**

Market Potential (MW)	**8.37**	**21.28**	**55.63**	**105.72**	**164.59**
Market Potential (% of System Peak)	**0.6%**	**1.5%**	**4.0%**	**7.3%**	**10.9%**
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.52	1.02	1.81	1.31	0.88
CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	0.50	1.59	5.18	10.25	15.34
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	1.02	3.25	11.12	23.68	38.26
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.40	1.28	4.15	8.20	12.26
Thermal Energy Storage	0.05	0.13	0.39	0.40	0.36
Third Party Contracts	3.46	6.92	13.84	13.88	13.96
Time-of-Use Opt-in	0.49	1.41	3.76	3.22	2.41
Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	1.63	4.60	11.26	9.41	6.91

Table 6-25 Achievable DR Potential by Option for Idaho TOU Opt-In (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**2.98**	**9.97**	**31.21**	**46.19**	**67.38**
Market Potential (% of System Peak)	**0.22%**	**0.72%**	**2.25%**	**3.20%**	**4.47%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.31	0.83	0.80	0.78
CTA-2045 WH	-	-	-	-	-
DLC Central AC	0.28	0.89	2.90	5.92	9.11
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35
DLC Smart Thermostats - Cooling	0.56	1.81	6.24	13.67	22.72
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	0.01	0.06	0.24	0.27	0.27

Third Party Contracts	1.00	2.88	7.55	7.47	7.46
Time-of-Use Opt-in	0.09	0.46	1.77	1.90	1.85
Time-of-Use Opt-out	-	-	-	-	-
Variable Peak Pricing Rates	0.30	1.55	5.42	5.73	5.57

Cost Results

Table 6-26 presents the levelized costs per kW of equivalent generation capacity over 2022-2031 for both Washington and Idaho as well as the system weighted average levelized costs across both states. In addition, we show the 2031 savings potential from DR options for reference purposes.

Key findings include:

- DLC Smart Thermostats deliver the highest savings in 2031 (28.68 MW) at approximately $127.27/kW-year cost. Capacity-based and energy-based payments to the third-party constitutes the major cost component for this option. All O&M and administrative costs are expected to be incurred by the representative third party contractor.
- The Variable Peak Pricing option has the lowest levelized cost among all the DR options. It delivers 16.89 MW of savings in 2031 at $37.51/kW-year system wide. Enabling technology purchase and installation costs for enhancing customer response is a large part of CPP deployment costs.

Table 6-26 DR Program Costs and Potential – Summer TOU Opt-In

DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Summer Potential MW in Year 2031
Battery Energy Storage	$833.17	$849.86	$839.87	2.81
Behavioral	$143.96	$164.86	$151.82	2.41
CTA-2045 WH	$174.13		$174.13	17.36
DLC Central AC	$161.09	$156.97	$159.34	12.80
DLC Electric Vehicle Charging	$449.91	$452.04	$450.67	2.85
DLC Smart Appliances	$398.04	$401.96	$399.70	3.21
DLC Smart Thermostats - Cooling	$129.24	$124.60	$127.27	28.68
DLC Smart Thermostats - Heating				-
DLC Water Heating		$239.74	$239.74	5.48
Thermal Energy Storage	$1,000.92	$957.45	$983.76	0.68
Third Party Contracts	$77.29	$76.39	$76.97	21.35
Time-of-Use Opt-in	$74.13	$94.63	$81.21	5.71
Time-of-Use Opt-out				-
Variable Peak Pricing Rates	$36.25	$39.64	$37.51	16.89

Summer TOU Opt-out Scenario

Figure 6-6 and Table 6-27 show the total summer demand savings from individual DR options for selected years of the analysis. These savings represent integrated savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- Once again the highest savings potential resides in DLC Smart Thermostats, increasing from 1.6 MW in 2022 to 61.0 MW in 2045.
- The next two biggest potential options in Summer include CTA-2045 WH (48.9 MW by 2045), DLC Electric Vehicle Charging (30.2 MW), and DLC Central AC (24.5 MW). DLC Smart Thermostat and DLC Central AC options together contribute 85.5 MW of potential by 2045.
- In the TOU opt-out scenario, customers are placed on the Time-of-Use rate by default and will need to go through an added step to switch rates. Therefore, the majority of savings among the rates are concentrated in TOU which is expected to reach 18.3 MW by 2045.
- In the Opt-out scenario, most of the participants are likely to be on the TOU pricing rate and we see a much lower savings potential for the VPP rate (4.1 MW by 2045).
- The total potential savings in the summer TOU Opt-in scenario are expected to increase from 39.0 MW in 2022 to 225.6 MW by 2045. The respective increase in the percentage of system peak goes from 2.8% in 2022 to 15.0% by 2045.

Figure 6-6 Summary of Summer Potential – TOU Opt-Out (MW @Generator)

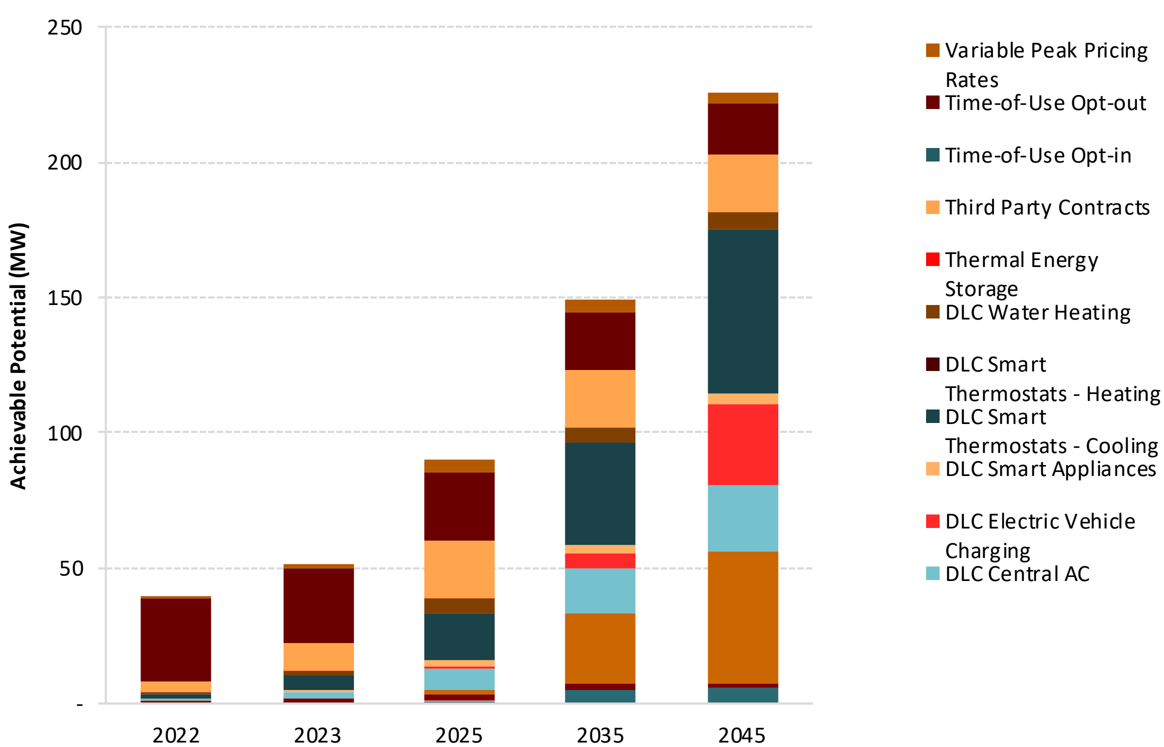


Table 6-27 Achievable DR Potential by Option – TOU Opt-Out (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**39.0**	**51.4**	**90.0**	**149.4**	**225.6**
Market Potential (% of baseline)	**2.8%**	**3.7%**	**6.5%**	**10.3%**	**15.0%**
Potential Forecast	**1,330**	**1,324**	**1,299**	**1,296**	**1,282**
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.3	2.7	2.2	1.8
CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
DLC Central AC	0.8	2.5	8.1	16.2	24.5
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7
DLC Smart Thermostats - Cooling	1.6	5.1	17.4	37.4	61.0
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.5	1.6	4.9	5.5	5.5
Thermal Energy Storage	0.1	0.2	0.6	0.7	0.6
Third Party Contracts	4.5	9.8	21.4	21.3	21.4
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	30.4	28.0	24.6	20.9	18.3
Variable Peak Pricing Rates	0.2	1.4	4.8	4.9	4.1
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.38%
Behavioral	0.04%	0.09%	0.19%	0.15%	0.12%
CTA-2045 WH	0.00%	0.02%	0.12%	1.82%	3.24%
DLC Central AC	0.06%	0.18%	0.58%	1.12%	1.62%
DLC Electric Vehicle Charging			0.02%	0.39%	2.00%
DLC Smart Appliances	0.02%	0.06%	0.20%	0.23%	0.25%
DLC Smart Thermostats - Cooling	0.12%	0.37%	1.25%	2.58%	4.04%
DLC Smart Thermostats - Heating					
DLC Water Heating	0.04%	0.12%	0.35%	0.38%	0.37%
Thermal Energy Storage	0.00%	0.01%	0.05%	0.05%	0.04%
Third Party Contracts	0.33%	0.71%	1.54%	1.48%	1.42%
Time-of-Use Opt-in					
Time-of-Use Opt-out	2.22%	2.04%	1.77%	1.45%	1.21%
Variable Peak Pricing Rates	0.01%	0.10%	0.35%	0.34%	0.27%

Table 6-28 and Table 6-29 show demand savings by individual DR option for the states of Washington and Idaho separately.

Table 6-28 Achievable DR Potential by Option for Washington – TOU Opt-Out (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**31.19**	**35.70**	**56.62**	**101.68**	**156.75**
Market Potential (% of System Peak)	**2.3%**	**2.6%**	**4.1%**	**7.0%**	**10.4%**
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.53	1.03	1.88	1.44	1.06
CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	0.50	1.59	5.18	10.25	15.34
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	1.02	3.25	11.12	23.68	38.26
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	-	-	-	-	-
Thermal Energy Storage	0.05	0.13	0.39	0.40	0.36
Third Party Contracts	3.46	6.92	13.84	13.88	13.96
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	25.32	20.94	16.79	13.55	11.12
Variable Peak Pricing Rates	0.02	0.75	3.30	3.11	2.43

Table 6-29 Achievable DR Potential by Option for Idaho – TOU Opt-Out (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**7.83**	**15.71**	**33.37**	**47.70**	**68.85**
Market Potential (% of System Peak)	**0.57%**	**1.14%**	**2.40%**	**3.30%**	**4.57%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.31	0.83	0.80	0.78
CTA-2045 WH	-	-	-	-	-
DLC Central AC	0.28	0.89	2.90	5.92	9.11
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35

DLC Smart Thermostats - Cooling	0.56	1.81	6.24	13.67	22.72
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	0.01	0.06	0.24	0.27	0.27
Third Party Contracts	1.00	2.88	7.55	7.47	7.46
Time-of-Use Opt-in	-	-	-	-	-
Time-of-Use Opt-out	5.07	7.08	7.82	7.39	7.18
Variable Peak Pricing Rates	0.17	0.67	1.54	1.76	1.71

Cost Results

Table 6-30 presents the levelized costs per kW of equivalent generation capacity over 2022-2031 for both Washington and Idaho as well as the system weighted average levelized costs across both states. In addition, we show the 2031 savings potential from DR options for reference purposes.

Key findings include:

- DLC Smart Thermosts delivers the highest savings potential in 2031 (28.68 MW) at approximately $127.27/kW-year cost. Capacity-based and energy-based payments to the third-party constitutes the major cost component for this option. All O&M and administrative costs are expected to be incurred by the representative third party contractor.
- The Variable Peak Pricing option has the lowest levelized cost among all the DR options. It delivers 5.18 MW of savings in 2031 at $56.48/kW-year system wide. Enabling technology purchase and installation costs for enhancing customer response is a large part of CPP deployment costs.

Table 6-30 DR Program Costs and Potential – Summer TOU Opt-Out

DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Summer Potential MW in Year 2031
Battery Energy Storage	$833.17	$849.86	$839.87	2.81
Behavioral	$143.96	$164.86	$151.02	2.41
CTA-2045 WH	$174.13		$174.13	17.36
DLC Central AC	$161.09	$156.97	$159.34	12.80
DLC Electric Vehicle Charging	$449.91	$452.04	$450.67	2.85
DLC Smart Appliances	$398.04	$401.96	$399.70	3.21
DLC Smart Thermostats - Cooling	$129.24	$124.60	$127.27	28.68
DLC Smart Thermostats - Heating				-
DLC Water Heating		$239.74	$239.74	5.48
Thermal Energy Storage	$1,000.92	$957.45	$983.76	0.68
Third Party Contracts	$77.29	$76.39	$76.97	21.35

Time-of-Use Opt-in				
Time-of-Use Opt-out	$93.94	$100.94	$96.35	22.10
Variable Peak Pricing Rates	$55.64	$57.91	$56.48	5.18

Stand-alone Potential Results

The above results assume that the programs are offered on an integrated basis where participation across similar options do not overlap. However, it is also important to see the potential by option where each program is unaffected by participation in other options. This way, Avista can gauge the impact from implementing an individual program. For this scenario we do not combine the potential savings and only show individual potential contributions by program for each scenario.

Winter Results

Figure 6-7 and Table 6-31 show the winter demand savings from individual DR options for selected years of the analysis. These savings represent stand-alone savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- The largest savings potential resides in CTA-2045 WH, contributing 0.1 MW of potential in 2022 and increasing to 48.9 MW by 2045.
- The next biggest option is DLC Electric Vehicle Charging, at 30.2 MW of potential by 2045.
- When each TOU option is examined as an individual program, the Time-of-Use Opt-out option has a much larger potential savings then if participants could opt-in to the rate. The TOU Opt-out option is expected to reach 29.9 MW by 2045 in the stand-alone case.
- Since the different rate options do not influence other rates in the stand-alone scenario, each rate has a larger potential savings than in the Opt-out/Opt-in scenarios.

Figure 6-8 Summary of Potential Analysis for Avista (Winter Peak MW @Generator)

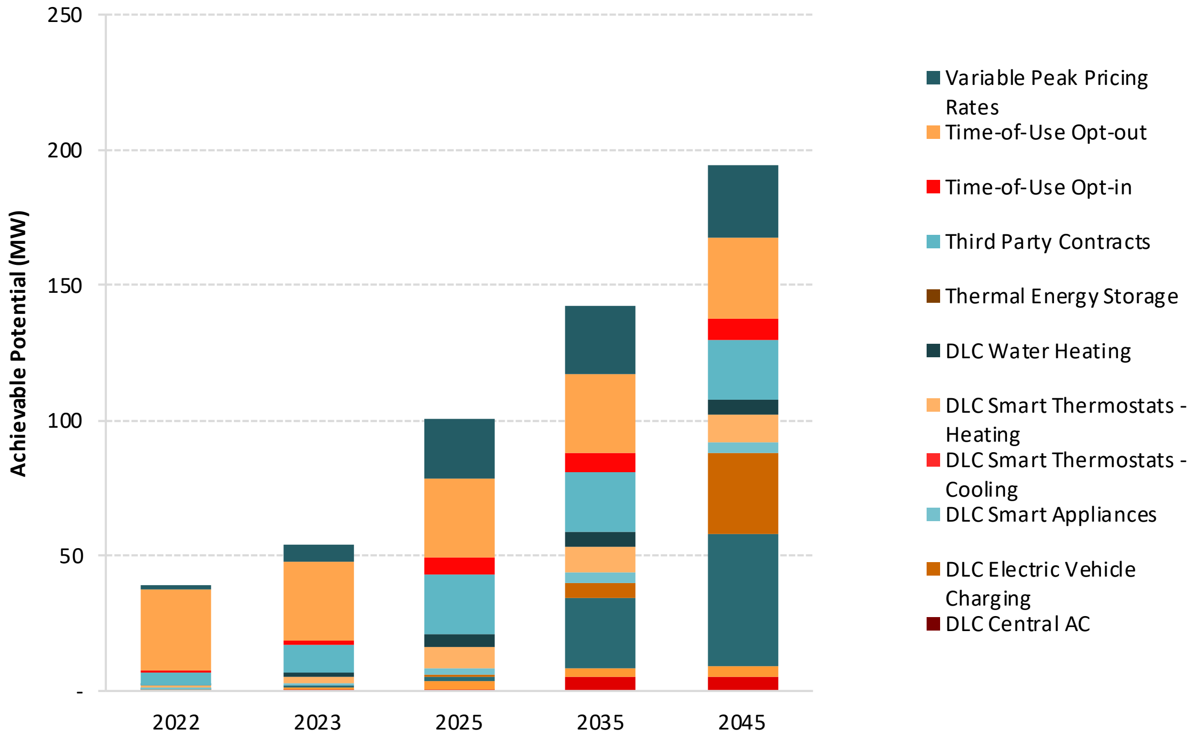


Table 6-32 Achievable DR Potential by Option (Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,444**
Market Potential (MW)	**39.5**	**54.2**	**100.2**	**142.6**	**194.5**
Market Potential (% of baseline)	**3.0%**	**4.1%**	**7.4%**	**10.2%**	**13.5%**
Potential Forecast	**1,291**	**1,282**	**1,249**	**1,261**	**1,250**
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.3	3.0	3.1	3.3
CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.9	2.6	8.0	9.8	10.9
DLC Water Heating	0.5	1.6	4.9	5.5	5.5
Thermal Energy Storage	-	-	-	-	-

Third Party Contracts	4.6	10.0	21.9	21.8	21.9
Time-of-Use Opt-in	0.6	1.9	6.4	7.5	7.8
Time-of-Use Opt-out	30.1	28.8	28.5	28.9	29.9
Variable Peak Pricing Rates	1.9	6.5	22.0	25.7	26.9
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.39%
Behavioral	0.04%	0.10%	0.22%	0.22%	0.23%
CTA-2045 WH	0.00%	0.02%	0.12%	1.88%	3.38%
DLC Central AC					
DLC Electric Vehicle Charging			0.02%	0.40%	2.09%
DLC Smart Appliances	0.02%	0.07%	0.20%	0.24%	0.26%
DLC Smart Thermostats - Cooling					
DLC Smart Thermostats - Heating	0.06%	0.19%	0.59%	0.70%	0.75%
DLC Water Heating	0.04%	0.12%	0.37%	0.39%	0.38%
Thermal Energy Storage					
Third Party Contracts	0.34%	0.75%	1.62%	1.56%	1.52%
Time-of-Use Opt-in	0.04%	0.14%	0.48%	0.53%	0.54%
Time-of-Use Opt-out	2.26%	2.16%	2.11%	2.06%	2.07%
Variable Peak Pricing Rates	0.14%	0.49%	1.63%	1.83%	1.86%

Table 6-33 and Table 6-34 show demand savings by individual DR option for the states of Washington and Idaho separately.

Table 6-33 Achievable DR Potential by Option for Washington (Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,463**
Market Potential (MW)	**31.90**	**38.50**	**63.59**	**99.07**	**140.00**
Market Potential (% of System Peak)	**2.4%**	**2.9%**	**4.7%**	**7.1%**	**9.6%**
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.49	0.99	2.01	2.10	2.18
CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.57	1.71	5.23	6.37	6.97

DLC Water Heating	-	-	-	-	-
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	3.55	7.10	4.20	14.23	14.31
Time-of-Use Opt-in	0.47	1.43	4.32	4.95	5.11
Time-of-Use Opt-out	24.92	21.36	19.07	19.18	19.71
Variable Peak Pricing Rates	1.60	4.83	14.65	16.88	17.49

Table 6-34 Achievable DR Potential by Option for Idaho (Winter MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,463**
Market Potential (MW)	**7.59**	**15.74**	**36.63**	**43.52**	**54.53**
Market Potential (% of System Peak)	**0.57%**	**1.18%**	**2.71%**	**3.10%**	**3.73%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.31	0.97	1.05	1.14
CTA-2045 WH	-	-	-	-	-
DLC Central AC	-	-	-	-	-
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35
DLC Smart Thermostats - Cooling	-	-	-	-	-
DLC Smart Thermostats - Heating	0.29	0.89	2.74	3.44	3.89
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	-	-	-	-	-
Third Party Contracts	1.02	2.93	7.69	7.60	7.58
Time-of-Use Opt-in	0.09	0.48	2.12	2.50	2.66
Time-of-Use Opt-out	5.15	7.45	9.46	9.70	10.22
Variable Peak Pricing Rates	0.30	1.66	7.40	8.79	9.41

Summer Results

Figure 6-9 and Table 6-36 show the summer demand savings from individual DR options for selected years of the analysis. These savings represent the individual stand-alone savings from all available DR options in Avista's Washington and Idaho service territories.

Key findings include:

- The largest potential option is DLC Smart thermostats, at 61.0 MW by 2045.

- The next two biggest potential options in summer include CTA-2045 WH and TOU Opt-out, each of which are projected to contribute over 30 MW by 2045. DLC Central AC and DLC Electric Vehicle Charging also have high savings potential by 2045.
- When each TOU option is examined as an individual program, the Time-of-Use Opt-out option has a much larger potential savings then if participants could opt-in to the rate. The TOU Opt-out option makes up the second-largest savings potential in the stand-alone case and is expected to reach 31.1 MW by 2045.
- Since the different rate options do not influence other rates in the stand-alone scenario, each rate has a larger potential savings than in the Opt-out/Opt-in scenarios.

Figure 6-9 Summary of Summer Potential by Option (MW @Generator)

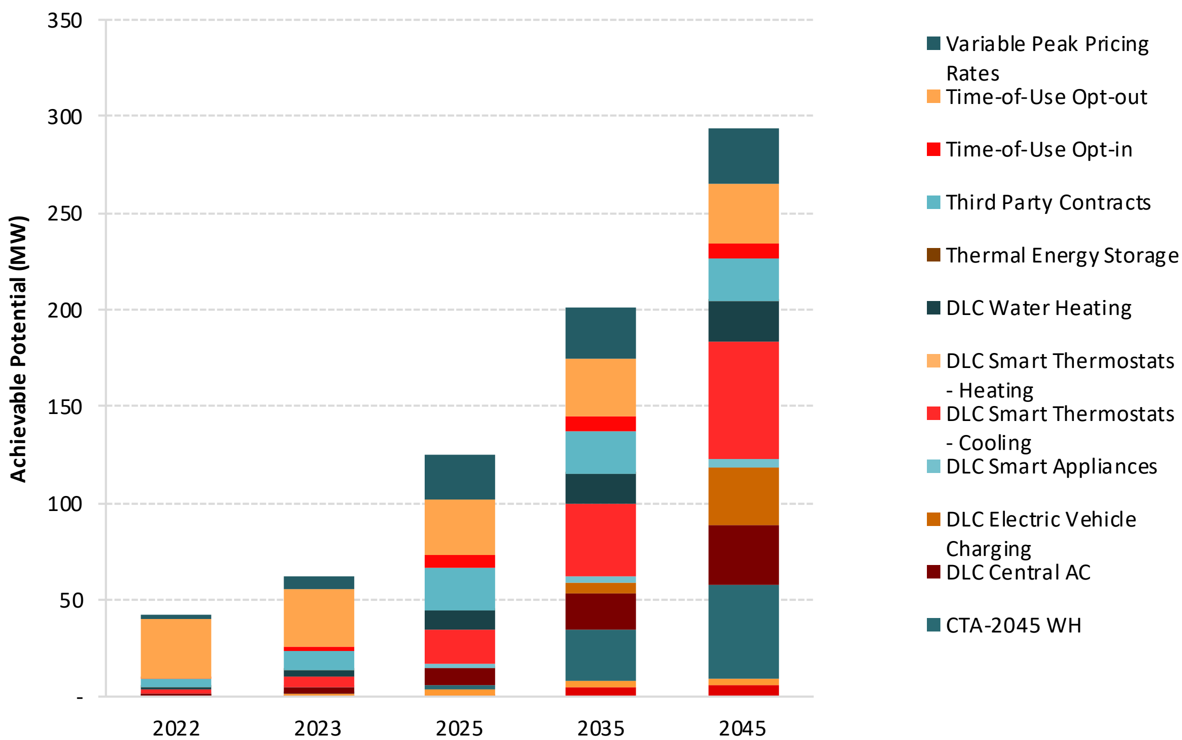


Table 6-35 Achievable DR Potential by Option (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**42.6**	**62.1**	**125.5**	**201.5**	**293.8**
Market Potential (% of baseline)	**3.1%**	**4.5%**	**9.0%**	**13.9%**	**19.5%**
Potential Forecast	**1,327**	**1,314**	**1,264**	**1,244**	**1,214**
Achievable Potential (MW)					
Battery Energy Storage	0.1	0.2	0.7	5.0	5.6
Behavioral	0.6	1.4	3.2	3.4	3.5
CTA-2045 WH	0.1	0.3	1.7	26.3	48.9

DLC Central AC	0.8	2.5	8.7	18.7	30.5
DLC Electric Vehicle Charging	-	-	0.3	5.6	30.2
DLC Smart Appliances	0.3	0.9	2.7	3.3	3.7
DLC Smart Thermostats - Cooling	1.6	5.1	17.4	37.4	61.0
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	1.0	2.9	9.4	15.0	20.8
Thermal Energy Storage	0.1	0.2	0.7	0.8	0.8
Third Party Contracts	4.5	9.8	21.4	21.3	21.4
Time-of-Use Opt-in	0.6	2.0	6.7	7.8	8.1
Time-of-Use Opt-out	31.2	29.9	29.6	30.0	31.1
Variable Peak Pricing Rates	2.0	6.8	23.1	26.9	28.2
Achievable Potential (% of Baseline)					
Battery Energy Storage	0.01%	0.02%	0.05%	0.36%	0.39%
Behavioral	0.04%	0.10%	0.22%	0.22%	0.23%
CTA-2045 WH	0.00%	0.02%	0.12%	1.82%	3.24%
DLC Central AC	0.06%	0.18%	0.62%	1.29%	2.02%
DLC Electric Vehicle Charging			0.02%	0.39%	2.00%
DLC Smart Appliances	0.02%	0.06%	0.20%	0.23%	0.25%
DLC Smart Thermostats - Cooling	0.12%	0.37%	1.25%	2.58%	4.04%
DLC Smart Thermostats - Heating					
DLC Water Heating	0.07%	0.21%	0.68%	1.04%	1.38%
Thermal Energy Storage	0.00%	0.01%	0.05%	0.05%	0.06%
Third Party Contracts	0.33%	0.71%	1.54%	1.48%	1.42%
Time-of-Use Opt-in	0.04%	0.15%	0.49%	0.54%	0.54%
Time-of-Use Opt-out	2.28%	2.17%	2.13%	2.07%	2.06%
Variable Peak Pricing Rates	0.15%	0.49%	1.66%	1.86%	1.87%

Table 6-37 and Table 6-38 show summer demand savings by individual DR option for the states of Washington and Idaho separately. The programs with the largest potential savings are CTA-2045 WH, DLC Smart Thermostat, and TOU rates.

Table 6-36 Achievable DR Potential by Option for Washington (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**34.41**	**44.24**	**81.54**	**140.01**	**208.12**
Market Potential (% of System Peak)	**2.5%**	**3.2%**	**5.9%**	**9.7%**	**13.8%**
Achievable Potential (MW)					
Battery Energy Storage	0.06	0.18	0.48	3.25	3.54
Behavioral	0.53	1.07	2.17	2.26	2.35

CTA-2045 WH	0.05	0.33	1.67	26.33	48.86
DLC Central AC	0.51	1.63	5.56	11.84	19.13
DLC Electric Vehicle Charging	-	-	0.20	3.65	19.47
DLC Smart Appliances	0.19	0.58	1.77	2.15	2.35
DLC Smart Thermostats - Cooling	1.02	3.25	11.12	23.68	38.26
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.41	1.30	4.45	9.47	15.28
Thermal Energy Storage	0.05	0.14	0.41	0.48	0.50
Third Party Contracts	3.46	6.92	13.84	13.88	13.96
Time-of-Use Opt-in	0.50	1.50	4.55	5.22	5.39
Time-of-Use Opt-out	25.96	22.26	19.87	20.00	20.57
Variable Peak Pricing Rates	1.69	5.09	15.45	17.80	18.46

Table 6-37 Achievable DR Potential by Option for Idaho (Summer MW @Generator)

	2022	2023	2025	2035	2045
Total System Peak (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Market Potential (MW)	**8.21**	**17.81**	**43.96**	**61.44**	**85.68**
Market Potential (% of System Peak)	**0.60%**	**1.29%**	**3.17%**	**4.25%**	**5.68%**
Achievable Potential (MW)					
Battery Energy Storage	0.01	0.06	0.26	1.80	2.02
Behavioral	0.08	0.33	1.02	1.10	1.20
CTA-2045 WH	-	-	-	-	-
DLC Central AC	0.28	0.91	3.12	6.84	11.36
DLC Electric Vehicle Charging	-	-	0.11	1.95	10.75
DLC Smart Appliances	0.10	0.31	0.95	1.19	1.35
DLC Smart Thermostats - Cooling	0.56	1.81	6.24	13.67	22.72
DLC Smart Thermostats - Heating	-	-	-	-	-
DLC Water Heating	0.55	1.64	4.93	5.49	5.52
Thermal Energy Storage	0.01	0.06	0.26	0.31	0.33
Third Party Contracts	1.00	2.88	7.55	7.47	7.46
Time-of-Use Opt-in	0.09	0.50	2.19	2.59	2.75
Time-of-Use Opt-out	5.22	7.61	9.71	9.97	10.51
Variable Peak Pricing Rates	0.31	1.71	7.63	9.07	9.72

Ancillary Services

Traditionally, ancillary services have been defined broadly as an option for Avista to use that stem from other DR programs at their disposal. This year, AEG wanted to provide Avista with feasible ancillary programs that are subsets of several programs defined above. AEG chose seven parent programs off of which to base ancillary options: Smart Thermostats Cooling, Smart Thermostats Heating, DLC Water Heating, CTA-2045 Water Heating, Electric Vehicle Charging, Third Party Contracts, and Battery Energy Storage. The results in this section are considered to be separate from the achievable potential discussed earlier in this chapter.

The ancillary programs were replicas of their parent programs with several exceptions. For participation, AEG assumed the same participation as the parent program for Battery Energy Storage, Electric Vehicle Charging, DLC Water Heating, and CTA-2045 Water Heating projecting that the same customers would also be eligible for an ancillary program. Participation in Third Party Contracts were based on the saturations of EMS systems for commercial customers in the PacifiCorp territory and the participation in Smart Thermostats Programs were assumed to be half of their respective parent programs.

For Impact assumptions, AEG assumed the same impacts for ancillary Battery Energy Storage, DLC Water Heating, and CTA-2045 Water Heating programs as their parent programs. For Ancillary Third Party Contracts, AEG assumed a 75% realization rate of the parent impact since there is more of a change a C&I customer will contribute less on an ancillary option. For ancillary Smart Thermostat and Electric Vehichle Charging options AEG assumed half the impacts of their respective parent programs.

Since the ancillary programs are subsets of the main programs, AEG assumed the ancillary programs would take half of the administrative and development costs of the parent programs to implement. In addition, to avoid double counting, equipment costs and O&M costs are assumed to be zero for the ancillary programs. The ancillary programs assume the same annual marketing and recruitment costs and incentive costs as the parent programs.

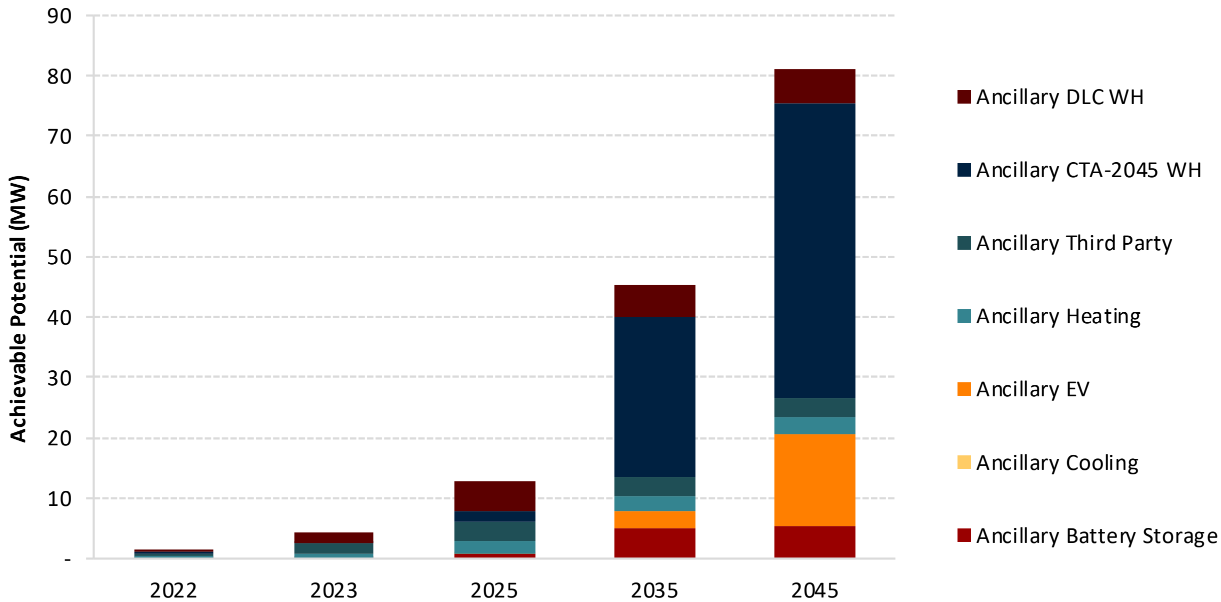
Winter Results

Table 6-40 and *Figure 6-11* show the winter demand savings from individual DR options for selected years of the analysis. These savings represent stand-alone savings from all available DR options in Avista's Washington and Idaho service territories.

Table 6-38 Achievable DR Potential by Ancillary Option (Winter MW @Generator)

	2022	2023	2025	2035	2045
Baseline Forecast (MW)	**1,331**	**1,337**	**1,349**	**1,403**	**1,444**
Ancillary Potential (MW)	**2**	**4**	**13**	**45**	**81**
Ancillary Battery Storage	0.1	0.2	0.7	5.0	5.6
Ancillary Cooling	-	-	-	-	-
Ancillary EV	-	-	0.2	2.8	15.1
Ancillary Heating	0.2	0.7	2.0	2.5	2.7
Ancillary Third Party	0.7	1.5	3.3	3.3	3.3
Ancillary CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
Ancillary DLC WH	0.5	1.6	4.9	5.5	5.5

Figure 6-10 Achievable DR Potential by Ancillary Option (Winter MW @Generator)



For winter ancillary potential, the Ancillary CTA-2045 Water Heater Program is expected to have the highest potential by 2031 (13.91 MW), reaching 48.9 MW by 2045. This is due to the fact that full participation and impacts are assumed for this ancillary program. Ancillary EV has the second most potential and is expected to reach 1.43 MW by 2031 and 15.1 MW by 2045.

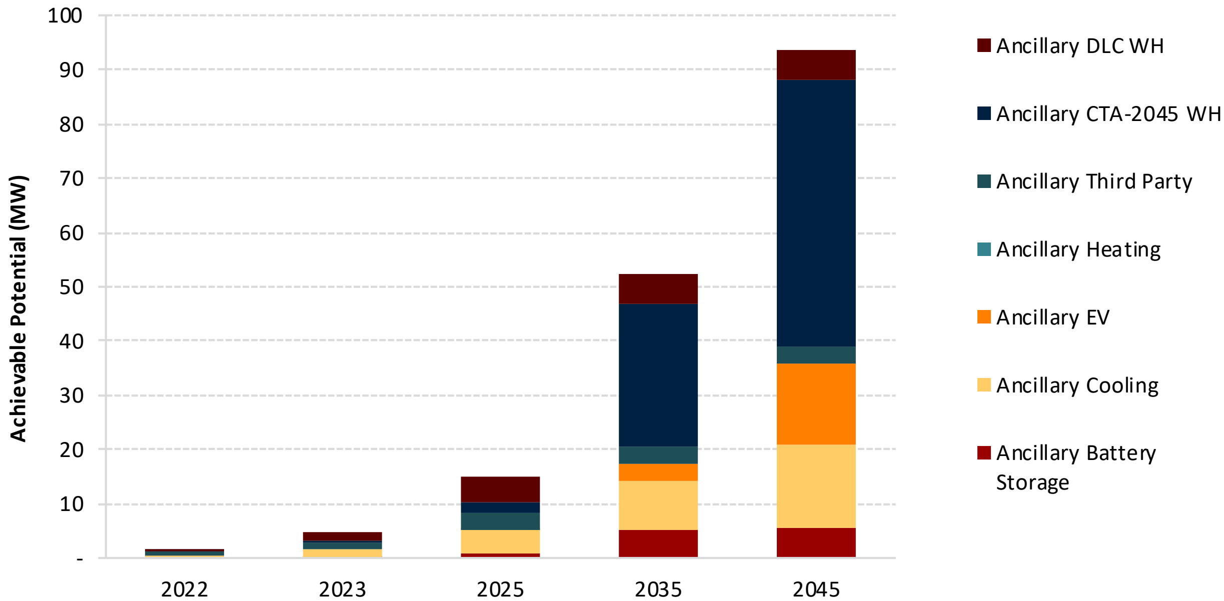
Table 6-39 Winter Levelized Costs for Ancillary Options

Class	DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Winter Potential MW in Year 2031
Residential	Ancillary Battery Storage	$91.29	$94.85	$92.52	2.41
	Ancillary Cooling				
	Ancillary EV	$275.23	$275.76	$275.41	1.43
	Ancillary Heating	$75.10	$75.98	$75.41	2.29
	Ancillary Third Party				
	Ancillary CTA-2045 WH	$101.25		$101.25	13.91
	Ancillary DLC WH		$87.27	$87.27	4.73
C&I	Ancillary Battery Storage	$89.74	$94.46	$91.63	0.41
	Ancillary Cooling				
	Ancillary EV				
	Ancillary Heating	$198.09	$197.74	$197.94	0.07
	Ancillary Third Party	$37.68	$37.54	$37.63	3.27
	Ancillary CTA-2045 WH	$43.51		$43.51	3.46
	Ancillary DLC WH		$42.99	$42.99	0.76

The levelized costs are calculated using a ten year horizon between 2022 and 2031. *Table 6-39* splits these out by residential and C&I sectors. On average, Ancillary Third Party Contracts are the cheapest option at a cost of $37.63 per kW while Ancillary Electric Vehicle Charging is the most expensive option at a cost of $275.41 per kW.

Table 6-40 Achievable DR Potential by Ancillary Option (Summer MW @Generator)

	2022	2023	2025	2035	2045
Baseline Forecast (MW)	**1,369**	**1,376**	**1,389**	**1,446**	**1,508**
Ancillary Potential (MW)	**2**	**5**	**15**	**52**	**94**
Ancillary Battery Storage	0.1	0.2	0.7	5.0	5.6
Ancillary Cooling	0.4	1.3	4.3	9.3	15.2
Ancillary EV	-	-	0.2	2.8	15.1
Ancillary Heating	-	-	-	-	-
Ancillary Third Party	0.7	1.5	3.2	3.2	3.2
Ancillary CTA-2045 WH	0.1	0.3	1.7	26.3	48.9
Ancillary DLC WH	0.5	1.6	4.9	5.5	5.5



Similar to winter, the Ancillary CTA-2045 Water Heater Program is again expected to have the highest potential by 2045 (48.9 MW) during the summer season. Ancillary Smart Thermostats-Cooling is projected to have the second highest potential at 15.2 MW while Ancillary EV is projected to have the third most potential and is expected to reach 15.1 MW by 2045 (same as winter).

The levelized costs are calculated using a ten year horizon between 2022 and 2031. *Table 6-41* splits these out by residential and C&I sectors. On average, Ancillary Third Party Contracts are the cheapest option at a cost of $38.49 per kW while Ancillary Electric Vehicle Charging is the most expensive option at a cost of $275.42 per kW.

Table 6-41 Summer Levelized Costs for Ancillary Options

Class	DR Option	WA	ID	System Wtd Avg Levelized $/kW (2022-2031)	System Winter Potential MW in Year 2031
Residential	Ancillary Battery Storage	$91.29	$94.85	$92.56	2.41
	Ancillary Cooling	$126.38	$127.03	$126.61	5.59
	Ancillary EV	$275.23	$275.76	$275.42	1.43
	Ancillary Heating				
	Ancillary Third Party				
	Ancillary CTA-2045 WH	$101.25		$101.25	13.91
	Ancillary DLC WH		$87.27	$87.27	4.73
C&I	Ancillary Battery Storage	$89.74	$94.46	$91.63	0.41
	Ancillary Cooling	$59.69	$59.76	$59.72	1.58
	Ancillary EV				
	Ancillary Heating				

	Ancillary Third Party	$38.64	$38.19	$38.49	3.20
	Ancillary CTA-2045 WH	$43.51		$43.51	3.46
	Ancillary DLC WH		$42.99	$42.99	0.76

A

MARKET PROFILES

This appendix presents the market profiles for each sector and segment for Washington and Idaho, in the embedded spreadsheet.

Avista 2020 Electric
CPA Market Profile T

B

MARKET ADOPTION (RAMP) RATES

This appendix presents the Power Council's 2021 Power Plan ramp rates we applied to technical potential to estimate Technical Achievable Potential.

Table B-1 Measure Ramp Rates Used in CPA

Ramp Rate	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040	2041
LO12Med	11%	22%	33%	44%	55%	65%	72%	79%	84%	88%	91%	94%	96%	97%	99%	100%	100%	100%	100%	100%
LO5Med	4%	10%	16%	24%	32%	42%	53%	64%	75%	84%	91%	96%	99%	100%	100%	100%	100%	100%	100%	100%
LO1Slow	1%	1%	2%	3%	5%	9%	13%	19%	26%	34%	43%	53%	63%	72%	81%	87%	92%	96%	98%	100%
LO50Fast	45%	66%	80%	89%	95%	98%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
LO20Fast	22%	38%	48%	57%	64%	70%	76%	80%	84%	88%	90%	92%	94%	95%	96%	97%	98%	98%	99%	100%
LOEven20	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
LO3Slow	1%	1%	3%	6%	11%	18%	26%	36%	46%	57%	67%	76%	83%	88%	92%	95%	97%	98%	99%	100%
LO80Fast	76%	83%	88%	92%	95%	97%	98%	99%	99%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Retro12Med	11%	11%	11%	11%	11%	10%	8%	6%	5%	4%	3%	3%	2%	2%	1%	1%	0%	0%	0%	0%
Retro5Med	4%	5%	6%	8%	9%	10%	11%	11%	11%	9%	7%	5%	3%	1%	1%	0%	0%	0%	0%	0%
Retro1Slow	0%	1%	1%	1%	2%	3%	4%	6%	7%	8%	9%	10%	10%	9%	8%	7%	5%	4%	2%	2%
Retro50Fast	45%	21%	14%	9%	6%	3%	1%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Retro20Fast	22%	16%	11%	8%	7%	6%	5%	5%	4%	3%	3%	2%	2%	1%	1%	1%	1%	1%	1%	0%
RetroEven20	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
Retro3Slow	1%	1%	2%	3%	5%	7%	8%	10%	11%	11%	10%	9%	7%	6%	4%	3%	2%	1%	1%	1%

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MEASURE DATA

Measure level assumptions and data are available in the "Avista 2019 DSM Potential Study Measure Assumptions" workbook provided to Avista alongside this file.

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