2020 AVISTA UTILITIES NATURAL GAS CONSERVATION POTENTIAL ASSESSMENT

Volume 1, Final Report

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Report prepared for:
AVISTA UTILITIES

Energy Solutions. Delivered.

This work was performed by:

Applied Energy Group, Inc.
500 Ygnacio Valley Road, Suite 250
Walnut Creek, CA 94596

Project Director: I. Rohmund
Project Manager: K. Walter

AEG would also like to acknowledge the valuable contributions of

Avista Utilities
1411 E Mission MSC-15
Spokane, WA 99220

Project Team: Ryan Finesilver
James Gall
Leona Haley
Tom Pardee

EXECUTIVE SUMMARY

Early in 2020, Avista Utilities (Avista) contracted with Applied Energy Group (AEG) to conduct this Conservation Potential Assessment (CPA) in support of their conservation and resource planning activities. This report documents this effort and provides estimates of the potential reductions in annual energy usage for natural gas customers in Avista's Washington and Idaho service territories from energy conservation efforts in the time period of 2021 to 2040. To produce a reliable and transparent estimate of energy efficiency (EE) resource potential, the AEG team performed the following tasks to meet Avista's key objectives:

- Used information and data from Avista, as well as secondary data sources, to describe how customers currently use gas by sector, segment, end use and technology.
- Developed a baseline projection of how customers are likely to use gas in absence of future EE programs. This defines the metric against which future program savings are measured. This projection used up-to-date technology data, modeling assumptions, and energy baselines that reflect both current and anticipated federal, state, and local energy efficiency legislation that will impact energy EE potential.
- Estimated the technical, achievable technical, and achievable economic potential at the measure level for energy efficiency within Avista's service territory over the 2021 to 2040 planning horizon.
- Delivered a fully configured end-use conservation planning model, LoadMAP, for Avista to use in future potential and resource planning initiatives

In summary, the potential study provided a solid foundation for the development of Avista's energy savings targets.

Table ES-1 summarizes the results for Avista's Washington territory at a high level. AEG analyzed potential for the residential, commercial, and industrial market sectors. First-year utility cost test (UCT) achievable economic potential in Washington is 75,820 dekatherms. This increases to a cumulative total of 173,838 dekatherms in the second year and 1,386,479 dekatherms by the tenth year (2030).

Table ES-1 Washington Conservation Potential by Case, Selected Years (dekatherms)

Scenario	2021	2022	2023	2030	2040
Baseline Forecast (Dth)	19,118,293	19,289,575	19,805,020	20,612,516	21,619,876
Cumulative Savings (Dth)					
UCT Achievable Economic	75,820	173,838	457,423	1,386,479	3,560,512
Achievable Technical	41,871	416,584	1,221,810	3,183,398	6,309,826
Technical	187,983	897,098	2,314,334	5,084,999	8,908,493
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	0.9%	2.3%	6.7%	16.5%
Achievable Technical Potential	0.2%	2.2%	6.2%	15.4%	29.2%
Technical Potential	1.0%	4.7%	11.7%	24.7%	41.2%

Table ES-2 summarizes the results for Avista's Idaho territory at a high level. First-year utility cost test (UCT) achievable economic potential in Idaho is 35,816 dekatherms. This increases to a cumulative total of 87,995 dekatherms in the second year and 737,710 dekatherms by the tenth year (2030).

Table ES-2 Idaho Conservation Potential by Case, Selected Years (dekatherms)

Scenario	2021	2022	2023	2030	2040
Baseline Forecast (Dth)	10,019,377	10,144,894	10,520,169	11,004,568	12,006,819
Cumulative Savings (Dth)					
UCT Achievable Economic	35,816	87,995	229,283	737,710	2,025,410
Achievable Technical	26,220	226,613	657,997	1,722,830	3,544,048
Technical	102,031	490,826	1,273,202	2,777,509	5,013,697
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	0.9%	2.2%	6.7%	16.9%
Achievable Technical Potential	0.3%	2.2%	6.3%	15.7%	29.5%
Technical Potential	1.0%	4.8%	12.1%	25.2%	41.8%

As part of this study, we also estimated total resource cost (TRC) potential, with the focus of fully balancing non-energy impacts. This includes the use of full measure costs as well as quantified and monetizable non-energy impacts and non-gas fuel impacts (e.g. electric cooling or wood secondary heating) consistent with methodology within the 2021 Northwest Conservation and Electric Power Plan (2021 Plan). We explore this potential in more detail throughout the report.

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INTRODUCTION

This report documents the results of the Avista Utilities 2021-2040 Conservation Potential Assessment (CPA) as well as the steps followed in its completion. Throughout this study, AEG worked with Avista to understand the baseline characteristics of their service territory, including a detailed understanding of energy consumption in the territory, the assumptions and methodologies used in Avista's official load forecast, and recent programmatic accomplishments. Adapting methodologies consistent with the Northwest Power and Conservation Council's (Council's) 2021 Power Plan[1] for natural gas studies, AEG then developed an independent estimate of achievable, cost-effective EE potential within Avista's service territory between 2021 and 2040.

Goals of the Conservation Potential Assessment

The first primary objective of this study was to develop independent and credible estimates of EE potential achievably available within Avista's service territory using accepted regional inputs and methodologies. This included estimating technical, *achievable* technical, then achievable *economic* potential, using the Council's ramp rates as the starting point for all achievability assumptions, leveraging Northwest Energy Efficiency Alliance's (NEEA's) market research initiatives, and utilizing assumptions consistent with 2021 Power Plan supply curves and RTF measure workbooks when appropriate for use in natural gas planning studies.

Additionally, the CPA is intended to support the design of programs to be implemented by Avista during the upcoming years. One output of the LoadMAP model is a comprehensive summary of measures. This summary documents input assumptions and sources on a per-unit value, program applicability and achievability (ramp rates), and potential results (units, incremental potential, and cumulative potential) as well as cost-effectiveness at the UCT and TRC levels. This summary was developed in collaboration with Avista and refined throughout the project.

Finally, this study was developed to provide EE inputs into Avista's Integrated Resource Planning (IRP) process. To this end, AEG developed detailed achievable economic EE inputs by measure for input into Avista's SENDOUT planning model under the utility cost test (UCT). These inputs are highly customizable and provide potential estimates at the state level by measure and end use. We present a map of Avista's service territory in Figure 1-1.

[1] "2021 Power Plan. Northwest Power & Conservation Council, 2020. https://www.nwcouncil.org/2021-northwest-power-plan

Figure 1-1 Avista's Service Territory (courtesy Avista)

Summary of Report Contents

The document is divided into seven additional chapters, summarizing the approach, assumptions, and results of the EE potential analysis. We describe each section below:

Volume 1, Final Report:

- **Analysis Approach and Data Development.** Detailed description of AEG's approach to conducting Avista's 2021-2040 Natural Gas CPA and documentation of primary and secondary sources used.
- **Market Characterization and Market Profiles.** Characterization of Avista's service territory in the base year of the study, 2019, including total consumption, number of customers and market units, and energy intensity. This also includes a breakdown of the energy consumption for residential, commercial, and eligible industrial customers by end use and technology.
- **Baseline Projection.** Projection of baseline energy consumption under a naturally occurring efficiency case, described at the end-use level. The LoadMAP models were first aligned with actual sales and Avista's official, weather-normalized econometric forecast and then varied to include the impacts of future federal standards, ongoing impacts of energy codes, such as the 2015 Washington State Energy Code on new construction, and future technology purchasing decisions.
- **Overall Energy Efficiency Potential.** Summary of EE potential for Avista's Washington and Idaho service territories for selected years between 2021 and 2040.
- **Sector-Level Energy Efficiency Potential.** Summary of EE potential for each market sector within Avista's service territory, including residential, commercial, and eligible industrial customers for both

Washington and Idaho. This section includes a more detailed breakdown of potential by measure type, vintage, market segment, end use, and state.

- **Comparison with Current Programs** Detailed comparison of potential with current Avista programs, including new opportunities for potential.
- **Comparison with 2018 CPA** Detailed comparison of potential with Avista's 2018 CPA, conducted by AEG.

Volume 2, Appendices:

The appendices for this report are provided in separate spreadsheets accompanying delivery of this report and consist of the following:

- **Market Profiles.** Detailed market profiles for each market segment. Includes equipment saturation, unit energy consumption or energy usage index, energy intensity, and total consumption.
- **Customer Adoption Factors.** Documentation of the ramp rates used in this analysis. These were adapted from the 2021 Power Plan electrical power conservation supply curve workbooks for use in the estimation of achievable natural gas potential.
- **Measure List.** List of measures, along with example baseline definitions and efficiency options by market sector analyzed.
- **Detailed Measure Assumptions.** This dataset provides input assumptions, measure characteristics, cost-effectiveness results, and potential estimates for each measure permutation analyzed within the study.

Abbreviations and Acronyms

Throughout the report we use several abbreviations and acronyms. Table 1-1 shows the abbreviation or acronym, along with an explanation.

Table 1-1 Explanation of Abbreviations and Acronyms

Acronym	Explanation
AEO	Annual Energy Outlook forecast developed by EIA
B/C Ratio	Benefit to Cost Ratio
BEST	AEG's Building Energy Simulation Tool
BPA	Bonneville Power Administration
C&I	Commercial and Industrial
CBSA	NEEA's 2019 Commercial Building Stock Assessment
Council	Northwest Power and Conservation Council (NWPCC)
DHW	Domestic Hot Water
DSM	Demand Side Management
EE	Energy Efficiency
EIA	Energy Information Administration
EUL	Estimated Useful Life
EUI	Energy Usage Intensity
HVAC	Heating Ventilation and Air Conditioning
IFSA	NEEA's 2014 Industrial Facilities Site Assessment
IRP	Integrated Resource Plan
LoadMAP	AEG's Load Management Analysis and Planning™ tool
NEEA	Northwest Energy Efficiency Alliance
O&M	Operations and Maintenance
RBSA	NEEA's 2016 Residential Building Stock Assessment
RTF	Regional Technical Forum
RVT	Resource Value Test
TRC	Total Resource Cost test
UCT	Utility Cost Test
UEC	Unit Energy Consumption
UES	Unit Energy Savings
WSEC	2015 Washington State Energy Code

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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. Performed a market characterization to describe sector-level natural gas use for the residential, commercial, and industrial sectors for the base year, 2019. This included extensive use of Avista data and other secondary data sources from NEEA and the Energy Information Administration (EIA).
2. Developed a baseline projection of energy consumption by sector, segment, end use, and technology for 2021 through 2040.
3. Defined and characterized several hundred EE measures to be applied to all sectors, segments, and end uses.
4. Estimated technical, achievable technical, and achievable economic energy savings at the measure level for 2021-2040. Achievable economic potential was assessed using both the UCT and TRC screens.

Comparison with Northwest Power & Conservation Council Methodology

It is important to note the Council's methodology was developed for, and used, in electric CPAs. Natural gas impacts are typically assessed when they overlap with electricity measures (e.g. gas water heating impacts in an electrically heated "Built Green Washington" home). The Council's ramp rates were also developed with electric utility DSM programs in mind. Electricity is the primary focus of the regionwide potential assessed in the Council's Plans. Although Avista is a dual-fuel utility, this study focuses on natural gas measures and programs, which exhibit noticeable differences from electric programs, notably regarding avoided costs. To account for this, AEG adapted Council methodologies in some cases, rather than using them directly from the source. This is especially relevant in the development of ramp rates when achievability was determined to not be applicable to a specific natural gas measure or program. We discuss this in Section 7 of this report.

A primary objective of the study was to estimate natural gas potential consistent with the Northwest Power & Conservation Council's (NWPCC) analytical methodologies and procedures for electric utilities. While developing Avista's 2021-2040 CPA, the AEG team relied on an approach vetted and adapted through the successful completion of CPAs under the Council's Fifth, Sixth, Seventh, and now 2021 Power Plans. Among other aspects, this approach involves using consistent:

- **Data sources**: Avista surveys, regional surveys, market research, and assumptions
- **Measures and assumptions**: Avista TRM, Seventh Plan supply curves and RTF work products
- **Potential factors**: 2021 Power Plan ramp rates
- **Levels of potential**: technical, achievable technical, and achievable economic

- **Cost-effectiveness approaches:** assessed potential under the UCT as well as Council's TRC method, including non-energy impacts (and non-gas energy impacts) which may be quantified and monetized as well as O&M impacts within the TRC
- **Conservation credits:** applied a 10% conservation credit to avoided energy costs for energy benefits was applied to the TRC calculation

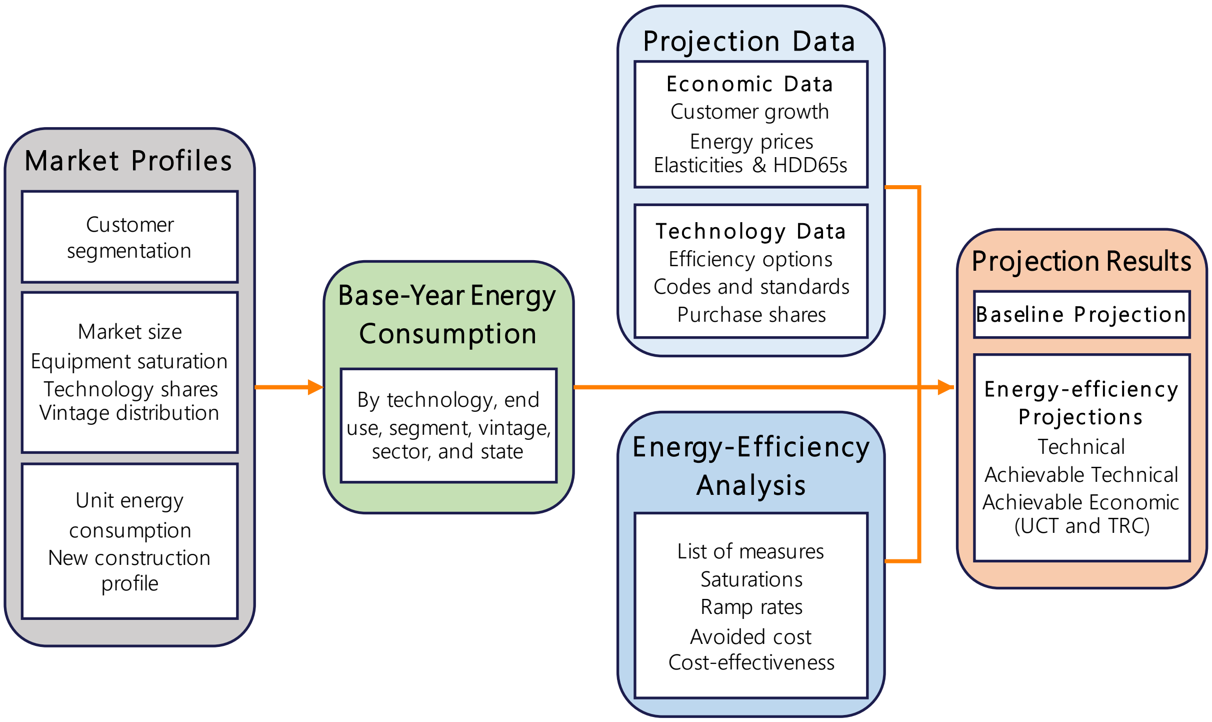
LoadMAP Model

For this analysis, 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. 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 Residential End-Use Energy Planning System (REEPS) and Commercial End-Use Planning System (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. This is especially relevant in the state of Washington where the 2015 WSEC substantially enhances the efficiency of the new construction market.
- Uses a simple logic for appliance and equipment decisions. Other models available for this purpose embody complex customer 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 water heating is distinct from furnaces and fireplaces.
- 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, state, or income level).
- Natively outputs model results in a detailed line-by-line summary file, allowing for review of input assumptions, cost-effectiveness results, and potential estimates at a granular level. Also allows for the development of IRP supply curves, both at the achievable technical and achievable economic potential levels.

- 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.[2]

Figure 2-1 LoadMAP Analysis Framework



Definitions of Potential

Before we delve into the details of the analysis approach, it is important to define what we mean when discussing energy efficiency (EE) potential. In this study, the savings estimates are developed for three types of potential: technical potential, economic potential, and achievable potential. These are developed at the measure level, and results are provided as savings impacts over the 20-year forecasting horizon. The various levels are described below.

- **Technical Potential** is defined as the *theoretical* upper limit of EE potential. It assumes customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the most efficient option available. In new construction, customers and developers also choose the most efficient equipment option.
  - Technical potential also assumes the adoption of every other available measure, where technically feasible. For example, it includes installation of high-efficiency windows in all new construction opportunities and furnace maintenance in all existing buildings with installed furnaces. These retrofit measures are phased in over a number of years to align with the stock turnover of related equipment units, rather than modeled as immediately available all at once.

[2] The model computes energy forecasts for each type of potential for each end use as an intermediate calculation. Annual-energy 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).

- **Achievable Technical Potential** refines technical potential by applying customer participation rates that account for market barriers, customer awareness and attitudes, program maturity, and other factors that affect market penetration of conservation measures. The customer adoption rates used in this study were the ramp rates developed for the Northwest Power & Conservation Council's Seventh Plan based on the electric-utility model, tailored for use in natural gas EE programs.
- **UCT Achievable Economic Potential** further refines achievable technical potential by applying an economic cost-effectiveness screen. In this analysis, primary cost-effectiveness is measured by the utility cost test (UCT), which assesses cost-effectiveness from the utility's perspective. This test compares lifetime energy benefits to the costs of delivering the measure through a utility program, excluding monetized non-energy impacts. These costs are the incentive, as a percent of incremental cost of the given efficiency measure, relative to the relevant baseline course of action (e.g. federal standard for lost opportunity and no action for retrofits), plus any administrative costs that are incurred by the program to deliver and implement the measure. If the benefits outweigh the costs (that is, if the UCT ratio is greater than 1.0), a given measure is included in the economic potential.
- **TRC Achievable Economic Potential** is similar to UCT achievable economic potential in that it refines achievable technical potential through cost-effectiveness analysis. The total resource cost (TRC) test assesses cost-effectiveness from a combined utility and participant perspective. As such, this test includes full measure costs but also includes non-energy impacts realized by the customer if quantifiable and monetized. In addition to non-energy impacts, we assessed the impacts of non-gas savings following Council methodology. This includes a calibration credit for space heating equipment consumption to account for secondary heating equipment present in an average home as well as other electric end-use impacts such as cooling and interior lighting as applicable on a measure-by-measure basis. As a secondary screen, we include TRC results for comparative purposes.

Market Characterization

Now that we have described the modeling tool and provided the definitions of the potential cases, the first step in the actual analysis approach is market characterization. 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 in service. This characterization begins with a segmentation of Avista's natural gas footprint to quantify energy use by sector, segment, end-use application, and the current set of technologies in use. For this we rely primarily on information from Avista, augmenting with secondary sources as necessary.

Segmentation for Modeling Purposes

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

Table 2-1 Overview of Avista Analysis Segmentation Scheme

Dimension	Segmentation Variable	Description
0	State	Washington and Idaho
1	Sector	Residential, Commercial, Industrial
2	Segment	Residential: Single Family, Multifamily, Mobile Home, Low Income Commercial: Office, Restaurant, Retail, Grocery, School, College, Health, Lodging, Warehouse, Miscellaneous Industrial
3	Vintage	Existing and new construction
4	End uses	Heating, secondary heating, water heating, food preparation, process, and miscellaneous (as appropriate by sector)
5	Appliances/end uses and technologies	Technologies such as furnaces, water heaters, and process heating 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 natural gas sales in the base year, 2019. 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, the unit we use is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is number of employees.
- **Saturations** indicate the share of the market that is served by a particular end-use technology. Three types of saturation definitions are commonly used:

- The conditioned space approach accounts for the fraction of each building that is conditioned by the end use. This applies to cooling and heating end uses.
- The whole-building approach measures shares of space in a building with an end use regardless of the portion of each building that is served by the end use. Examples are commercial refrigeration and food service, and domestic water heating and appliances.
- The 100% saturation approach applies to end uses that are generally present in every building or home and are simply set to 100% in the base year.

- **UEC (Unit Energy Consumption) or EUI (Energy Usage Index)** define consumption for a given technology. UEC represents the amount of energy a given piece of equipment is expected to use in one year. EUI is a UEC indexed to a non-building market unit, such as per square foot or per employee)
- These are indices that refer to a measure of average annual energy use per market unit (home, floor space, or employee in the residential, commercial, and industrial sector, respectively) that are served by an end-use technology. UECs and EUIs embody an average level of service and average equipment efficiency for the market segment.
- **Annual energy intensity** for the residential sector represents the average energy use for the technology across all homes in 2015. It is computed as the product of the saturation and the UEC and is defined as therms/household for natural gas. For the commercial and industrial sectors, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space or all employees in the base year.
- **Annual usage** is the annual energy used by each end-use technology in the segment. It is the product of the market size and intensity and is quantified in therms or dekatherms.

The market characterization results and the market profiles are presented in Section 3 and Appendix A.

Baseline Projection

The next step was to develop the baseline projection of annual natural gas use for 2021 through 2040 by customer segment and end use in the absence of new utility energy efficiency programs.

We first aligned with Avista's official forecast. AEG incorporated assumptions and data utilized in the official utility forecast. Avista's heating degree days (base 65°F) were incorporated into the LoadMAP model to align the baseline projection with the official utility forecast. We calibrated to actual sales when available.

The end-use projection includes impacts of future federal standards that were effective as of December 2017, which drive energy consumption down through the study period.

Naturally occurring energy conservation, that is, energy conservation that is realized within the service area independent of utility-sponsored programs, is incorporated into the baseline projection consistent with the US Energy Information Administration's Annual Energy Outlook for the Pacific region. Results of the primary market research were used to calibrate these assumptions to ensure the secondary sources were relevant to Avista customers. For example, some customers will purchase and install energy conservation measures that are available in the market without a utility incentive.

As such, the baseline projection is the foundation for the analysis of savings in future conservation cases and scenarios 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, changes in weather (Heating Degree Day, base-65°F (HDD65) normalization))
- Trends in fuel shares and equipment saturations
- Existing and approved changes to building codes and equipment standards

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

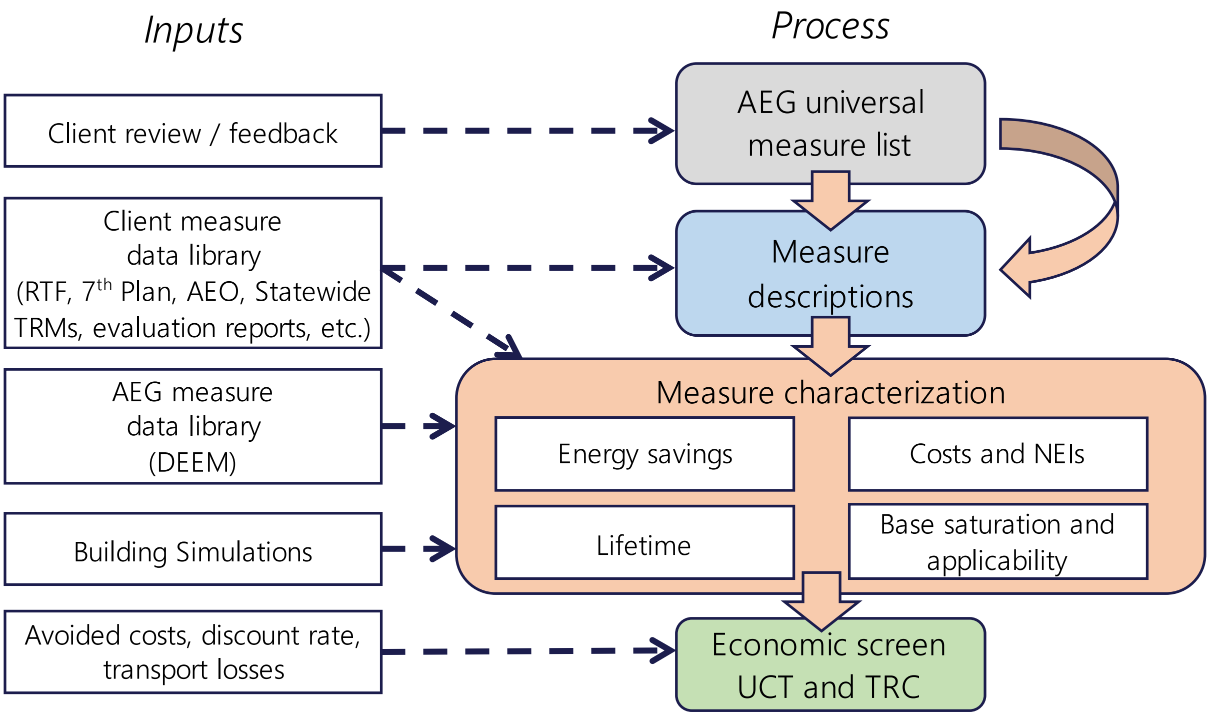
Energy Efficiency Measure Development

This section describes the framework used to assess the savings, costs, and other attributes of energy efficiency 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. This information combined with Avista's avoided cost data informs the economic screens that determine economically feasible measures. In this section, AEG would like to acknowledge the work of the Avista team in detailed measure assumptions specific to the territory and region within the Avista TRM, which was provided at the outset of this study.

Figure 2-2 outlines the framework for measure characterization analysis. First, the list of measures is identified; each measure is then assigned an applicability for each market sector and segment and characterized with appropriate savings, costs and other attributes; then the cost-effectiveness screening is performed. Avista provided feedback during each step of the process to ensure measure assumptions and results lined up with programmatic experience.

We compiled a robust list of conservation measures for each customer sector, drawing upon Avista's TRM and program experience, AEG's own measure databases and building simulation models, and secondary sources, primarily the Regional Technical Forum's (RTF) UES measure workbooks and the Seventh Plan's electric power conservation supply curves. This universal list of measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption.

Figure 2-2 Approach for ECM Assessment



The selected measures are categorized into two types according to the LoadMAP modeling 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® residential water heater (UEF 0.64) that replaces a standard efficiency water heater (UEF 0.58). For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by a code or standard) up to the most efficient product commercially available. These measures are applied on a stock-turnover basis, and in general, are referred to as lost opportunity (LO) measures by the Council because once a purchase decision is made, there will not be another opportunity to improve the efficiency of that equipment item until its effective useful life (EUL) is reached once again.
- **Non-equipment measures** save energy by reducing the need for delivered energy, but do not necessarily involve replacement or purchase of major end-use equipment (such as a furnace or water heater). Measure installation is not tied to a piece of equipment reaching end of useful life, so these are generally categorized as "retrofit" measures. An example would be low-flow showerheads that modify a household's hot water consumption. The existing showerheads can be achievably replaced without waiting for the existing showerhead to malfunction, and saves energy used by the water heating equipment. Non-equipment measures typically fall into one of the following categories:
  - Building shell (windows, insulation, roofing material)
  - Equipment controls (smart thermostats, water heater setback)
  - Whole-building design (ENERGY STAR homes)

- o Retrocommissioning and strategic energy management

We developed a preliminary list of efficient measures, which was distributed to Avista's project team for review. Once we assembled the list of measures, the AEG team assessed their energy-saving characteristics. For each measure, we also characterized incremental cost, service life, non-energy impacts, and other performance factors. Following the measure characterization, we performed an economic screening of each measure, which serves as the basis for developing the economic and achievable potential scenarios.

Representative Measure Data Inputs

To provide an example of 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 direct-fuel furnaces in single-family homes in Washington. Table 2-2 displays the various efficiency levels available as equipment measures, as well as the corresponding effective 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.

Table 2-2 Example Equipment Measures for Direct Fuel Furnace – Single-Family Home, Washington

Efficiency Level	Useful Life (years)	Equipment Cost	Energy Usage (therms/yr)	On Market	Off Market
AFUE 80%	20	$1,955	517	2019	2023
AFUE 90%	20	$2,058	465	2019	2023
AFUE 92%	20	$2,099	453	2019	n/a
AFUE 95%	20	$2,778	438	2019	n/a
AFUE 98%	20	$3,035	423	2019	n/a
Convert to NG Heat Pump	20	$6,739	345	2019	n/a

Table 2-3 lists some of the non-equipment measures applicable to a direct-fuel furnace in an existing single-family home. All measures are evaluated for cost effectiveness based on the lifetime benefits relative to the cost of the measure. The total savings, costs, and monetized non-energy impacts are calculated for each year of the study and depend on the base year saturation of the measure, the applicability of the measure, and the savings as a percentage of the relevant energy end uses. We model two flavors of most shell insulations measures. The first is the installation of insulation where there is none (or very little). This applies to a small subset of the population (roughly 7% of the population is eligible for this measure per RBSA 2016) but has large savings impacts. This percentage is low due to the impacts of current Avista programs, strict Washington building codes, and naturally occurring efficiency. The second is an insulation upgrade measure where homes with existing insulation below the threshold but not classified as no insulation, may be upgraded to higher R-values. This applies to a much larger percentage of the market.

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

End Use	Measure	Saturation in 2019[4]	Applicability	Lifetime (yrs)	Measure Installed Cost	Energy Savings (%)
Heating	Insulation - Ceiling Installation	0%	7%	45	$1,280	31.3%
Heating	Insulation – Ceiling Upgrade	78%	87%	45	$1,739	1.2%
Heating	Ducting Repair and Sealing	20%	50%	20	$794	6.0%
Heating	Windows - High Efficiency[5]	0%	25%	45	$5,337	25.5%

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/ All Segments & States
Residential	46	92	736
Commercial	51	102	2,040
Industrial	30	60	120
Total Measures Evaluated	**127**	**254**	**2,896**

Calculation of Energy Conservation Potential

The approach we used for this study to calculate the energy conservation potential adheres to the approaches and conventions outlined in the National Action Plan for Energy-Efficiency (NAPEE) Guide for Conducting Potential Studies.[6] This document represents credible and comprehensive industry best practices for specifying energy conservation potential. Three types of potential were developed as part of this effort: technical potential, achievable technical potential, and achievable economic potential (using UCT and TRC). The calculation of technical potential is a straightforward algorithm which, as described above, assumes that customers adopt all feasible measures regardless of their cost.

Stacking of Measures and Interactive Effects

An important factor when estimating potential is to consider interactions between measures when they are applied within the same space. This is important to avoid double counting and could feasibly result in savings at greater than 100% of equipment consumption if not properly accounted for.

This occurs at the population or system level, where multiple DSM actions must be stacked or layered on top of each other in succession, rather than simply summed arithmetically. These interactions are automatically handled within the LoadMAP models where measure impacts are stacked on top of each

[3] The applicability factors consider whether the measure is applicable to a particular building type and whether it is feasible to install the measure. For instance, duct repair and sealing is not applicable to homes with zonal heating systems since there is no ductwork present to repair.

[4] Note that saturation levels reflected increase from their base year saturation as more measures are adopted.

[5] The RTF has increased the efficiency requirements for what is considered a "high efficiency" window for the purpose of future programs. As a result, no respondents to the 2016 RBSA have windows that already meet this threshold. However, the qualified savings in the RTF workbook require a certain level of *inefficiency* in the pre-existing window to be eligible. The 25% applicability reflects the population that is eligible to participate.

[6] 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.

other, modifying the baseline for each subsequent measure. We first compute the total savings of each measure on a standalone basis, then also assign a stacking priority, based on levelized cost, to the measures such that "integrated" or "stacked" savings will be calculated as a percent reduction to the running total of baseline energy remaining in each end use after the previous measures have been applied. This ensures that the available pie of baseline energy shrinks in proportion to the number of DSM measures applied, as it would in reality. The loading order is based on the levelized cost of conserved energy, such that the more economical measures that are more likely to be selected from a resource planning perspective will be the first to be applied to the modeled population.

We also account for exclusivity of certain measure options when defining measure assumptions. For instance, if an AFUE 95% furnace is installed in a single-family home, the model will not allow that same home to install an AFUE 98% furnace, or any other furnace, until the newly installed AFUE 95% option has reached its end of useful life. For non-equipment measures, which do not have a native applicability limit, we define base saturations and applicabilities such that measures do not overlap. For example, we model two flavors of ceiling insulation. The first assumes the installation of insulation where there previously was none. The second upgrades pre-existing insulation if it falls under a certain threshold. We used regional market research data to ensure exclusivity of these two options. NEEA's 2014 RBSA contains information on average R-values of insulation installed. The AEG team used this data to define the percent of homes that could install one measure, but not the other.

Estimating Customer Adoption

Once the technical potential is established, estimates for the market adoption rates for each measure are applied that specify the percentage of customers that will select the highest–efficiency economic option. This phases potential in over a more realistic time frame that considers barriers such as imperfect information, supplier constraints, technology availability, and individual customer preferences. The intent of market adoption rates is to establish a path to full market maturity for each measure or technology group and ensure resource planning does not overstep acquisition capabilities. We adapted the Northwest Power and Conservation Council's 2021 Plan ramp rates to develop these achievability factors for each measure. Applying these ramp rates as factors leads directly to the achievable technical potential.

Screening Measures for Cost-Effectiveness

With achievable technical potential established, the final step is to apply an economic screen and arrive at the subset of measures that are cost-effective and ultimately included in achievable economic potential.

LoadMAP performs an economic screen for each individual measure in each year of the planning horizon. This study uses the UCT test as the primary cost-effectiveness metric, which compares the lifetime hourly energy benefits of each applicable measure with the incentive and administrative costs incurred by the utility. The lifetime benefits are calculated by multiplying the annual energy savings for each measure by Avista's avoided costs and discounting the dollar savings to the present value equivalent. Lifetime costs represent incremental measure cost. The analysis uses each measure's values for savings, costs, and lifetimes that were developed as part of the measure characterization process described above.

The LoadMAP model performs this screening dynamically, considering changing savings and cost data over time. Thus, some measures pass the economic screen for some, but not all, of the years in the forecast.

It is important to note the following about the economic screen:

- The economic evaluation of every measure in the screen is conducted relative to a baseline condition. For instance, in order to determine the therm savings potential of a measure, consumption with the measure applied must be compared to the consumption of a baseline condition.
- The economic screening was conducted only for measures that are applicable to each building type and vintage; thus, if a measure is deemed to be irrelevant to a building type and vintage, it is excluded from the respective economic screen.

This constitutes the achievable economic potential and includes every program-ready opportunity for conservation savings. Potential results are presented in Sections 4 and 5. Measure-level detail is available as a separate appendix to this report.

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 were adapted to local conditions, for example, by using local sources for measure data and local weather for building simulations.

Data Sources

The data sources are organized into the following categories:

- Avista-provided 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, including the primary market research conducted specifically for this study. This data is specific to Avista's service territory and is an important consideration when customizing the model for Avista's market. This is best practice when developing CPA baselines when the data is available.

- **Avista customer account database.** Avista provided billing data for development of customer counts and energy use for each sector. This included a very detailed database of customer building classifications which was instrumental in the development of segmentation.
- **Avista's 2013 GenPOP Residential Survey.** In 2013, Avista hired The Cadmus Group to conduct a residential saturation survey, which included results from 1,051 customers. The results of this survey helped segment the residential sector and establish fuel and technology shares for the base year. This data was very useful in developing a detailed estimate of energy consumption within Avista's service territory.
- **Load forecasts.** Avista provided forecasts, by sector and state, of energy consumption, customer counts, weather actuals for 2015 and 2017, as well as weather-normal HDD65s.
- **Economic information.** Avista provided a discount rate as well as avoided cost forecasts consistent with those utilized in the IRP.
- **Avista program data.** Avista provided information about past and current programs, including program descriptions, goals, and measure achievements to date.

- **Avista TRM.** Avista provided a documented list of energy conservation measures and assumptions considered within current programs. We utilized this as a primary source of measure information, supplemented by Northwest data, AEG data, and secondary data as described below.

Northwest Regional Data

The study utilized a variety of local data and research, including research performed by the Northwest Energy Efficiency Alliance (NEEA) and analyses conducted by the Council. Most important among these are:

- **Northwest Power and Conservation Council, 2021 Power Plan and Regional Technical Forum workbooks.** To develop its Power Plan, the Council maintains workbooks with detailed information about measures. This was used as a primary data source when Avista-specific program data was not available, and the data was determined to be applicable to natural gas conservation measures. The most recent data and workbooks available were used at the time of this study.
    - https://www.nwcouncil.org/2021-northwest-power-plan
    - https://rtf.nwcouncil.org/measures
- **Northwest Energy Efficiency Alliance, 2011 Residential Building Stock Assessment Single-Family**, Market Research Report, http://neea.org/docs/reports/residential-building-stock-assessment-single-family-characteristics-and-energy-use.pdf?sfvrsn=8
- **Northwest Energy Efficiency Alliance, 2014 Commercial Building Stock Assessment**, December 16, 2014, http://neea.org/docs/default-source/reports/2014-cbsa-final-report_05-dec-2014.pdf?sfvrsn=12.
- **Northwest Energy Efficiency Alliance, 2014 Industrial Facilities Site Assessment,** December 29, 2014, http://neea.org/resource-center/regional-data-resources/industrial-facilities-site-assessment

Since Avista's GenPOP survey contained detailed appliance saturations, the RBSA was used more for benchmarking and comparative purposes, rather than as a primary source of data. The NEEA surveys were used extensively to develop base saturation and applicability assumptions for many of the non-equipment measures within the study.

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 (natural gas and electricity), 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 Database of Energy Conservation 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 more than 60 studies of EE potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, both within the region and across the country.

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 2015 and 2017 AEO.
- **American Community Survey.** The US Census American Community Survey is an ongoing survey that provides data every year on household characteristics. http://www.census.gov/acs/www/
- **Local Weather Data**. Weather from NOAA's National Climatic Data Center for Spokane in Washington and Coure d'Alene in Idaho were used where applicable.
- **EPRI End-Use Models (REEPS and COMMEND)**. These models provide the energy-use elasticities we apply to prices, household income, home size, 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 resources:** These include reports from the Consortium for Energy Efficiency, the EPA, and the American Council for an Energy-Efficient Economy. This also includes technical reference manuals (TRMs) from other states. When using data from outside the region, especially weather-sensitive data, AEG adapted assumptions for use within Avista's territory.

Application of Data to the Analysis

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 natural gas consumption and market size units (households for residential, floor space for commercial, and employees for industrial), we primarily used Avista's billing data as well as secondary data from AEG's Energy Market Profiles database.

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 used the following approach:

1. Develop control totals for each segment. These include market size, segment-level annual natural gas use, and annual intensity. Control totals were based on Avista's actual sales and customer-level information found in Avista's customer billing database. We used the market profiles from the 2016 CPA as a starting point.
2. Develop existing appliance saturations and the energy characteristics of appliances, equipment, and buildings using equipment flags within Avista's billing data, NEEA's 2016 RBSA, 2019 CBSA, and 2014 IFSA, DOE's 2015 RECS, the 2019 edition of the Annual Energy Outlook, AEG's Energy Market Profile (EMP) for the Pacific region, and the American Community Survey.
3. Ensure calibration to Avista control totals for annual natural gas sales in each sector and segment.
4. Compare and cross-check with other recent AEG studies.
5. Work with Avista staff to verify the data aligns with their knowledge and experience.

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 2019 actual sales Avista customer account database
Annual intensity	Residential: Annual use per household Commercial: Annual use per square foot Industrial: Annual use per employee	Avista customer account database AEG's Energy Market Profiles AEO 2019 – Pacific Region Other recent studies
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology Percentage of C&I floor space/employment with equipment/technology	Avista 2013 GenPOP Survey 2016 RBSA, 2019 CBSA and IFSA 2018 American Community Survey AEG's Energy Market Profiles
UEC/EUI for each end-use technology	UEC: Annual natural gas use in homes and buildings that have the technology EUI: Annual natural gas use per square foot/employee for a technology in floor space that has the technology	HVAC uses: BEST simulations using prototypes developed for Avista Engineering analysis AEG DEEM AEO 2019 – Pacific Region Recent AEG studies
Appliance/equipment age distribution	Age distribution for each technology	2016 RBSA, 2019 CBSA, and recent AEG studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	Avista current program offerings AEG DEEM AEO 2019 CA DEER Recent AEG studies

Data Application for Baseline Projection

Table 2-6 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 2-6 Data Applied for the Baseline Projection in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential and C&I sectors	Avista load 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	Shipment data from AEO and ENERGY STAR AEO 2019 regional forecast assumptions[7] Appliance/efficiency standards analysis
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models

In addition, assumptions were incorporated for known future equipment standards as of June 2020, as shown in Table 2-7 and Table 2-8. The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

[7] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2017), 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 distributions/allocations of efficiency levels to manufacturer shipment data for recent years.

Table 2-7 Residential Natural Gas Equipment Federal Standards[8]

End Use	Technology	2019	2020	2021	2022	2023	2024	2025
Space Heating	Furnace – Direct Fuel	AFUE 80%					AFUE 92%*	
	Boiler – Direct Fuel	AFUE 82%		AFUE 84%				
Secondary Heating	Fireplace	N/A						
Water Heating	Water Heater <= 55 gal.	UEF 0.58						
	Water Heater > 55 gal.	UEF 0.76						
Appliances	Clothes Dryer	CEF 3.30						
	Stove/Oven	N/A						
Miscellaneous	Pool Heater	TE 0.82						
	Miscellaneous	N/A						

* This code was originally set to take effect in 2021 but exempts smaller systems. The comment period was also extended into 2017 and the standard will not take effect until at least 5 years after that has concluded. As a result, we modeled this standard coming online officially in 2024.

Table 2-8 Commercial and Industrial Natural Gas Equipment Standards

End Use	Technology	2019	2020	2021	2022	2023	2024	2025
Cooling	Furnace	AFUE 80% / TE 0.80						
	Boiler	Average around AFUE 80% / TE 0.80 (varies by size)						
	Unit Heater	Standard (intermittent ignition and power venting or automatic flue damper)						
Water Heater	Water Heating	TE 0.80						

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

Energy 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 2-9 Data Inputs 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 TRM NWPCC workbooks, RTF AEG BEST AEG DEEM AEO 2019 CA DEER Other secondary sources
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, or per employee 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 TRM NWPCC workbooks, RTF AEG DEEM AEO 2019 CA 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 TRM NWPCC workbooks, RTF AEG DEEM AEO 2019 CA 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.	2016 RBSA, 2019 CBSA 2015 WSEC for limitations on new construction AEG DEEM CA 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 Cost-effectiveness Screening

To perform the cost-effectiveness screening, a number of economic assumptions were needed. All cost and benefit values were analyzed as real dollars, converted from nominal provided by Avista. We applied Avista's long-term discount rate of 4.34% excluding inflation. LoadMAP is configured to vary this by market sector (e.g. residential and commercial) if Avista develops alternative values in the future.

Estimates of Customer Adoption

To estimate the timing and rate of customer adoption in the potential forecasts, two sets of parameters are needed:

- **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. For this analysis, we used the Council's retrofit ramp rates, labeled "Retro".
- **Customer adoption rates**, also referred to as take rates or ramp rates, are applied to measures on a year by year basis. These rates represent customer adoption of measures when delivered through a best-practice portfolio of well-operated efficiency programs under a reasonable policy or regulatory framework. Information channels are assumed to be established and efficient for marketing, educating consumers, and coordinating with trade allies and delivery partners. The primary barrier to adoption reflected in this case is customer preferences. Again, these are based on the ramp rates from the Northwest Power and Conservation Council's 2021 Plan.

The ramp rates referenced above were adapted for use for assessing natural gas measure potential. We describe this process in Section 7. The customer adoption rates used in this study are available in Appendix B.

3

MARKET CHARACTERIZATION AND MARKET PROFILES

In this section, we describe how customers in the Avista service territory use natural gas 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.

Overall Energy Use Summary

Total natural gas consumption for all sectors for Avista's Washington territory in 2019 was 19,411,285 dekatherms. As shown in Figure 3-1 and Table 3-1, the residential sector accounts for the largest share of annual energy use at 64%, followed by the commercial sector at 35%. The industrial sector accounts for 2% of usage.

Figure 3-1 Sector-Level Natural Gas Use in Base Year 2019, Washington (annual therms, percent)

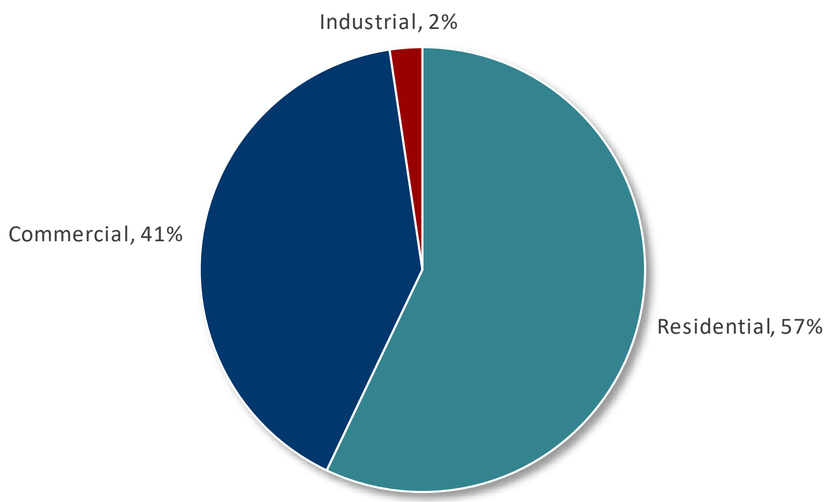


Table 3-1 Avista Sector Control Totals, Washington, 2019

Sector	Natural Gas Use (dekatherms)	% of Use
Residential	12,344,250	64%
Commercial	6,718,365	35%
Industrial	348,670	2%
Total	**19,411,285**	**100%**

Total natural gas consumption for all sectors for Avista's Idaho territory in 2019 was 10,131,866 dekatherms. As shown in Figure 3-2 and Table 3-2, the residential sector accounts for the largest share of annual energy use at 57%, followed by the commercial sector at 41%. The industrial sector accounts for 2% of usage.

Figure 3-2 Sector-Level Natural Gas Use in Base Year 2019, Idaho (annual therms, percent)

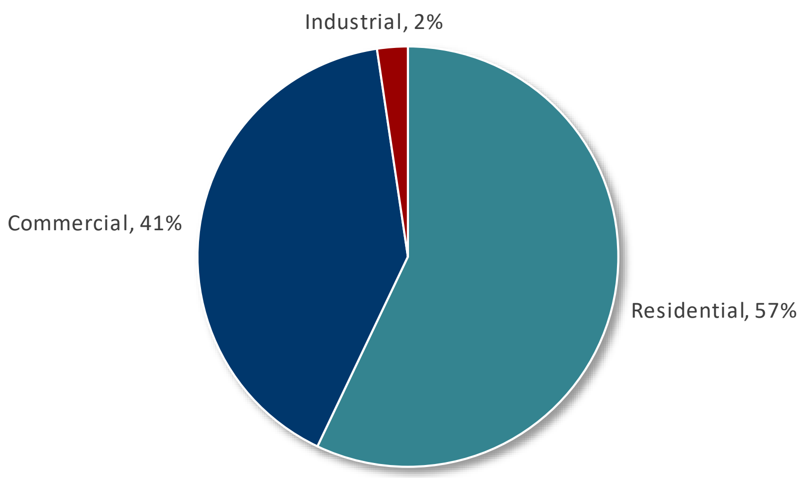


Table 3-2 Avista Sector Control Totals, Idaho, 2019

Sector	Natural Gas Use (dekatherms)	% of Use
Residential	5,782,934	57%
Commercial	4,110,228	41%
Industrial	238,705	2%
Total	**10,131,866**	**100%**

Residential Sector

Washington Characterization

The total number of households and gas sales for the service territory were obtained from Avista's actual sales for 2019. Details, including number of households and 2019 natural gas consumption for the residential sector in Washington can be found in Table 3-3 below. In 2019, there were nearly 156,000 households in Avista's Washington territory that used a total of 12,344,250 dekatherms, resulting in an average use per household of 796 therms per year. This is an important number for the calibration process.

These values represent weather actuals for 2019 and were adjusted within LoadMAP to normal weather using heating degree day, base 65°F, using data provided by Avista.

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

Segment	Households	Natural Gas Use (dekatherms)	Annual Use/Customer (therms/HH)
Single Family	94,282	8,083,082	857
Multi-Family	8,684	469,031	540
Mobile Home	5,582	402,027	720
Low Income	46,521	3,390,109	729
Total	**155,069**	**12,344,250**	**796**

Figure 3-3 Residential Natural Gas Use by Segment, Washington, 2019

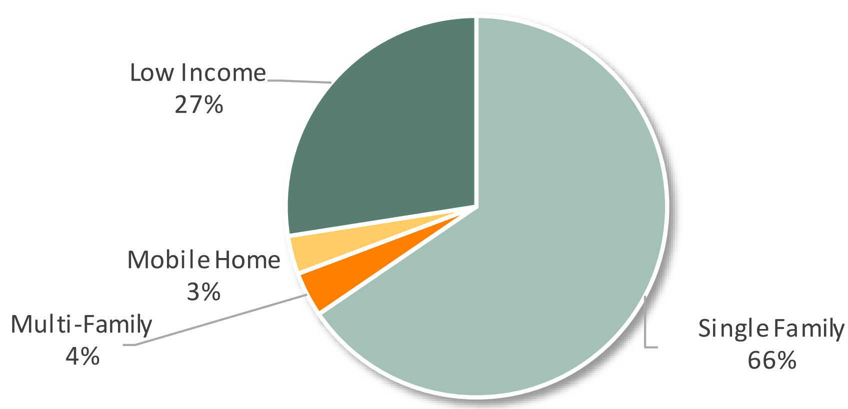
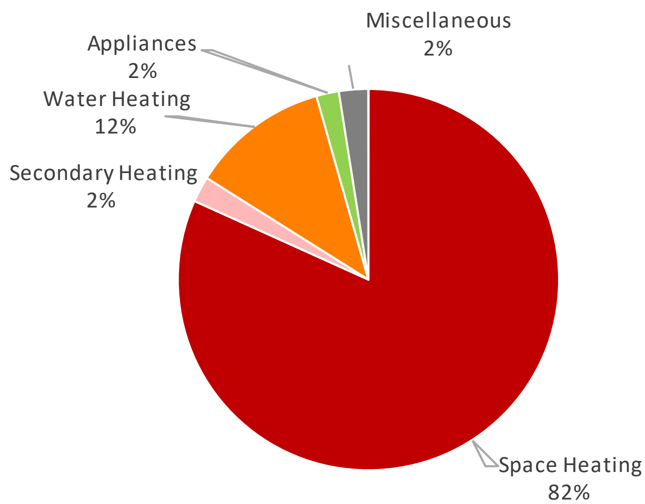


Figure 3-4 shows the distribution of annual natural gas consumption by end use for an average residential household. Space heating comprises most of the load at 82% followed by water heating at 12%. Appliances, Secondary Heating, and Miscellaneous loads make up the remaining portion (6%) of the total load. This is expected for a natural gas profile as there are very few miscellaneous technologies. One example is natural gas barbecues.

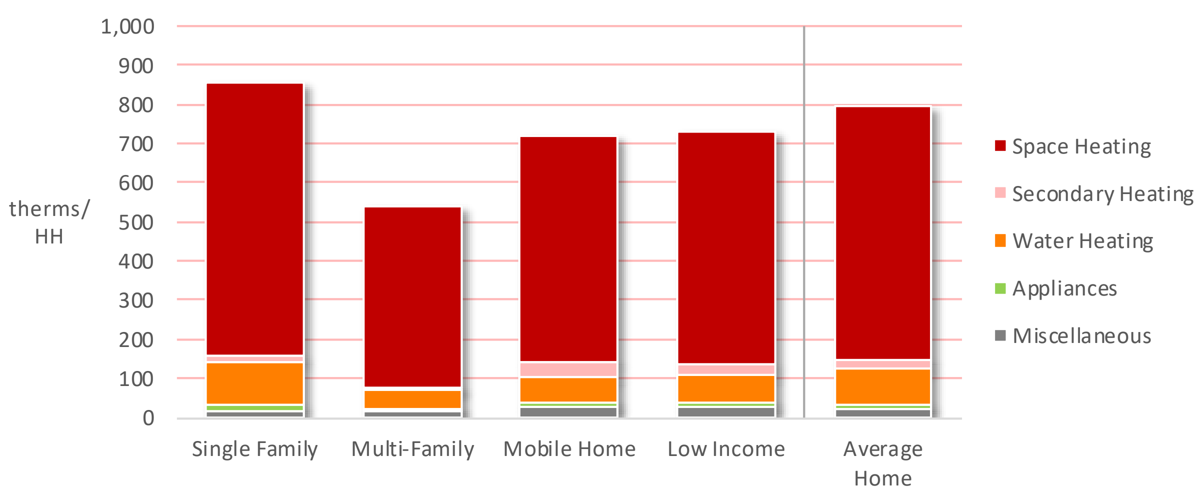
Figure 3-4 Residential Natural Gas Use by End Use, Washington, 2019



Avista's GenPOP survey informed estimates of the saturation of key equipment types, which were used to distribute usage at the technology and end use level. However, because the vintage of the GenPOP survey is 2013, trends from more recent surveys were applied where appropriate, while still maintaining the more unique characteristics of Avista's market.

Figure 3-4 presents average natural gas intensities by end use and housing type. Single family homes consume substantially more energy in space heating. This is due to two factors. The first is that single family homes are larger. The second is that more walls are exposed to the outside environment, compared to multifamily dwellings with many shared walls. This increases heat transfer, resulting in greater heating loads. Water heating consumption is higher in single family homes as well. This is due to a greater number of occupants, which increases the demand for hot water.

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



The market profile for an average home in the residential sector is presented in Table 3-4 below. An important step in the profile development process is model calibration. All consumption within an average home must sum up to the intensity extracted from billing data. This is necessary so estimates of consumption for a piece of equipment do not exceed the actual usage in a home.

Table 3-4 Average Market Profile for the Residential Sector, Washington, 2019

End Use	Technology	Saturation	UEC (therms)	Intensity (therms/HH)	Usage (dekatherms)
Space Heating	Furnace - Direct Fuel	84.9%	747.2	634.6	9,840,233
	Boiler - Direct Fuel	2.4%	674.2	16.2	251,417
Secondary Heating	Fireplace	12.7%	137.3	17.4	269,840
Water Heating	Water Heater <= 55 gal.	52.2%	177.8	92.9	1,440,263
Appliances	Clothes Dryer	27.3%	18.0	4.9	76,440
	Stove/Oven	58.9%	17.4	10.3	159,040
Miscellaneous	Pool Heater	0.8%	80.1	0.6	9,491
	Miscellaneous	100.0%	19.2	19.2	297,525
Total				**796.0**	**12,344,250**

Idaho Characterization

Details for the residential sector in Idaho can be found in Table 3-5 below. In 2019, there were 77,804 households in Avista's Washington territory that used a total of 5,782,934 dekatherms, resulting in an average use per household of 743 therms per year.

Table 3-5 Residential Sector Control Totals, Idaho, 2019

Segment	Households	Natural Gas Use (dekatherms)	Annual Use/Customer (therms/HH)
Single Family	47,305	3,780,793	799
Multi-Family	3,812	191,962	504
Mobile Home	3,501	235,056	671
Low Income	23,186	1,575,123	679
Total	**77,804**	**5,782,934**	**743**

Figure 3-6 Residential Natural Gas Use by Segment, Idaho, 2019

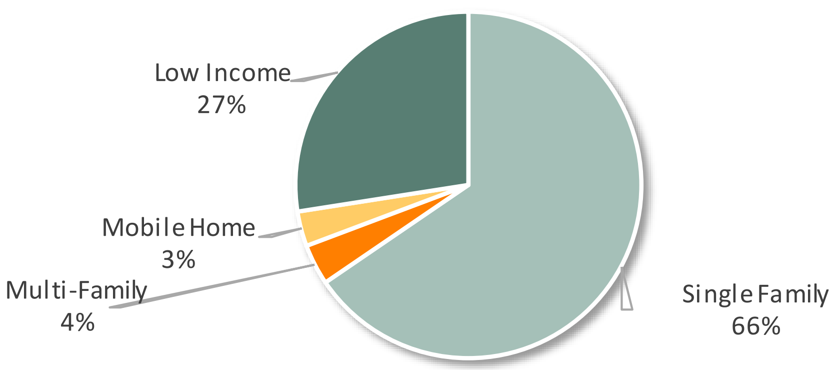
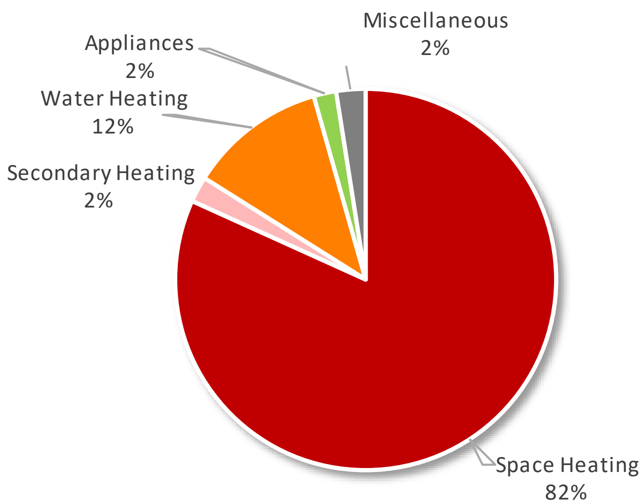


Figure 3-7 shows the distribution of annual natural gas consumption by end use for an average residential household. Space heating comprises a majority of the load at 82% followed by water heating at 12%. Miscellaneous loads make up a very small portion of the total load, as expected.

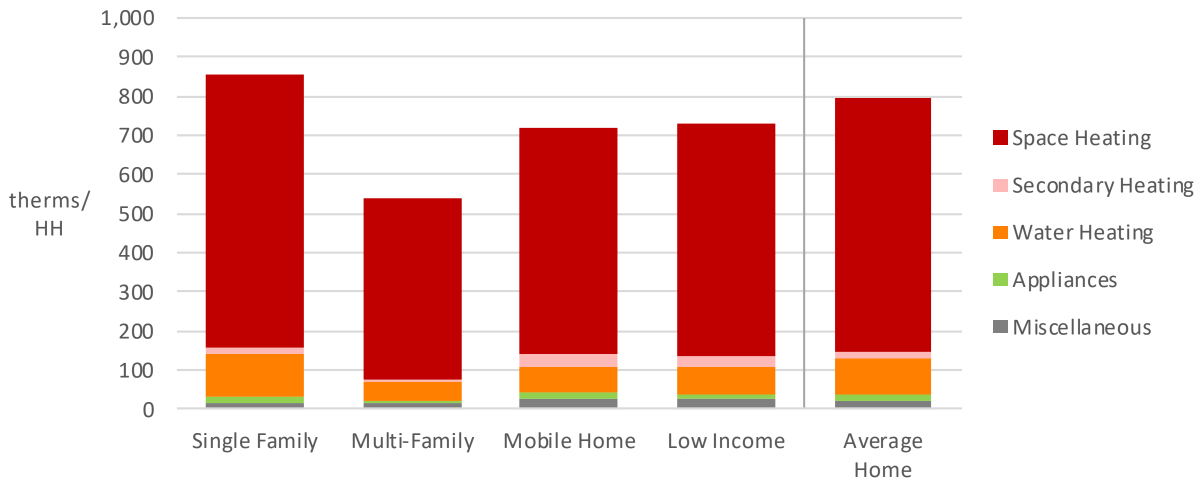
Figure 3-7 Residential Natural Gas Use by End Use, Idaho, 2019



Avista's 2013 GenPOP survey informed estimates of the saturation of key equipment types, which were used to distribute usage at the technology and end use level.

Figure 3-8 presents average natural gas intensities by end use and housing type. Single family homes consume substantially more energy in space heating. Water heating consumption is higher in single family homes as well, due to a greater number of occupants, which increases the demand for hot water.

Figure 3-8 Residential Energy Intensity by End Use and Segment, Idaho, 2019 (Annual Therms/HH)



The market profile for an average home in the residential sector is presented in Table 3-6 below. An important step in the profile development process is model calibration. All consumption within an average home must sum up to the intensity extracted from billing data. This is necessary so estimates of consumption for a piece of equipment do not exceed the actual usage in a home.

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

End Use	Technology	Saturation	UEC (therms)	Intensity (therms/HH)	Usage (dekatherms)
Space Heating	Furnace - Direct Fuel	81.0%	712.8	577.0	4,489,534
	Boiler - Direct Fuel	2.2%	643.6	14.0	108,672
Secondary Heating	Fireplace	16.9%	131.4	22.2	172,526
Water Heating	Water Heater <= 55 gal.	54.6%	177.5	96.9	753,951
Appliances	Clothes Dryer	14.7%	21.6	3.2	24,700
	Stove/Oven	31.7%	20.8	6.6	51,415
Miscellaneous	Pool Heater	0.3%	105.0	0.3	2,345
	Miscellaneous	100.0%	23.1	23.1	179,792
Total				**743.3**	**5,782,934**

Commercial Sector

Washington Characterization

The total number of nonresidential accounts and natural gas sales for the Washington service territory were obtained from Avista's customer account database.

AEG first separated the Commercial accounts from Industrial by analyzing the SIC codes and rate codes assigned in the company's billing system. Prior to using the data, AEG inspected individual accounts to confirm proper assignment. This was done on the top accounts within each segment, but also via spot checks when reviewing the database. Energy use from accounts where the customer type could not be identified were distributed proportionally to all C&I segments.

Once the billing data was analyzed, the final segment control totals were derived by distributing the total 2019 nonresidential load to the sectors and segments according to the proportions in the billing data.

Table 3-7 below shows the final allocation of energy to each segment in the commercial sector, as well as the energy intensity on a square-foot basis. Intensities for each segment were derived from a combination of the 2019 CBSA and equipment saturations extracted from Avista's database. The CBSA intensities corresponded to spaces with lower natural gas saturations than Avista's database, so AEG increased intensities proportionally based on the additional presence of natural gas-consuming equipment.

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

Segment	Description	Intensity (therms/Sq Ft)	2019 Natural Gas Use (dekatherms)
Office	Traditional office-based businesses including finance, insurance, law, government buildings, etc.	0.60	481,953
Restaurant	Sit-down, fast food, coffee shop, food service, etc.	2.68	65,351
Retail	Department stores, services, boutiques, strip malls etc.	0.83	837,065
Grocery	Supermarkets, convenience stores, market, etc.	0.95	154,034
School	Day care, pre-school, elementary, secondary schools	0.29	269,873
College	College, university, trade schools, etc.	0.62	272,030
Health	Health practitioner office, hospital, urgent care centers, etc.	1.04	315,668
Lodging	Hotel, motel, bed and breakfast, etc.	0.68	172,829
Warehouse	Large storage facility, refrigerated/unrefrigerated warehouse	0.68	358,315
Miscellaneous	Catchall for buildings not included in other segments, includes churches, recreational facilities, public assembly, correctional facilities, etc.	1.16	1,183,111
Total		**0.75**	**4,110,228**

Figure 3-9 shows each segments' natural gas consumption as a percentage of the entire commercial sector energy consumption. The three segments with the highest natural gas usage in 2019 are miscellaneous, retail, and office, in descending order. As expected, the highest intensity segment is restaurant. This is based on the high presence of food preparation equipment.

Figure 3-9 Commercial Natural Gas Use by Segment, Washington, 2019

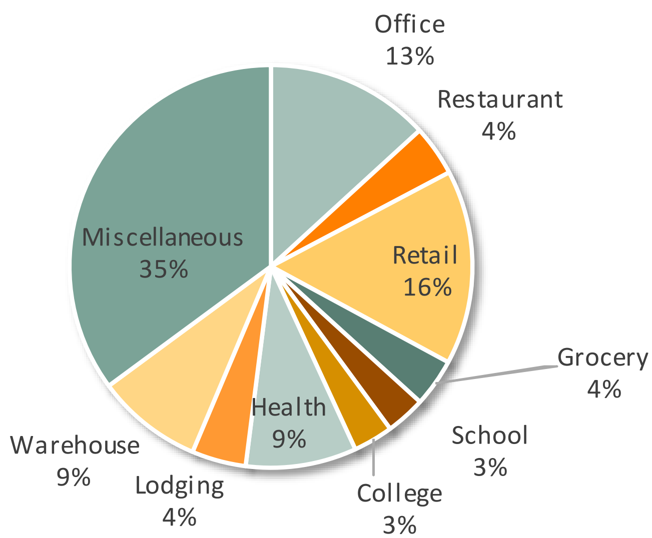


Figure 3-10 shows the distribution of natural gas consumption by end use for the entire commercial sector. Space heating is the largest end use, followed closely by water heating. The miscellaneous end use is quite small, as expected.

Figure 3-10 Commercial Sector Natural Gas Use by End Use, Washington, 2019

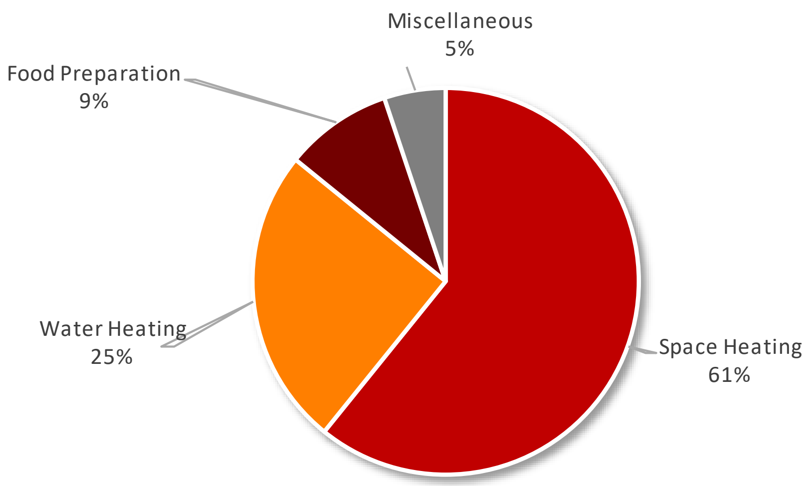
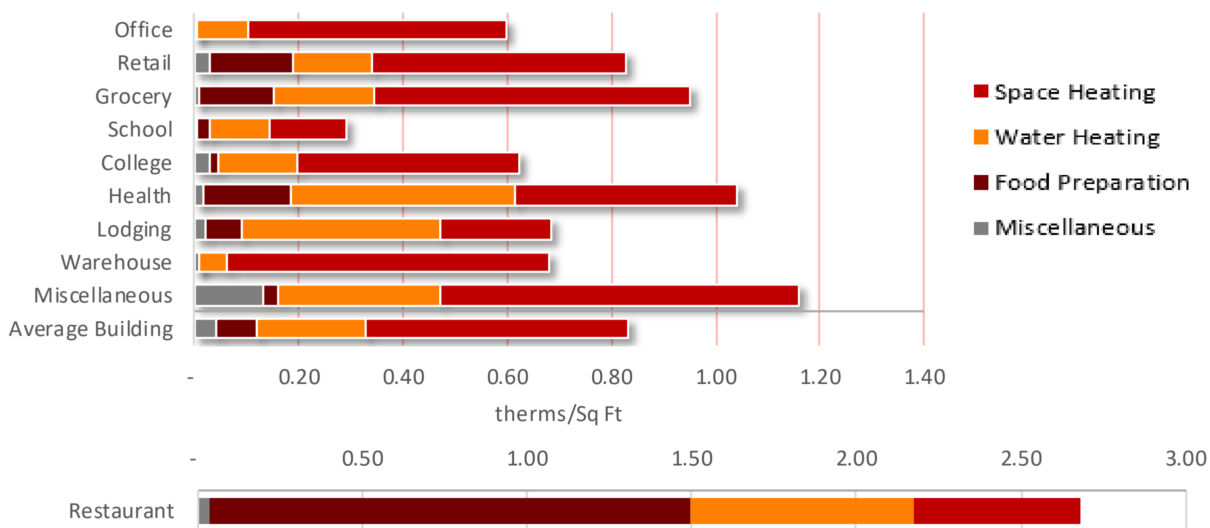


Figure 3-11 presents average natural gas intensities by end use and segment.

Figure 3-11 Commercial Energy Usage Intensity by End Use and Segment, Washington, 2019 (Annual Therms/Sq. Ft)



The total market profile for an average building in the commercial sector is presented in Table 3-8 below. Avista customer account data informed the market profile by providing information on saturation of key equipment types. Secondary data was used to develop estimates of energy intensity and square footage and to fill in saturations for any equipment types not included in the database.

Table 3-8 Average Market Profile for the Commercial Sector, Washington, 2019

End Use	Technology	Saturation	EUI (therms/ Sq Ft)	Intensity (therms/ Sq Ft)	Usage (dekatherms)
Space Heating	Furnace	53.6%	0.44	0.23	1,898,166
	Boiler	32.6%	0.79	0.26	2,086,967
	Unit Heater	4.7%	0.27	0.01	100,644
Water Heating	Water Heater	69.7%	0.30	0.21	1,681,122
Food Preparation	Oven	11.3%	0.06	0.01	53,746
	Conveyor Oven	5.6%	0.10	0.01	45,982
	Double Rack Oven	5.6%	0.15	0.01	69,855
	Fryer	7.3%	0.34	0.03	202,977
	Broiler	12.2%	0.07	0.01	70,869
	Griddle	16.4%	0.05	0.01	70,017
	Range	17.9%	0.06	0.01	82,852
	Steamer	2.1%	0.06	0.00	9,251
	Commercial Food Prep Other	0.2%	0.01	0.00	149
Miscellaneous	Pool Heater	0.9%	0.01	0.00	1,034
	Miscellaneous	100.0%	0.04	0.04	344,734
Total				**0.83**	**6,718,365**

Idaho Characterization

The total number of nonresidential accounts and natural gas sales for the Idaho service territory were obtained from Avista's customer account database.

Table 3-9 below shows the final allocation of energy to each segment in the commercial sector, as well as the energy intensity on a square-foot basis. Intensities for each segment were derived from a combination of the 2019 CBSA and equipment saturations extracted from Avista's database. The CBSA intensities corresponded to spaces with lower natural gas saturations than Avista's database, so AEG increased intensities proportionally based on the additional presence of natural gas-consuming equipment.

Table 3-9 Commercial Sector Control Totals, Idaho, 2019

Segment	Description	Intensity (therms/Sq Ft)	2019 Natural Gas Use (dekatherms)
Office	Traditional office-based businesses including finance, insurance, law, government buildings, etc.	0.60	481,953
Restaurant	Sit-down, fast food, coffee shop, food service, etc.	2.68	65,351
Retail	Department stores, services, boutiques, strip malls etc.	0.83	837,065
Grocery	Supermarkets, convenience stores, market, etc.	0.95	154,034
School	Day care, pre-school, elementary, secondary schools	0.29	269,873
College	College, university, trade schools, etc.	0.62	272,030
Health	Health practitioner office, hospital, urgent care centers, etc.	1.04	315,668
Lodging	Hotel, motel, bed and breakfast, etc.	0.68	172,829
Warehouse	Large storage facility, refrigerated/unrefrigerated warehouse	0.68	358,315
Miscellaneous	Catchall for buildings not included in other segments, includes churches, recreational facilities, public assembly, correctional facilities, etc.	1.16	1,183,111
Total		**0.75**	**4,110,228**

Figure 3-12 shows each segments' natural gas consumption as a percentage of the entire commercial sector energy consumption. The four segments with the highest natural gas usage in 2019 are miscellaneous, retail, office, and warehouse, in descending order. As expected, the highest intensity segment is restaurant. This is based on the high presence of food preparation equipment.

Figure 3-12 Commercial Natural Gas Use by Segment, Idaho, 2019

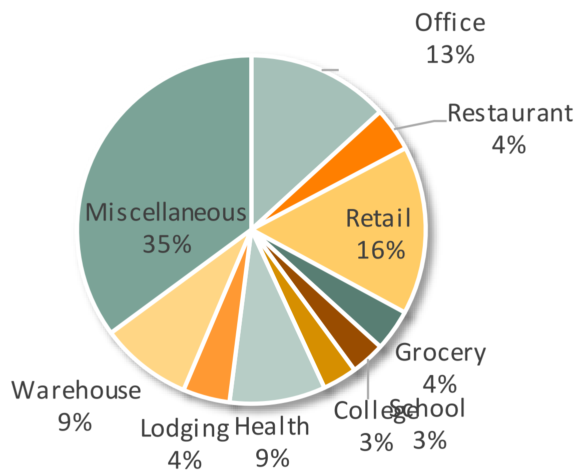


Figure 3-13 shows the distribution of natural gas consumption by end use for the entire commercial sector. Space heating is the largest end use, followed closely by water heating and food preparation. The miscellaneous end use is quite small, as expected.

Figure 3-13 Commercial Sector Natural Gas Use by End Use, Idaho, 2019

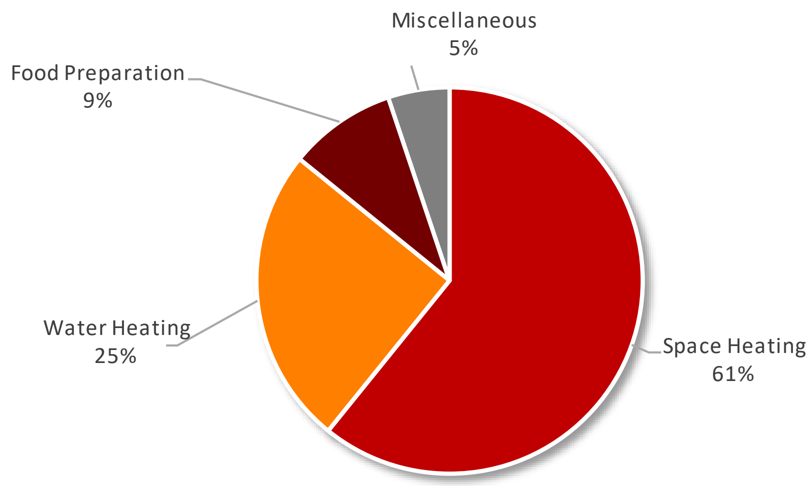
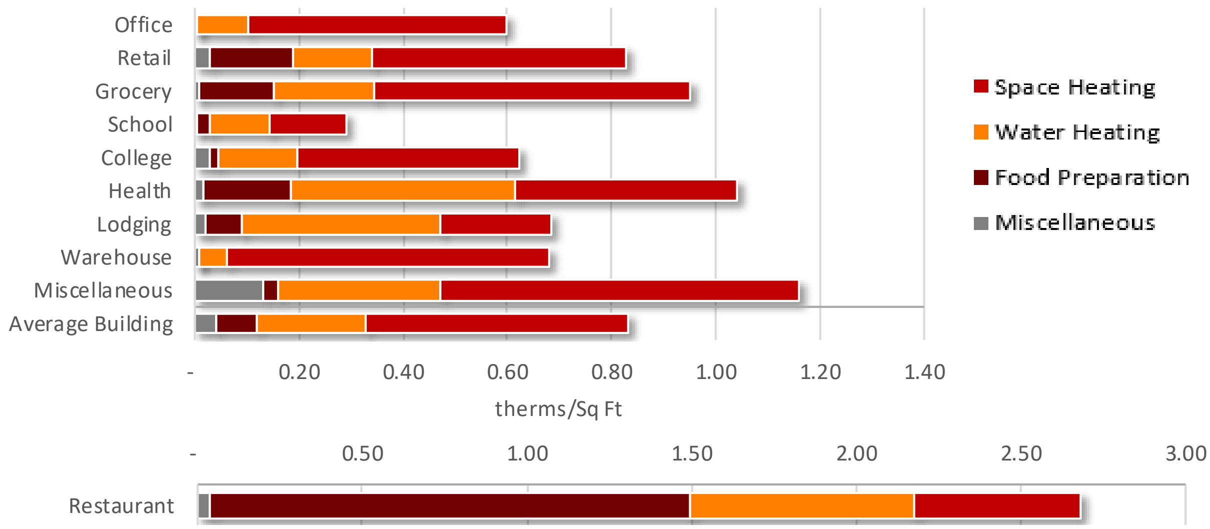


Figure 3-14 presents average natural gas intensities by end use and segment.

Figure 3-14 Commercial Energy Usage Intensity by End Use and Segment, Idaho, 2019 (Annual Therms/Sq. Ft)



The total market profile for an average building in the commercial sector is presented in Table 3-10 below. Avista customer account data informed the market profile by providing information on saturation of key equipment types. Secondary data was used to develop estimates of energy intensity and square footage and to fill in saturations for any equipment types not included in the database.

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

End Use	Technology	Saturation	EUI (therms/ Sq Ft)	Intensity (therms/ Sq Ft)	Usage (dekatherms)
Space Heating	Furnace	50.7%	0.43	0.22	1,183,907
	Boiler	35.7%	0.66	0.24	1,286,757
	Unit Heater	4.9%	0.25	0.01	67,294
Water Heating	Water Heater	69.3%	0.27	0.19	1,025,922
Food Preparation	Oven	9.9%	0.07	0.01	37,863
	Conveyor Oven	4.9%	0.12	0.01	32,393
	Double Rack Oven	4.9%	0.18	0.01	49,212
	Fryer	7.2%	0.32	0.02	125,738
	Broiler	11.3%	0.05	0.01	29,409
	Griddle	15.7%	0.04	0.01	32,103
	Range	17.5%	0.04	0.01	39,839
	Steamer	3.1%	0.04	0.00	5,935
	Commercial Food Prep Other	0.3%	0.01	0.00	141
Miscellaneous	Pool Heater	0.8%	0.01	0.00	563
	Miscellaneous	100.0%	0.04	0.04	193,152
Total				**0.75**	**4,110,228**

Industrial Sector

Washington Characterization

The total sum of natural gas used in 2019 by Avista's Washington industrial customers was 348,670 dekatherms. Like in the commercial sector, customer account data was used to allocate usage among segments. Energy intensity was derived from AEG's Energy Market Profiles database. Most industrial measures are installed through custom programs, where the unit of measure is not as necessary to estimate potential.

Table 3-11 Industrial Sector Control Totals, Washington, 2019

Segment	Intensity (therms/employee)	Natural Gas Usage (dekatherms)
Washington Industrial	**1,716**	**348,670**

Figure 3-15 shows the distribution of annual natural gas consumption by end use for all industrial customers. Two major sources were used to develop this consumption profile. The first was AEG's analysis of warehouse usage as part of the commercial sector. We begin with this prototype as a starting point to represent non-process loads. We then added in process loads using our Energy Market Profiles database, which summarizes usage by end use and process type. Accordingly, process is the largest overall end use for the industrial sector, accounting for 87% of energy use. Heating is the second largest end use, and miscellaneous, non-process industrial uses round out consumption.

Figure 3-15 Industrial Natural Gas Use by End Use, Washington, 2019

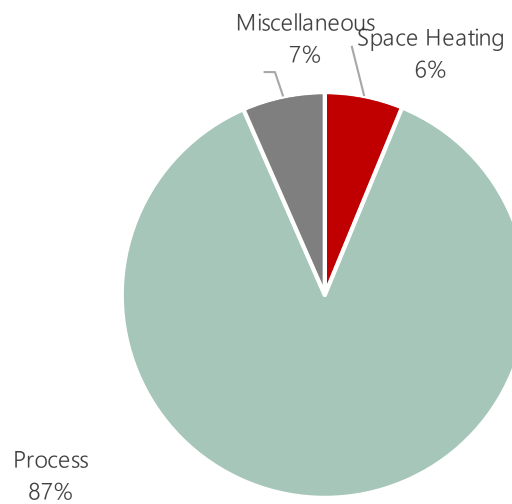


Table 3-12 shows the composite market profile for the industrial sector. Process cooling is very small and represents niche technologies such as gas-driven absorption chillers.

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

End Use	Technology	Saturation	EUI (therms/ sq ft)	Intensity (therms/ Sq ft)	Usage (dekatherms)
Space Heating	Furnace	27.5%	107.88	29.64	6,024
	Boiler	58.8%	107.88	63.42	12,890
	Unit Heater	13.7%	107.88	14.82	3,012
Process	Process Boiler	100.0%	758.47	758.47	154,154
	Process Heating	100.0%	675.00	675.00	137,190
	Process Cooling	100.0%	7.83	7.83	1,592
	Other Process	100.0%	50.93	50.93	10,350
Miscellaneous	Miscellaneous	100.0%	115.41	115.41	23,457
Total				**1,715.53**	**348,670**

Idaho Characterization

The total sum of natural gas used in 2019 by Avista's Idaho industrial customers was 238,705 dekatherms. Energy use intensity is slightly higher than Washington at 2,008 therms/sq ft.

Table 3-13 Industrial Sector Control Totals, Idaho, 2019

Segment	Intensity (therms/employee)	Natural Gas Usage (dekatherms)
Idaho Industrial	**2,008**	**238,705**

Figure 3-16 shows the distribution of annual natural gas consumption by end use for all industrial customers. Two major sources were used to develop this consumption profile. The first was AEG's analysis of warehouse usage as part of the commercial sector. We begin with this prototype as a starting point to represent non-process loads. We then added in process loads using our Energy Market Profiles database, which summarizes usage by end use and process type. Accordingly, process is the largest overall end use for the industrial sector, accounting for 87% of energy use. Heating is the second largest end use, and miscellaneous, non-process industrial uses round out consumption.

Figure 3-16 Industrial Natural Gas Use by End Use, Idaho, 2019

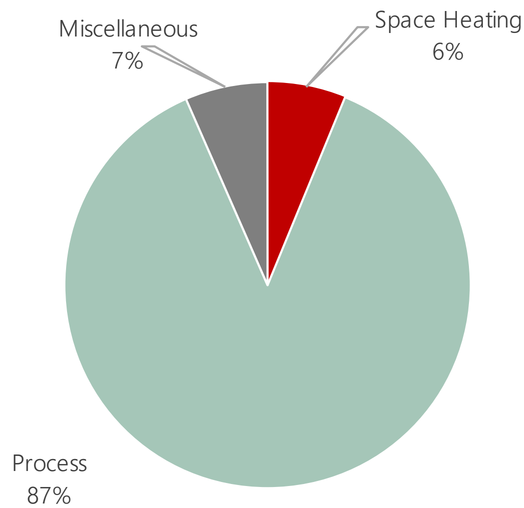


Table 3-14 shows the composite market profile for the industrial sector. Process cooling is very small and represents technologies such as gas-driven absorption chillers.

Table 3-14 Average Natural Gas Market Profile for the Industrial Sector, Idaho, 2019

End Use	Technology	Saturation	EUI (therms/ sq ft)	Intensity (therms/ Sq ft)	Usage (dekatherms)
Space Heating	Furnace	27.5%	126.29	34.70	4,124
	Boiler	58.8%	126.29	74.24	8,824
	Unit Heater	13.7%	126.29	17.35	2,062
Process	Process Boiler	100.0%	887.92	887.92	105,537
	Process Heating	100.0%	790.21	790.21	93,922
	Process Cooling	100.0%	9.17	9.17	1,090
	Other Process	100.0%	59.62	59.62	7,086
Miscellaneous	Miscellaneous	100.0%	135.11	135.11	16,059
Total				**2,008.33**	**238,705**

4

BASELINE PROJECTION

Prior to developing estimates of energy conservation potential, we developed a baseline end-use projection to quantify what the consumption is likely to be in the future in absence of any energy 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. Thus, the potential analysis captures all possible savings from future programs.

The baseline projection incorporates assumptions about:

- 2019 energy consumption based on the market profiles
- Customer population growth
- Appliance/equipment standards and building codes already mandated
- Appliance/equipment purchase decisions
- Avista's customer forecast

Trends in fuel shares and appliance saturations and assumptions about miscellaneous natural gas growth

Although it aligns closely, the baseline projection is not Avista's official load forecast. Rather it was developed as an integral component of our modeling construct to serve as the metric against which energy conservation potentials are measured. This chapter presents the baseline projections we developed for this study. Below, we present the baseline projections for each sector, which include projections of annual use in dekatherms. We also present a summary across all sectors.

Overall Baseline Projection

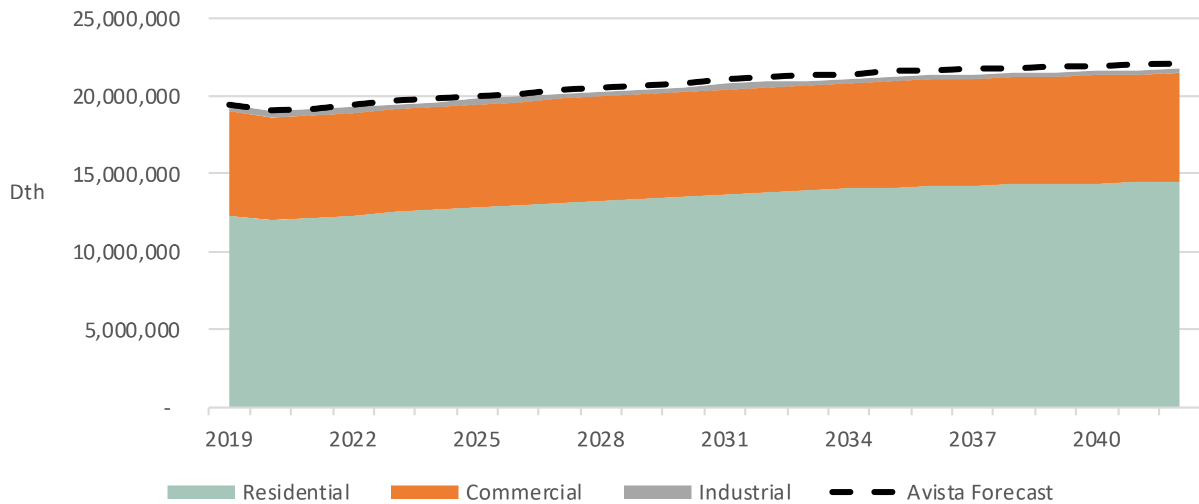
Washington Projection

Table 4-1 and Figure 4-1 provide a summary of the baseline projection for annual use by sector for the Avista's Washington service territory. Overall, the forecast shows modest growth in natural gas consumption, driven by the residential and commercial sectors

Table 4-1 Baseline Projection Summary by Sector, Washington, Selected Years (dekatherms)

Sector	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Residential	12,344,250	12,180,267	12,523,563	13,568,829	14,418,227	16.8%	0.7%
Commercial	6,718,365	6,596,157	6,622,904	6,725,824	6,909,984	2.9%	0.1%
Industrial	348,670	341,870	336,318	317,863	291,665	-16.3%	-0.9%
Total	**19,411,285**	**19,118,293**	**19,482,785**	**20,612,516**	**21,619,876**	**11.4%**	**0.5%**

Figure 4-1 Baseline Projection Summary by Sector, Washington (dekatherms)



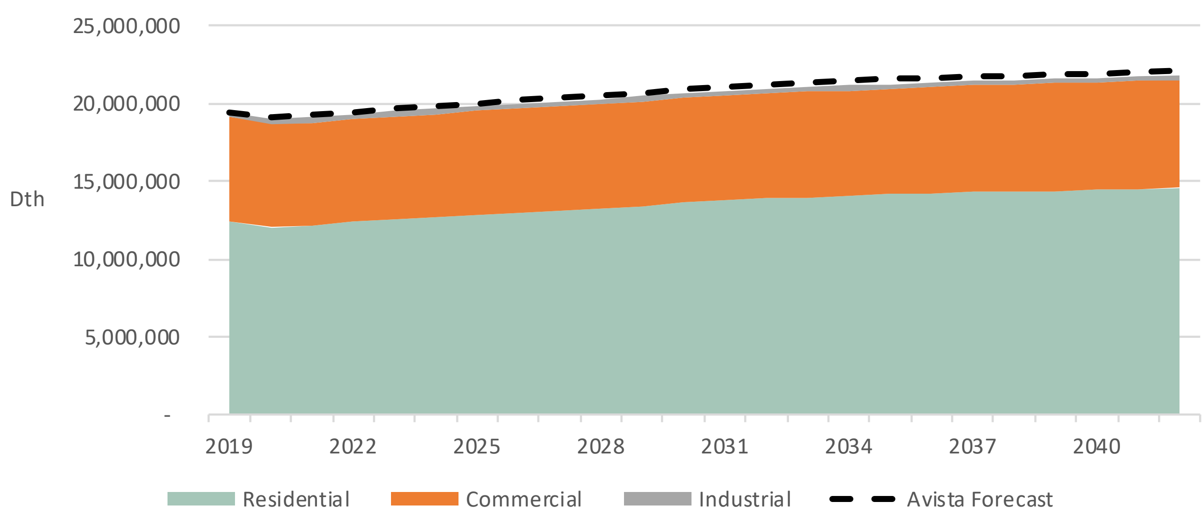
Idaho Projection

Table 4-2 and Figure 4-2 provide a summary of the baseline projection for annual use by sector for Avista's Idaho service territory. Overall, the forecast shows modest growth in natural gas consumption, driven roughly equally by the residential sector.

Table 4-2 Baseline Projection Summary by Sector, Idaho, Selected Years (dekatherms)

Sector	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Residential	5,782,934	5,757,753	5,989,779	6,677,657	7,614,162	31.7%	1.3%
Commercial	4,110,228	4,027,575	4,071,925	4,112,209	4,199,550	2.2%	0.1%
Industrial	238,705	234,049	229,897	214,701	193,107	-19.1%	-1.0%
Total	10,131,866	10,019,377	10,291,600	11,004,568	12,006,819	18.5%	0.8%

Figure 4-2 Baseline Projection Summary by Sector, Idaho (dekatherms)



Residential Sector

Washington Projection

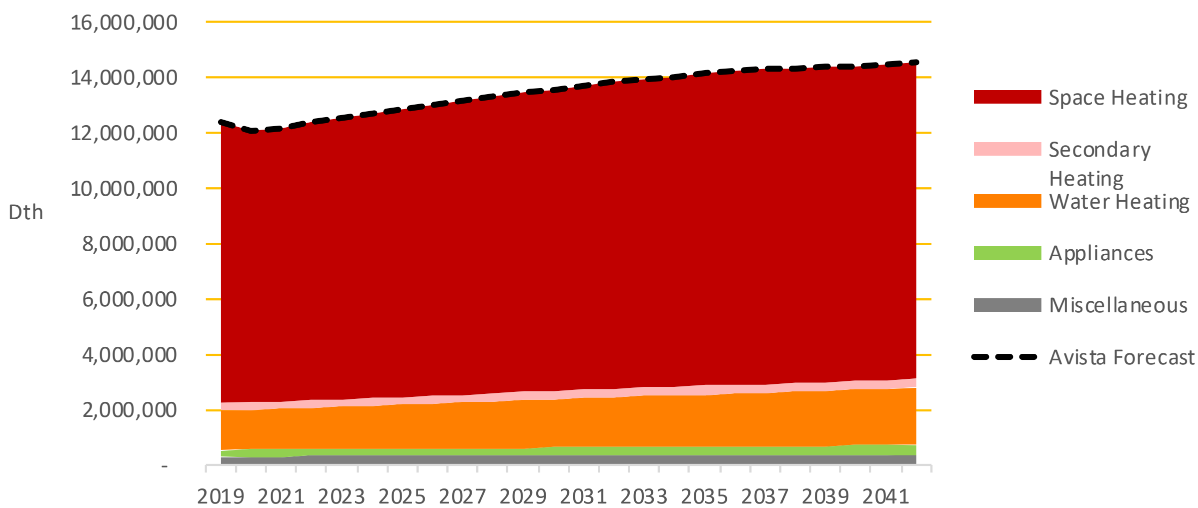
Table 4-3 and Figure 4-3 present the baseline projection for natural gas at the end-use level for the residential sector, as a whole. Overall, residential use increases from 12,344,250 dekatherms in 2019 to 14,418,227 dekatherms in 2040, an increase of 16.8%. Factors affecting growth include a moderate increase in number of households and customers, and a decrease in equipment consumption due to future standards and naturally occurring efficiency improvements (notably the AFUE upcoming 92% furnace standard).

We model gas-fired fireplaces as secondary heating. These consume energy and may heat a space but are rarely relied on to be a primary heating technology. As such, they are estimated to be more aesthetic and less weather-dependent. This end use grows faster than others since new homes are more likely to install a unit, increasing fireplace stock. Miscellaneous is a very small end use including technologies with low penetration, such as gas barbeques.

Table 4-3 Residential Baseline Projection by End Use, Washington (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Space Heating	10,091,649	9,884,547	10,148,613	10,898,317	11,377,205	12.7%	0.6%
Secondary Heating	269,840	268,460	275,328	300,411	328,634	21.8%	0.9%
Water Heating	1,440,263	1,475,763	1,532,049	1,743,214	2,015,278	39.9%	1.6%
Appliances	235,480	240,292	248,325	278,255	315,399	33.9%	1.4%
Miscellaneous	307,017	311,205	319,248	348,632	381,710	24.3%	1.0%
Total	**12,344,250**	**12,180,267**	**12,523,563**	**13,568,829**	**14,418,227**	**16.8%**	**0.7%**

Figure 4-3 Residential Baseline Projection by End Use, Washington (dekatherms)



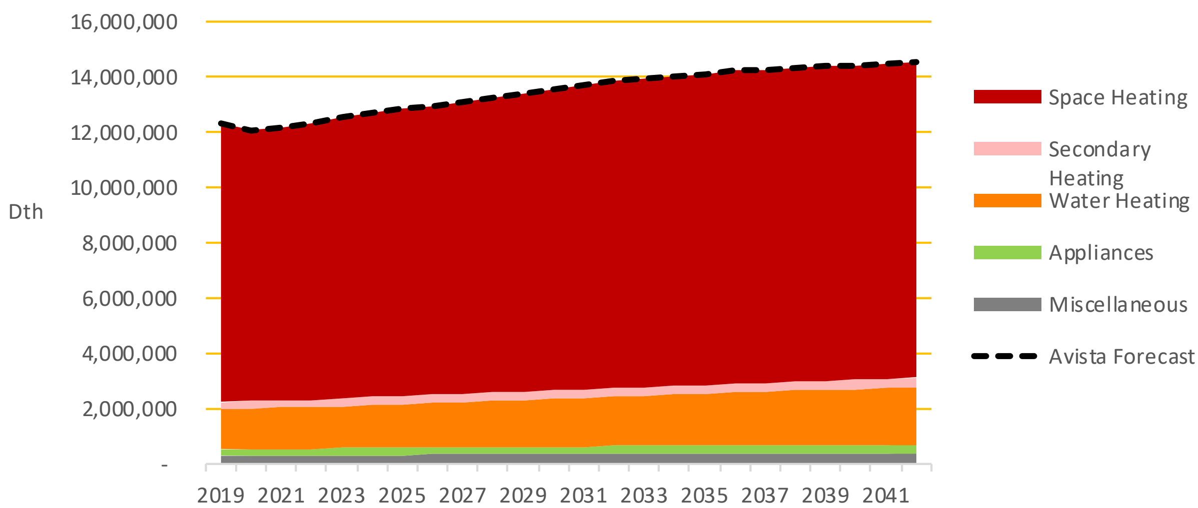
Idaho Projection

Table 4-4 and Figure 4-4 present the baseline projection for natural gas at the end-use level for the residential sector, as a whole. Overall, residential use increases from 5,782,934 dekatherms in 2019 to 7,614,162 dekatherms in 2040, an increase of 31.7%.

Table 4-4 Residential Baseline Projection by End Use, Idaho (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Space Heating	4,598,206	4,543,217	4,723,227	5,238,352	5,912,290	28.6%	1.2%
Secondary Heating	172,526	172,767	178,636	197,303	224,372	30.1%	1.3%
Water Heating	753,951	777,712	814,170	936,965	1,126,311	49.4%	1.9%
Appliances	76,115	78,239	81,587	92,714	109,623	44.0%	1.7%
Miscellaneous	182,137	185,819	192,158	212,322	241,565	32.6%	1.3%
Total	**5,782,934**	**5,757,753**	**5,989,779**	**6,677,657**	**7,614,162**	**31.7%**	**1.3%**

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



Commercial Sector

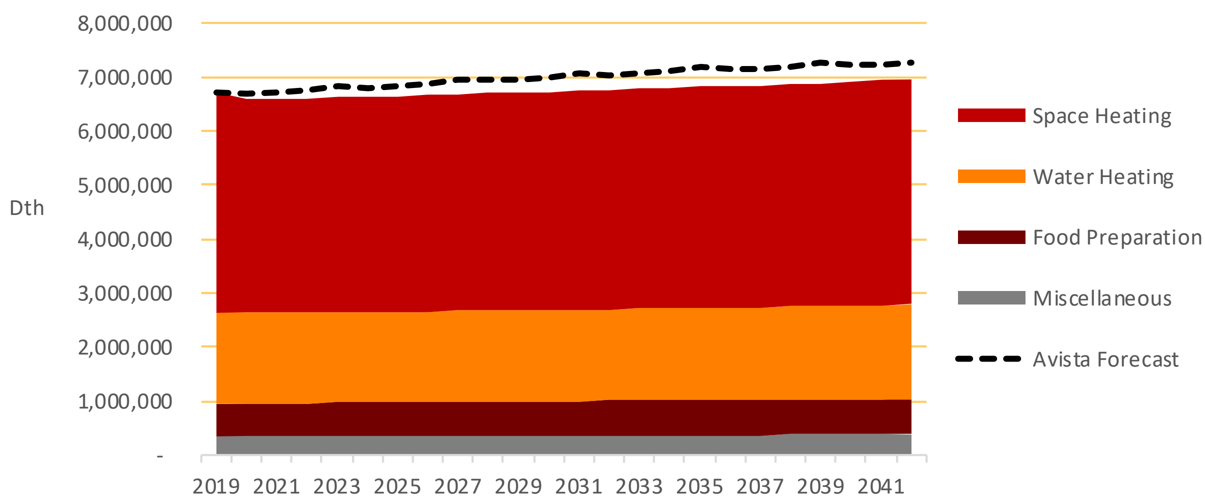
Washington Projection

Annual natural gas use in the commercial sector grows 24.7% during the overall forecast horizon, starting at 6,197,173 dekatherms in 2019, and increasing to 6,909,984 dekatherms in 2040. Table 4-5 and Figure 4-5 present the baseline projection at the end-use level for the commercial sector, as a whole. Similar to the residential sector, market size is increasing and usage per square foot is decreasing slightly.

Table 4-5 Commercial Baseline Projection by End Use, Washington (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Space Heating	4,085,777	3,956,080	3,975,113	4,039,997	4,138,972	1.3%	0.1%
Water Heating	1,681,122	1,679,620	1,678,355	1,686,750	1,736,171	3.3%	0.2%
Food Preparation	605,698	611,422	617,138	636,007	658,775	8.8%	0.4%
Miscellaneous	345,768	349,035	352,298	363,069	376,067	8.8%	0.4%
Total	**6,718,365**	**6,596,157**	**6,622,904**	**6,725,824**	**6,909,984**	**2.9%**	**0.1%**

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



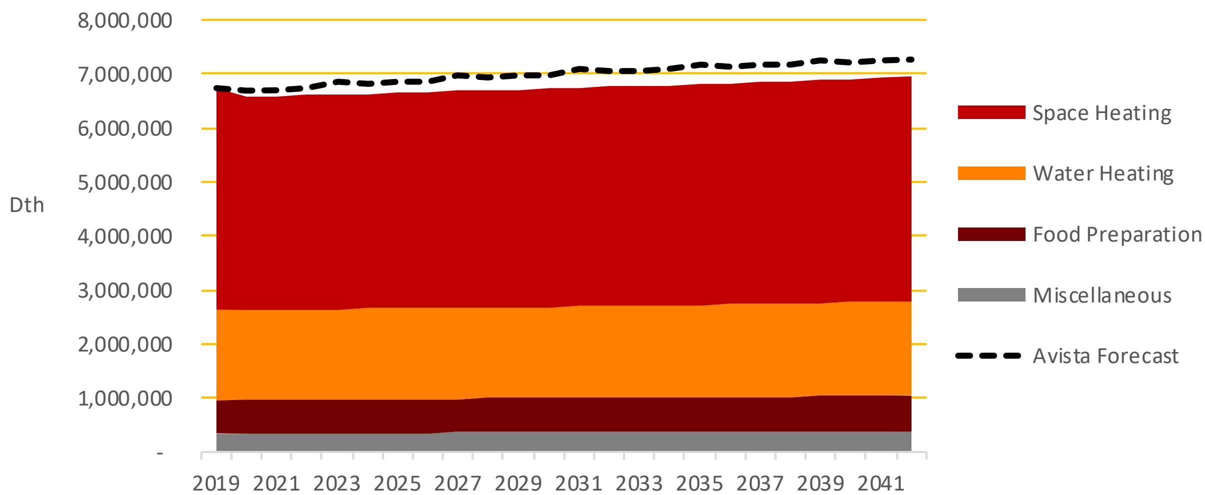
Idaho Projection

Annual natural gas use in the Idaho commercial sector grows 2.2% during the overall forecast horizon, starting at 4,110,228 dekatherms in 2019, and increasing to 4,199,550 dekatherms in 2040. Table 4-6 and Figure 4-6 present the baseline projection at the end-use level for the commercial sector, as a whole. Similar to the residential sector, market size is increasing and usage per square foot is decreasing slightly.

Table 4-6 Commercial Baseline Projection by End Use, Idaho (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Space Heating	2,537,957	2,453,619	2,482,525	2,509,340	2,555,560	0.7%	0.0%
Water Heating	1,025,922	1,023,306	1,029,755	1,029,131	1,052,936	2.6%	0.1%
Food Preparation	352,633	355,410	361,216	370,312	381,488	8.2%	0.4%
Miscellaneous	193,715	195,240	198,430	203,426	209,566	8.2%	0.4%
Total	**4,110,228**	**4,027,575**	**4,071,925**	**4,112,209**	**4,199,550**	**2.2%**	**0.1%**

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



Industrial Sector

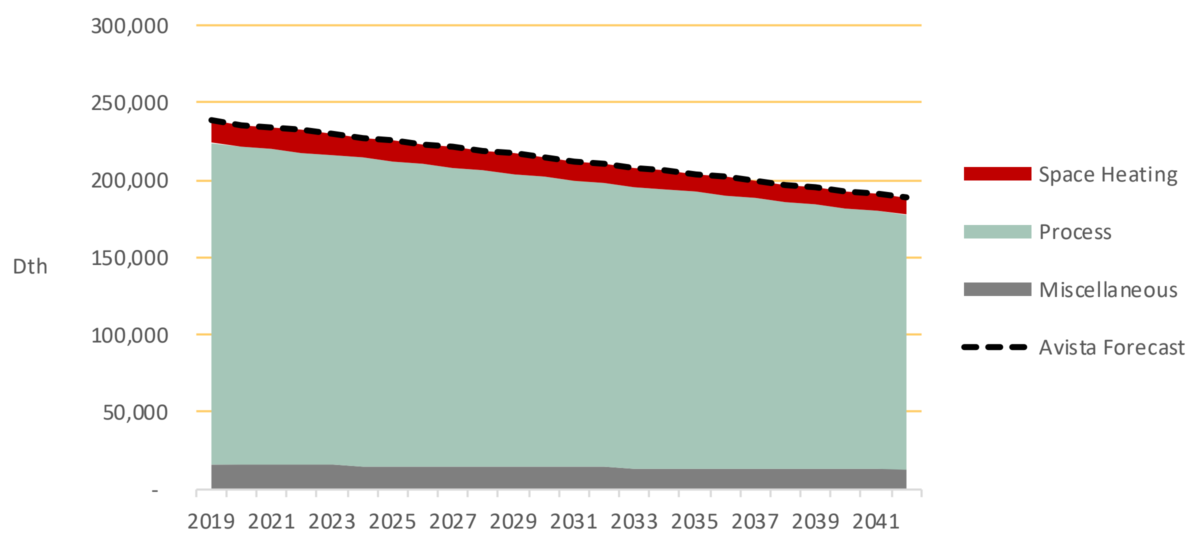
Washington Projection

Industrial sector usage increases throughout the planning horizon. Table 4-7 and Figure 4-7 present the projection at the end-use level. Overall, industrial annual natural gas use decreases from 348,670 dekatherms in 2019 to 291,665 dekatherms in 2040. Growth is consistently around -0.9% per year.

Table 4-7 Industrial Baseline Projection by End Use, Washington (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Space Heating	21,926	20,665	20,227	18,789	16,903	-22.9%	-1.2%
Process	303,287	298,146	293,399	277,603	255,037	-15.9%	-0.8%
Miscellaneous	23,457	23,059	22,692	21,470	19,725	-15.9%	-0.8%
Total	**348,670**	**341,870**	**336,318**	**317,863**	**291,665**	**-16.3%**	**-0.9%**

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



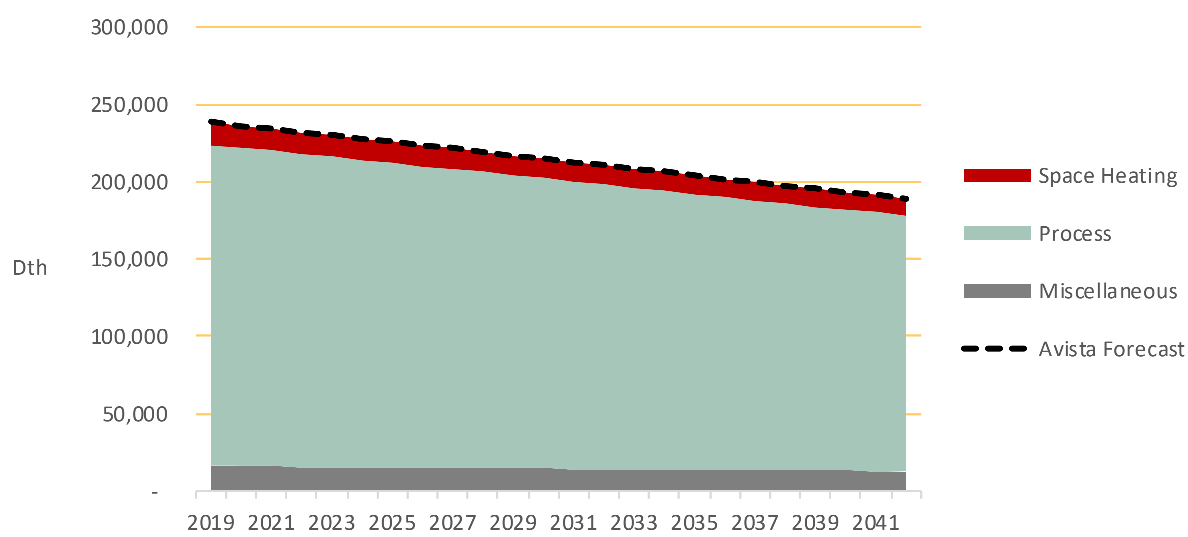
Idaho Projection

Industrial sector usage increases throughout the planning horizon. Table 4-8 and Figure 4-8 present the projection at the end-use level. Overall, industrial annual natural gas use descreases from 238,705 dekatherms in 2019 to 193,107 dekatherms in 2040.

Table 4-8 Industrial Baseline Projection by End Use, Idaho (dekatherms)

End Use	2019	2021	2023	2030	2040	% Change ('19-'40)	Avg. Growth
Heating	15,011	14,147	13,829	12,713	11,232	-25.2%	-1.4%
Process	207,635	204,115	200,556	187,488	168,818	-18.7%	-1.0%
Miscellaneous	16,059	15,787	15,511	14,501	13,057	-18.7%	-1.0%
Total	**238,705**	**234,049**	**229,897**	**214,701**	**193,107**	**-19.1%**	**-1.0%**

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



5

OVERALL ENERGY EFFICIENCY POTENTIAL

This chapter presents the measure-level energy conservation potential across all sectors for Avista's Washington and Idaho territories. This includes every possible measure that is considered in the measure list, regardless of program implementation concerns. Year-by-year savings for annual energy usage are available in the LoadMAP model and measure assumption summary, which were provided to Avista at the conclusion of the study. Please note that all savings are provided at the customer site. This section includes potential from the residential, commercial, and industrial analyses.

Overall Energy Efficiency Potential

Washington Potential

Table 5-1 and Figure 5-1 summarize the energy conservation savings in terms of annual energy use for all measures for four levels of potential relative to the baseline projection. Figure 5-2 displays the energy conservation forecasts. Savings are represented in cumulative terms, which reflect the effects of persistent savings in prior years in addition to new savings. This allows for the reporting of annual savings impacts as they actually impact each year of the forecast.

- **Technical Potential** reflects the adoption of all conservation measures regardless of cost-effectiveness. In this potential case, efficient equipment makes up all lost opportunity installations and all retrofit measures are installed, regardless of achievability. 2021 first-year savings are 421,965 dekatherms, or 2.2% of the baseline projection. Cumulative savings in 2030 are 5,084,999 dekatherms, or 24.7% of the baseline. By 2040, cumulative savings reach 8,908,493 dekatherms, or 41.2% of the baseline. Technical potential is useful as a theoretical construct, applying an upper bound to the potential that may be realized in any one year. Other levels of potential are based off this level which makes it an important component in the estimation of potential.
- **Achievable Technical Potential** refines technical potential by applying customer participation rates that account for market barriers, customer awareness and attitudes, program maturity, and other factors that affect market penetration of conservation measures. For Avista's gas CPA, ramp rates from the 2021 Power Plan were customized for use in natural gas programs and applied. Since the 2021 Plan does not assign ramp rates for the majority of natural gas measures, we assigned these based on similar electric technologies present in the Plan as a starting point. These ramp rates may be found in Appendix B. 2021 first-year net savings are 187,983 dekatherms, or 1.0% of the baseline projection. Cumulative net savings in 2030 are 3,183,398 dekatherms, or 15.4% of the baseline. By 2040 cumulative savings reach 6,309,826 dekatherms, or 29.2% of the baseline.
- **UCT Achievable Economic Potential** further refines achievable technical potential by applying an economic cost-effectiveness screen. In this analysis, the cost-effectiveness is measured by the utility cost test (UCT), which compares lifetime energy benefits to the total utility costs of delivering the measure through a utility program, excluding monetized non-energy impacts. Avoided costs of energy were provided by Avista. 2021 first-year savings are 75,820 dekatherms, or 0.4% of the baseline projection. Cumulative savings in 2030 are 1,386,479 dekatherms, or 6.7% of the baseline. By 2040 cumulative savings reach 3,560,512 dekatherms, or 16.5% of the baseline.

- **TRC Achievable Economic Potential** further refines achievable technical potential by applying an economic cost-effectiveness screen. In this analysis, the cost-effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy benefits to the total customer and utility costs of delivering the measure through a utility program, including monetized non-energy impacts. AEG also applied benefits for non-gas energy savings, such as electric HVAC savings for weatherization and lighting savings for retrocommissioning. We also applied the Council's calibration credit to space heating savings to reflect the fact that additional fuels may be used as a supplemental heat source within an average home and may be accounted for within the TRC. Avoided costs of energy were provided by Avista. A 10% conservation credit was applied to these costs per the Council methodologies. 2021 first-year savings are 41,871 dekatherms, or 0.2% of the baseline projection. Cumulative net savings in 2030 are 708,778 dekatherms, or 3.4% of the baseline. By 2040 cumulative savings reach 2,319,723 dekatherms, or 10.7% of the baseline. Potential under the TRC test is lower than UCT due to the inclusion of full measure costs rather than the utility portion. For most measures, these far outweigh the quantified and monetized non-energy impacts included in the TRC.

Table 5-1 Summary of Energy Efficiency Potential, Washington (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Projection (Dth)	19,118,293	19,289,575	19,805,020	20,612,516	21,619,876
Cumulative Savings (Dth)					
UCT Achievable Economic Potential	75,820	173,838	457,423	1,386,479	3,560,512
TRC Achievable Economic Potential	41,871	100,872	227,922	708,778	2,319,723
Achievable Technical Potential	187,983	416,584	1,221,810	3,183,398	6,309,826
Technical Potential	429,965	897,098	2,314,334	5,084,999	8,908,493
Cumulative Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	0.9%	2.3%	6.7%	16.5%
TRC Achievable Economic Potential	0.2%	0.5%	1.2%	3.4%	10.7%
Achievable Technical Potential	1.0%	2.2%	6.2%	15.4%	29.2%
Technical Potential	2.2%	4.7%	11.7%	24.7%	41.2%

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

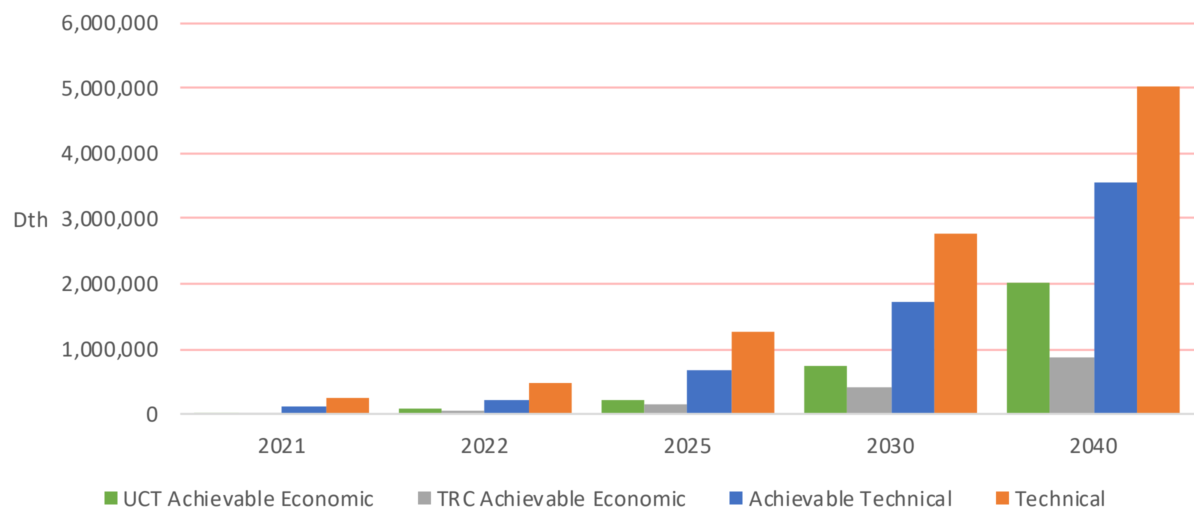


Figure 5-2 Baseline Projection and Energy Efficiency Forecasts, Washington (dekatherms)

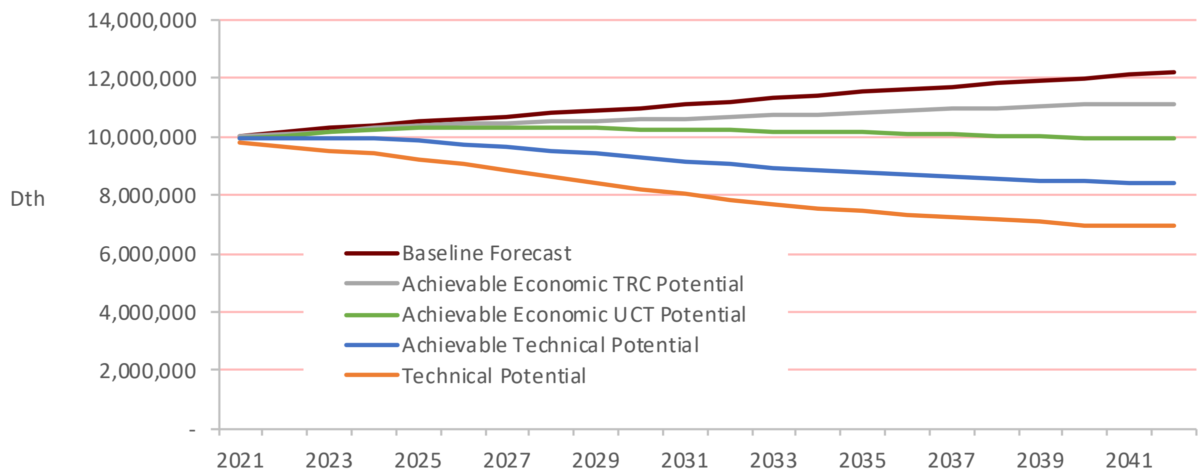


Figure 5-3 shows the cumulative UCT achievable potential by sector for the full timeframe of the analysis as percent of total. Table 5-2 summarizes UCT achievable potential by market sector for selected years.

While the residential and commercial sectors represent the lion's share of the overall potential in the early years, by the late-2020s, the residential sector share grows to a significant majority of savings potential. Since industrial consumption is such a low percentage of the baseline once ineligible customers have been excluded, potential for this sector makes up a lower percentage of the total. While residential and commercial potential ramps up, industrial potential is mainly retrofit in nature, and is much flatter. This is because process equipment is highly custom and most potential comes from controls modifications or process adjustments rather than high-efficiency equipment upgrades. Additionally, we model retrocommissioning to phase in evenly over the next twenty years. This measure has a maintenance component, and not all existing facilities may be old enough to require the tune-up immediately but will be eligible at some point over the course of the study.

There is a notable downtick in residential savings around 2024. This is due to the impacts of the residential forced-air furnace standard, which raises the baseline from AFUE 80% to AFUE 92%, which is a substantial increase when the efficient option is an AFUE 95% unit.

Figure 5-3 Cumulative UCT Achievable Economic Potential by Sector, Washington (% of Total)

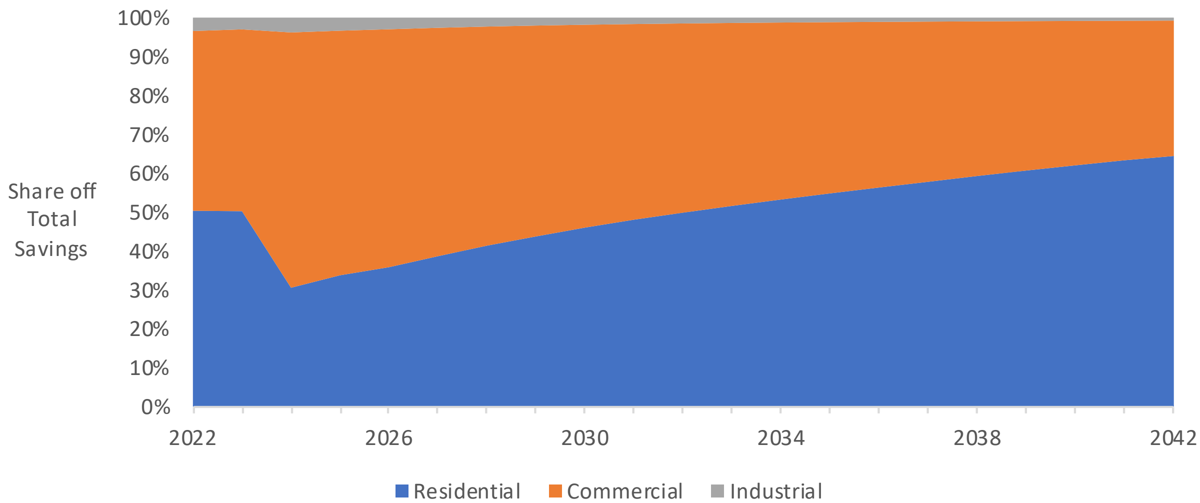


Table 5-2 Cumulative UCT Achievable Economic Potential by Sector, Washington, Selected Years (dekatherms)

Sector	2021	2022	2025	2030	2040
Residential	45,545	102,725	208,449	725,000	2,294,322
Commercial	28,070	66,690	237,773	642,051	1,241,314
Industrial	2,206	4,424	11,200	19,428	24,876
Total	**75,820**	**173,838**	**457,423**	**1,386,479**	**3,560,512**

Idaho Potential

Table 5-3 and Figure 5-4 summarize the energy conservation savings in terms of annual energy use for all measures for four levels of potential relative to the baseline projection. Figure 5-5 displays the energy conservation forecasts. Savings are represented in cumulative terms, which reflect the effects of persistent savings in prior years in addition to new savings. This allows for the reporting of annual savings impacts as they actually impact each year of the forecast.

- **Technical Potential** first-year savings in 2021 are 232,772 dekatherms, or 2.3% of the baseline projection. Cumulative savings in 2030 are 2,777,509 dekatherms, or 25.2% of the baseline. By 2040, cumulative savings reach 5,013,697 dekatherms, or 41.8% of the baseline.
- **Achievable Technical Potential** first-year net savings are 102,031 dekatherms, or 1.0% of the baseline projection. Cumulative net savings in 2030 are 1,722,830 dekatherms, or 15.7% of the baseline. By 2040 cumulative savings reach 3,544,048 dekatherms, or 29.5% of the baseline.
- **UCT Achievable Economic Potential** first-year savings are 35,816 dekatherms, or 0.4% of the baseline projection. Cumulative savings in 2030 are 737,710 dekatherms, or 6.7% of the baseline. By 2040 cumulative savings reach 2,025,410 dekatherms, or 16.9% of the baseline.
- **TRC Achievable Economic Potential** first-year savings are 26,220 dekatherms, or 0.3% of the baseline projection. Cumulative net savings in 2030 are 417,020 dekatherms, or 3.8% of the baseline. By 2040 cumulative savings reach 868,456 dekatherms, or 7.2% of the baseline. Potential under the TRC test is lower than UCT due to the inclusion of full measure costs rather than the utility portion. For most measures, these far outweigh the quantified and monetized non-energy impacts included in the TRC.

Table 5-3 Summary of Energy Efficiency Potential, Idaho (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Projection (Dth)	10,019,377	10,144,894	10,520,169	11,004,568	12,006,819
Cumulative Savings (Dth)					
UCT Achievable Economic Potential	35,816	87,995	229,283	737,710	2,025,410
TRC Achievable Economic Potential	26,220	62,285	136,883	417,028	868,456
Achievable Technical Potential	102,031	226,613	657,997	1,722,830	3,544,048
Technical Potential	232,772	490,826	1,273,202	2,777,509	5,013,697
Cumulative Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	0.9%	2.2%	6.7%	16.9%
TRC Achievable Economic Potential	0.3%	0.6%	1.3%	3.8%	7.2%
Achievable Technical Potential	1.0%	2.2%	6.3%	15.7%	29.5%
Technical Potential	2.3%	4.8%	12.1%	25.2%	41.8%

Figure 5-4 Summary of Energy Efficiency Potential as % of Baseline Projection, Idaho (dekatherms)

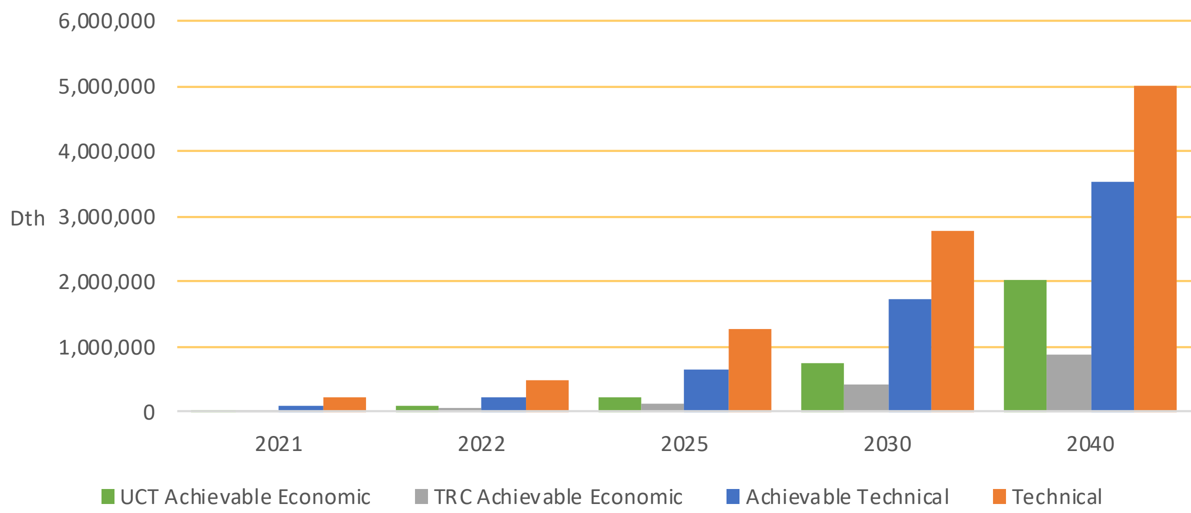


Figure 5-5 Summary of Energy Efficiency Potential as % of Baseline Projection, Idaho (dekatherms)

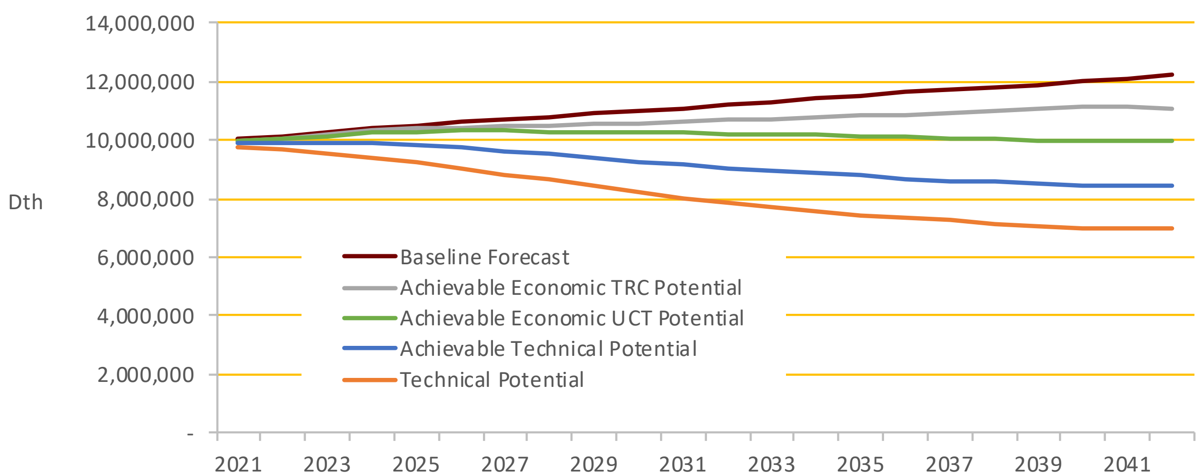


Figure 5-6 shows the cumulative UCT achievable potential by sector for the full timeframe of the analysis as percent of total. Table 5-4 summarizes UCT achievable potential by market sector for selected years.

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Figure 5-6 Cumulative UCT Achievable Economic Potential by Sector, Idaho (% of Total)

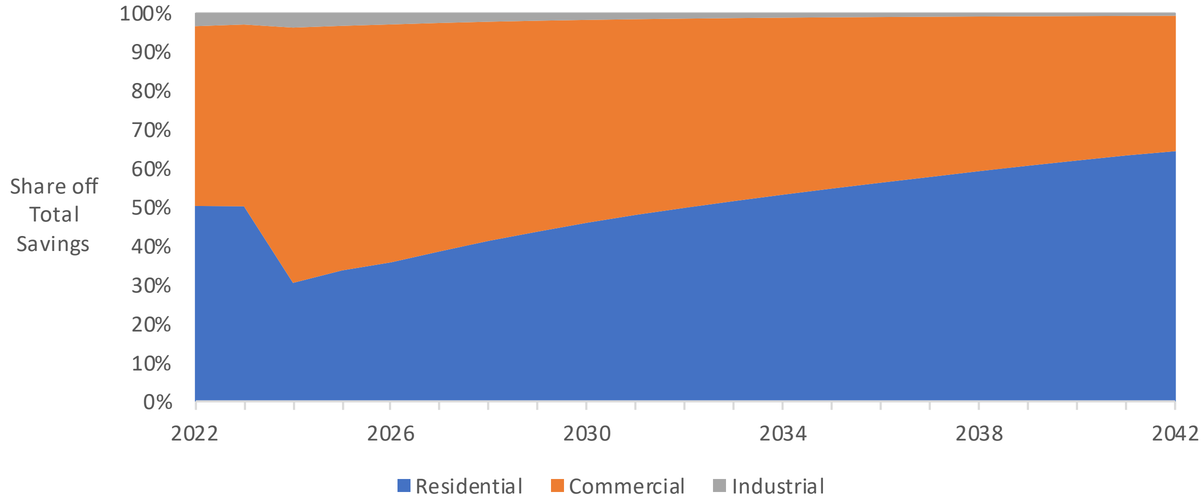


Table 5-4 Cumulative UCT Achievable Economic Potential by Sector, Idaho, Selected Years (dekatherms)

Sector	2021	2022	2025	2030	2040
Residential	17,529	44,289	77,379	339,502	1,256,282
Commercial	16,775	40,676	144,201	384,730	751,926
Industrial	1,512	3,030	7,703	13,477	17,202
Total	**35,816**	**87,995**	**229,283**	**737,710**	**2,025,410**

6

SECTOR-LEVEL ENERGY EFFICIENCY POTENTIAL

The previous section provided a summary of potential for the Avista territory at the state level. In this section, we provide details for each sector.

Residential Sector

Washington Potential

Table 6-1 and Figure 6-1 summarize the energy efficiency potential for the residential sector. In 2021, UCT achievable economic potential is 45,545 dekatherms, or 0.4% of the baseline projection. By 2040, cumulative savings are 2,294,322 dekatherms, or 15.9% of the baseline.

Table 6-1 Residential Energy Conservation Potential Summary, Washington (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (Dth)	12,180,267	12,342,203	12,822,709	13,568,829	14,418,227
Cumulative Savings (Dth)					
UCT Achievable Economic Potential	45,545	102,725	208,449	725,000	2,294,322
TRC Achievable Economic Potential	22,729	53,315	48,069	211,706	1,312,883
Achievable Technical Potential	137,500	304,182	858,976	2,272,407	4,576,510
Technical Potential	292,972	616,103	1,560,420	3,510,309	6,413,126
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	0.8%	1.6%	5.3%	15.9%
TRC Achievable Economic Potential	0.2%	0.4%	0.4%	1.6%	9.1%
Achievable Technical Potential	1.1%	2.5%	6.7%	16.7%	31.7%
Technical Potential	2.4%	5.0%	12.2%	25.9%	44.5%

Figure 6-1 Residential Energy Conservation by Case, Washington (dekatherms)

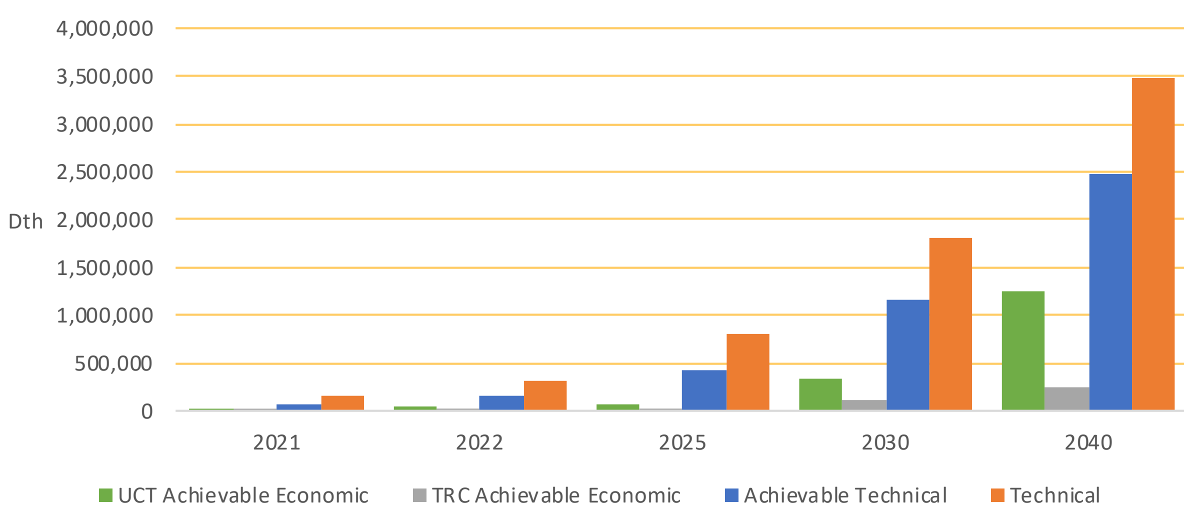


Figure 6-2 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Space heating makes up a majority of potential but declines slightly in the early to mid-2020s due to the future furnace standard.

Figure 6-2 Residential UCT Achievable Economic Potential – Cumulative Savings by End Use, Washington (dekatherms, % of total)

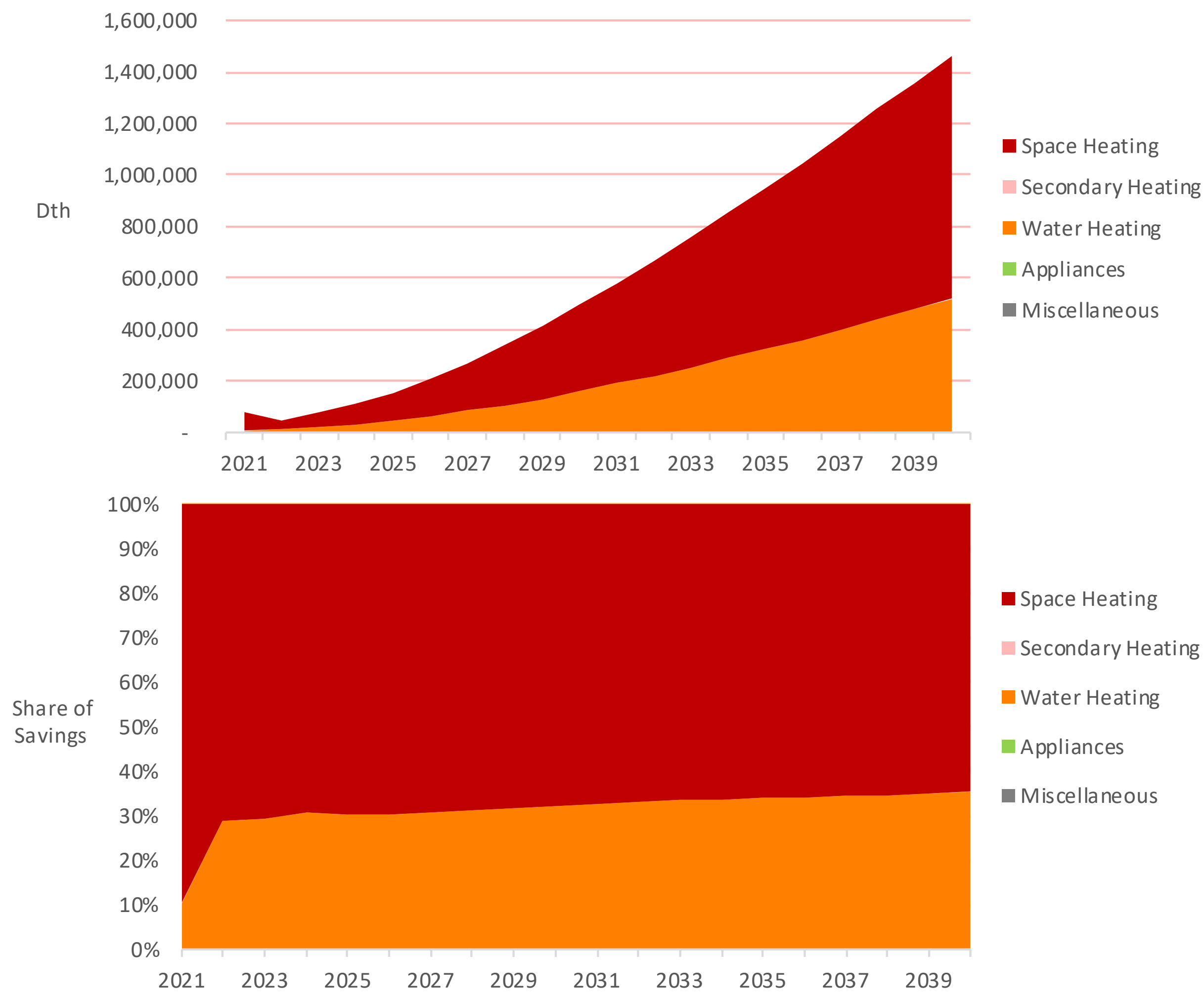


Table 6-2 identifies the top 20 residential measures by cumulative 2021 and 2022 savings. Furnaces, learning thermostats, insulation and water heating are the top measures.

Table 6-2 Residential Top Measures in 2021 and 2022, UCT Achievable Economic Potential, Washington (dekatherms)

Rank	Measure / Technology	2021 Cumulative Potential Savings (dekatherms)	% of Total	2022 Cumulative Potential Savings (dekatherms)	% of Total
1	Furnace - AFUE 92%	21,548	47%	50,231	49%
2	Gas Furnace - Maintenance - Restored to nameplate 80% AFUE	13,118	29%	26,107	25%
3	ENERGY STAR Connected Thermostat - Interactive/learning thermostat (ie, NEST)	4,435	10%	9,925	10%
4	Insulation - Ceiling, Installation - R-38 (Retro only)	3,611	8%	8,000	8%
5	Water Heater - Instantaneous - ENERGY STAR (UEF 0.87)	1,901	4%	5,973	6%
6	Insulation - Wall Cavity, Installation - R-11	333	1%	741	1%
7	Gas Boiler - Steam Trap Maintenance - Cleaned and restored	202	0%	399	0%
8	Building Shell - Whole-Home Aerosol Sealing - 20% reduction in ACH50	163	0%	492	0%
9	Water Heater - Low Flow Showerhead (1.5 GPM) - 1.5 GPM showerhead	75	0%	194	0%
10	Boiler - AFUE 85%	51	0%	130	0%
11	Water Heater - Faucet Aerators - 1.5 GPM faucet	51	0%	131	0%
12	ENERGY STAR Homes - Built Green spec (NC Only)	47	0%	265	0%
13	Water Heater - Pipe Insulation - Insulated 5' of pipe between unit and conditioned space	10	0%	25	0%
14	Insulation - Slab Foundation - R-11 (NC Only)	0	0%	23	0%
15	Building Shell - Liquid-Applied Weather-Resistive Barrier - Spray-on weather barrier applied	0	0%	0	0%
16	Clothes Dryer - NEEA/ENERGY STAR (CE >60%)	0	0%	0	0%
17	Combined Boiler + DHW System (Storage Tank) - Combined tankless boiler unit for space and DHW	0	0%	0	0%
18	Combined Boiler + DHW System (Tankless) - Combined tankless boiler unit for space and DHW	0	0%	0	0%
19	Doors - Storm and Thermal - R-5 door	0	0%	0	0%
20	Ducting - Repair and Sealing - 50% reduction in duct leakage	0	0%	0	0%
Subtotal		**45,545**	**100%**	**102,636**	**100%**
Total Savings in Year		**45,545**	**100%**	**102,725**	**100%**

Idaho Potential

Table 6-3 and Figure 6-3 summarize the energy efficiency potential for the residential sector. In 2021, UCT achievable economic potential is 17,529 dekatherms, or 0.3% of the baseline projection. By 2040, cumulative savings are 1,256,282 dekatherms, or 16.5% of the baseline.

Table 6-3 Residential Energy Conservation Potential Summary, Idaho (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (Dth)	5,757,753	5,864,931	6,201,524	6,677,657	7,614,162
Cumulative Savings (Dth)					
UCT Achievable Economic Potential	17,529	44,289	77,379	339,502	1,256,282
TRC Achievable Economic Potential	14,700	32,896	26,285	117,618	255,801
Achievable Technical Potential	70,759	156,239	432,644	1,167,372	2,486,556
Technical Potential	148,844	313,749	798,652	1,806,313	3,485,609
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.3%	0.8%	1.2%	5.1%	16.5%
TRC Achievable Economic Potential	0.3%	0.6%	0.4%	1.8%	3.4%
Achievable Technical Potential	1.2%	2.7%	7.0%	17.5%	32.7%
Technical Potential	2.6%	5.3%	12.9%	27.1%	45.8%

Figure 6-3 Residential Energy Conservation by Case, Idaho (dekatherms)

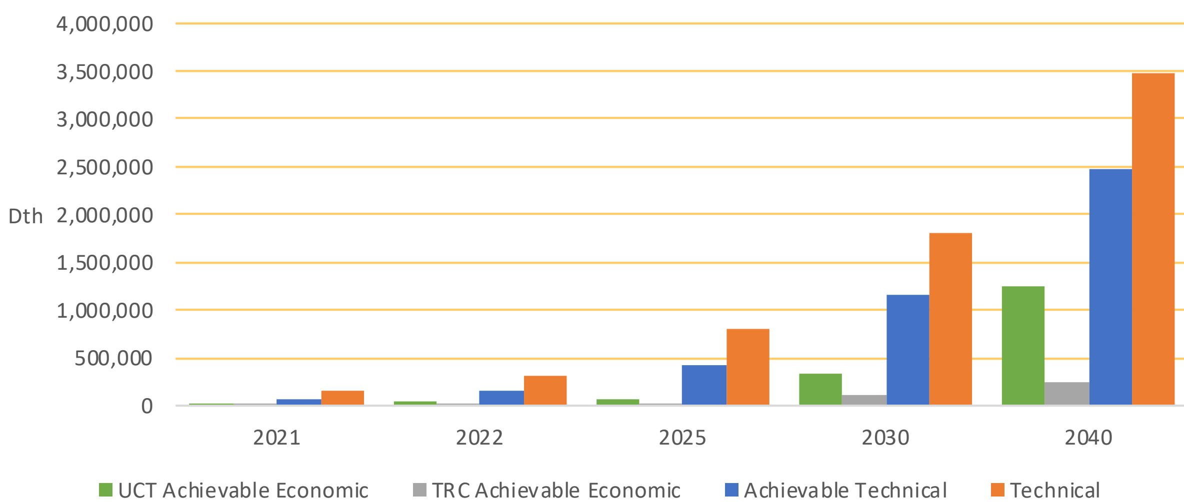


Figure 6-4 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Space heating makes up a majority of potential but declines slightly in the early to mid-2020s due to the future furnace standard.

Figure 6-4 Residential UCT Achievable Economic Potential – Cumulative Savings by End Use, Idaho (dekatherms, % of total)

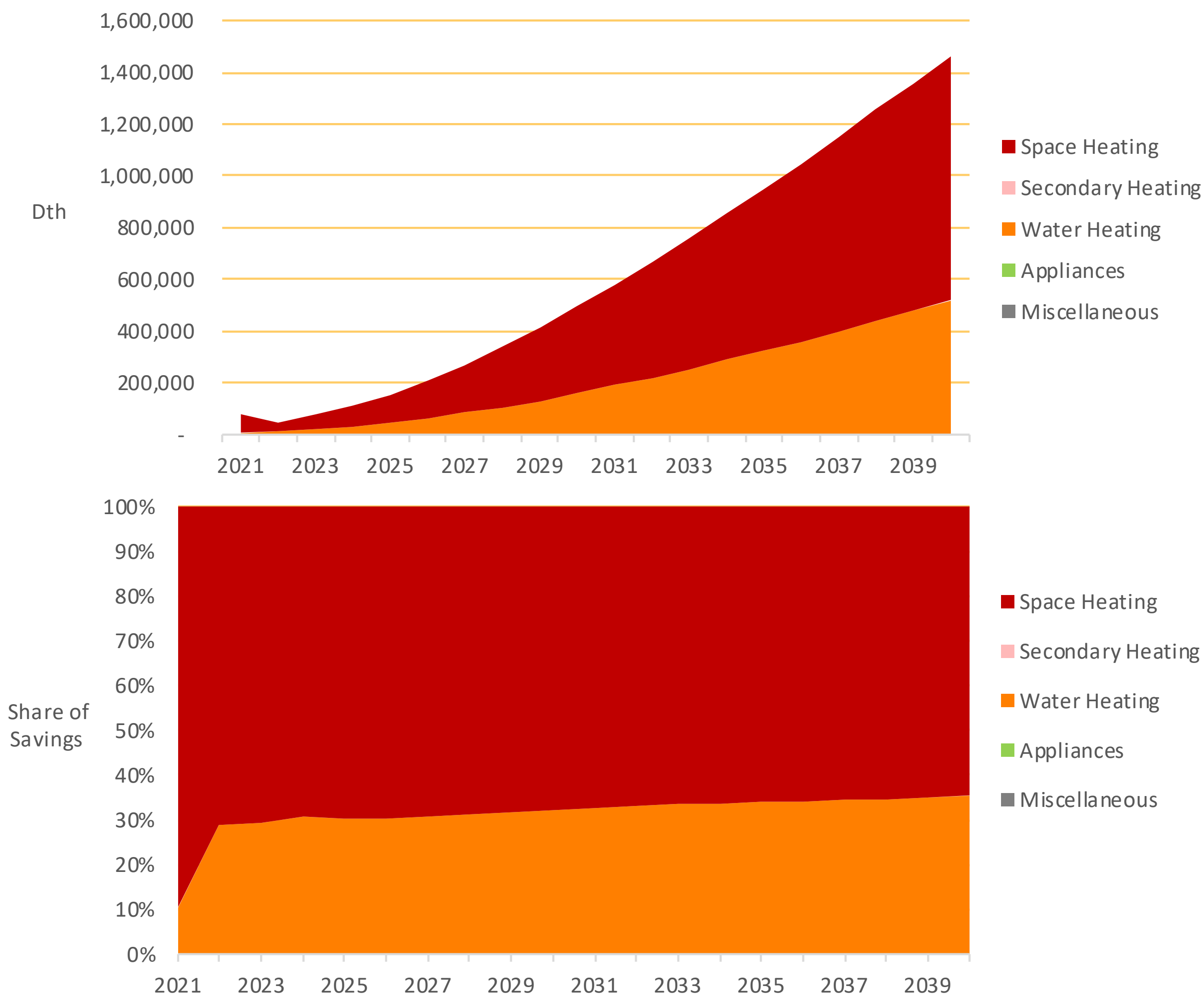


Table 6-4 identifies the top 20 residential measures by cumulative 2018 and 2019 savings. Furnaces, tankless water heaters, windows, and insulation are the top measures.

Table 6-4 Residential Top Measures in 2021 and 2022, UCT Achievable Economic Potential, Idaho (dekatherms)

Rank	Measure / Technology	2021 Cumulative Potential Savings (dekatherms)	% of Total	2022 Cumulative Potential Savings (dekatherms)	% of Total
1	Furnace - AFUE 92%	14,054	80%	31,241	71%
2	Insulation - Ceiling, Installation - R-38 (Retro only)	1,643	9%	3,640	8%
3	Water Heater - Instantaneous - ENERGY STAR (UEF 0.87)	1,053	6%	3,293	7%
4	Gas Furnace - Maintenance - Restored to nameplate 80% AFUE	284	2%	4,805	11%
5	Insulation - Wall Cavity, Installation - R-11	142	1%	316	1%
6	Water Heater - Low Flow Showerhead (1.5 GPM) - 1.5 GPM showerhead	93	1%	243	1%
7	Gas Boiler - Steam Trap Maintenance - Cleaned and restored	91	1%	180	0%
8	Building Shell - Whole-Home Aerosol Sealing - 20% reduction in ACH50	79	0%	237	1%
9	ENERGY STAR Homes - Built Green spec (NC Only)	32	0%	176	0%
10	Water Heater - Faucet Aerators - 1.5 GPM faucet	32	0%	87	0%
11	Water Heater - Low Flow Showerhead (2.0 GPM) - 2.0 GPM showerhead	21	0%	56	0%
12	Water Heater - Pipe Insulation - Insulated 5' of pipe between unit and conditioned space	5	0%	14	0%
Subtotal		**17,529**	**100%**	**44,289**	**100%**
Total Savings in Year		**17,529**	**100%**	**44,289**	**100%**

Commercial Sector

Washington Potential

Table 6-5 and Figure 6-5 summarize the energy conservation potential for the commercial sector. In 2021, UCT achievable economic potential is 28,070 dekatherms, or 0.4% of the baseline projection. By 2040, cumulative savings are 1,241,314 dekatherms, or 18.0% of the baseline.

Table 6-5 Commercial Energy Conservation Potential Summary, Washington

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (dekatherms)	6,596,157	6,608,411	6,651,275	6,725,824	6,909,984
Cumulative Savings (dekatherms)					
UCT Achievable Economic Potential	28,070	66,690	237,773	642,051	1,241,314
TRC Achievable Economic Potential	18,820	46,887	177,954	492,563	999,201
Achievable Technical Potential	47,867	107,183	349,669	887,910	1,704,037
Technical Potential	133,767	274,570	737,799	1,546,608	2,459,821
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	1.0%	3.6%	9.5%	18.0%
TRC Achievable Economic Potential	0.3%	0.7%	2.7%	7.3%	14.5%
Achievable Technical Potential	0.7%	1.6%	5.3%	13.2%	24.7%
Technical Potential	2.0%	4.2%	11.1%	23.0%	35.6%

Figure 6-5 Commercial Energy Conservation by Case, Washington (dekatherms)

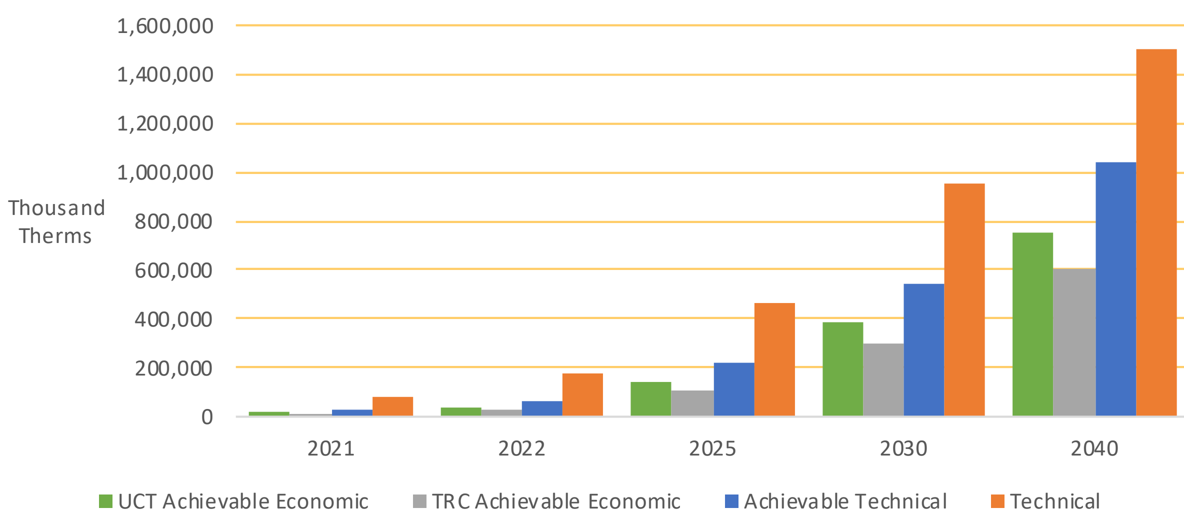


Figure 6-6 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Space heating makes up a majority of the potential early, but food preparation equipment upgrades provide substantial savings opportunities in the later years.

Figure 6-6 Commercial UCT Achievable Economic Potential – Cumulative Savings by End Use, Washington (dekatherms, % of total)

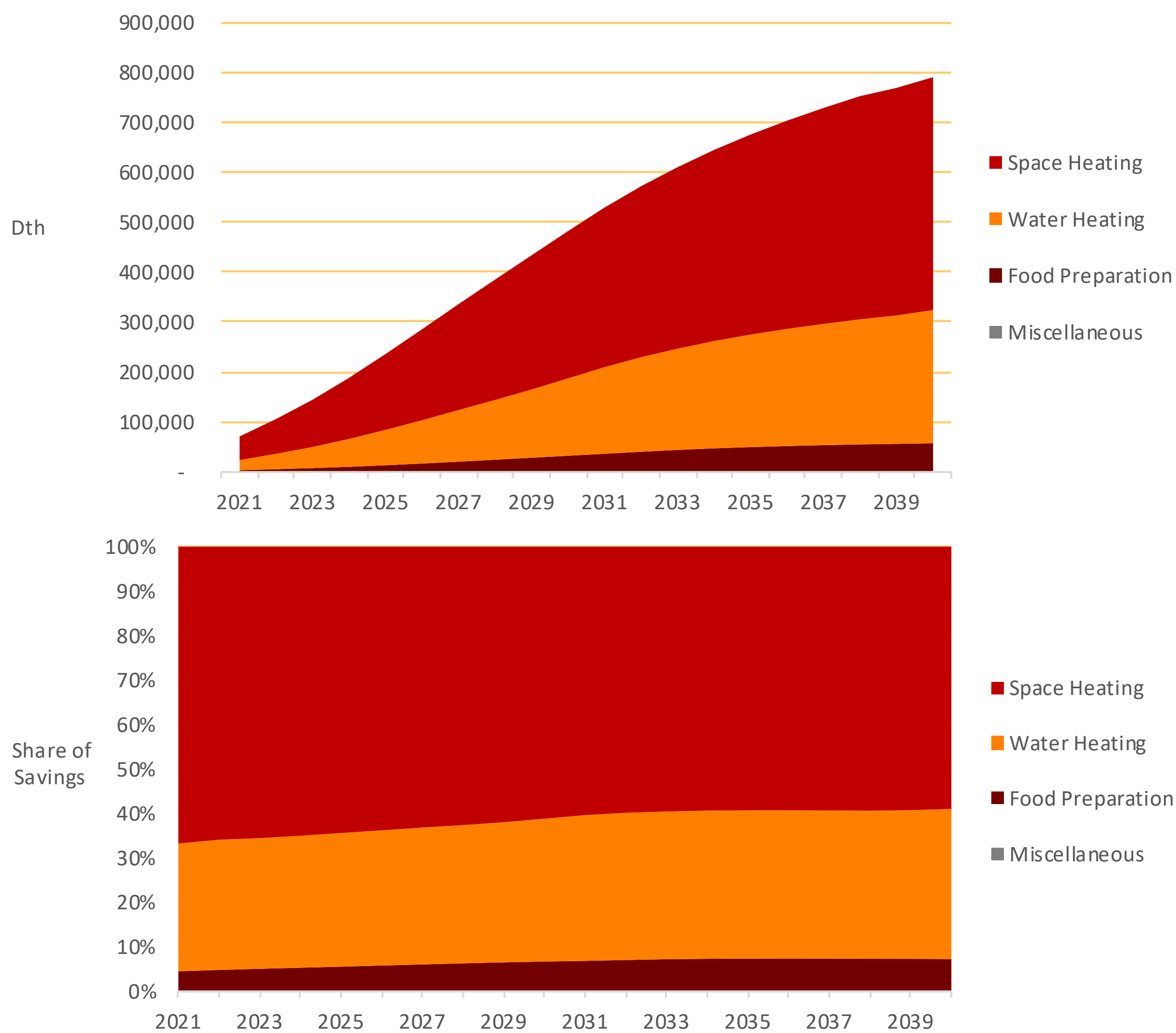


Table 6-6 identifies the top 20 commercial measures by cumulative savings in 2021 and 2022. Heat Pump Water Heaters are the top measure, followed by several HVAC and space heating measures, along with insulation.

Table 6-6 Commercial Top Measures in 2021 and 2022, UCT Achievable Economic Potential, Washington (dekatherms)

Rank	Measure / Technology	2018 Cumulative Potential Savings (dekatherms)	% of Total	2019 Cumulative Potential Savings (dekatherms)	% of Total
1	Water Heater - Gas-Fired Absorption HPWH	5,714	20%	15,883	24%
2	Space Heating - Heat Recovery Ventilator - HRV installed	4,763	17%	9,542	14%
3	Boiler - AFUE 97%	4,136	15%	10,378	16%
4	HVAC - Duct Repair and Sealing - 30% reduced duct leaking	2,323	8%	4,589	7%
5	Insulation - Wall Cavity - R-21	2,059	7%	5,578	8%
6	Insulation - Roof/Ceiling - R-38	1,584	6%	4,318	6%
7	Gas Boiler - Insulate Steam Lines/Condensate Tank - Lines and condenstate tank insulated	1,456	5%	2,871	4%
8	Water Heater - Central Controls - Central water boiler controls installed	1,267	5%	2,508	4%
9	Gas Boiler - Hot Water Reset - Reset control installed	1,127	4%	2,476	4%
10	Gas Boiler - High Turndown - Turndown control installed	766	3%	1,509	2%
11	Fryer - ENERGY STAR	751	3%	1,800	3%
12	Water Heater - Faucet Aerator - 1.5 GPM faucet	362	1%	791	1%
13	Building Automation System - Automation system installed and programmed	360	1%	1,059	2%
14	Kitchen Hood - DCV/MUA - DCV/HUA vent hood	316	1%	629	1%
15	HVAC - Demand Controlled Ventilation - DCV enabled	227	1%	539	1%
16	Furnace - AFUE 96%	129	0%	426	1%
17	Gas Furnace - Maintenance - General cleaning and maintenance	125	0%	211	0%
18	Double Rack Oven - FTSC Qualified (>50% Cooking Efficiency)	96	0%	257	0%
19	Steam Trap Maintenance - Cleaning and maintenance	78	0%	153	0%
20	Oven - ENERGY STAR (>42% Baking Efficiency)	74	0%	196	0%
Subtotal		**27,713**	**99%**	**65,714**	**99%**
Total Savings in Year		**28,070**	**100%**	**66,690**	**100%**

Idaho Potential

Table 6-7 and Figure 6-7 summarize the energy conservation potential for the commercial sector. In 2021, UCT achievable economic potential is 16,775 dekatherms, or 0.4% of the baseline projection. By 2040, cumulative savings are 751,926 dekatherms, or 17.9% of the baseline.

Table 6-7 Commercial Energy Conservation Potential Summary, Idaho

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (dekatherms)	4,027,575	4,047,905	4,093,096	4,112,209	4,199,550
Cumulative Savings (dekatherms)					
UCT Achievable Economic Potential	16,775	40,676	144,201	384,730	751,926
TRC Achievable Economic Potential	11,301	28,926	109,041	295,643	606,619
Achievable Technical Potential	29,482	66,801	216,357	539,726	1,037,584
Technical Potential	81,719	172,678	463,550	952,082	1,503,965
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.4%	1.0%	3.5%	9.4%	17.9%
TRC Achievable Economic Potential	0.3%	0.7%	2.7%	7.2%	14.4%
Achievable Technical Potential	0.7%	1.7%	5.3%	13.1%	24.7%
Technical Potential	2.0%	4.3%	11.3%	23.2%	35.8%

Figure 6-7 Commercial Energy Conservation by Case, Idaho (dekatherms)

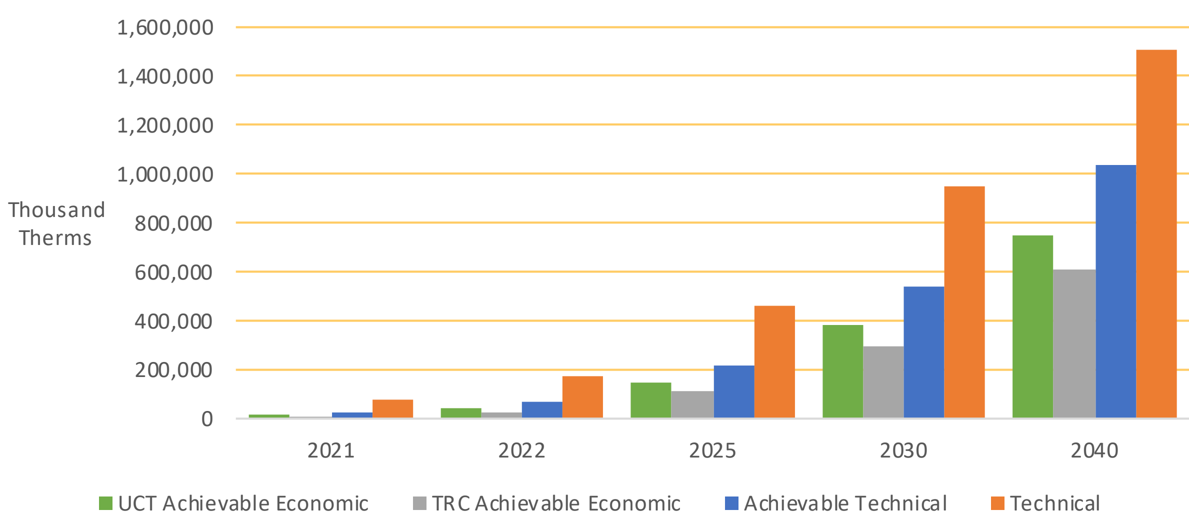


Figure 6-8 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Space heating makes up a majority of the potential early, but food preparation equipment upgrades provide substantial savings opportunities in the later years.

Figure 6-8 Commercial UCT Achievable Economic Potential – Cumulative Savings by End Use, Idaho (dekatherms, % of total)

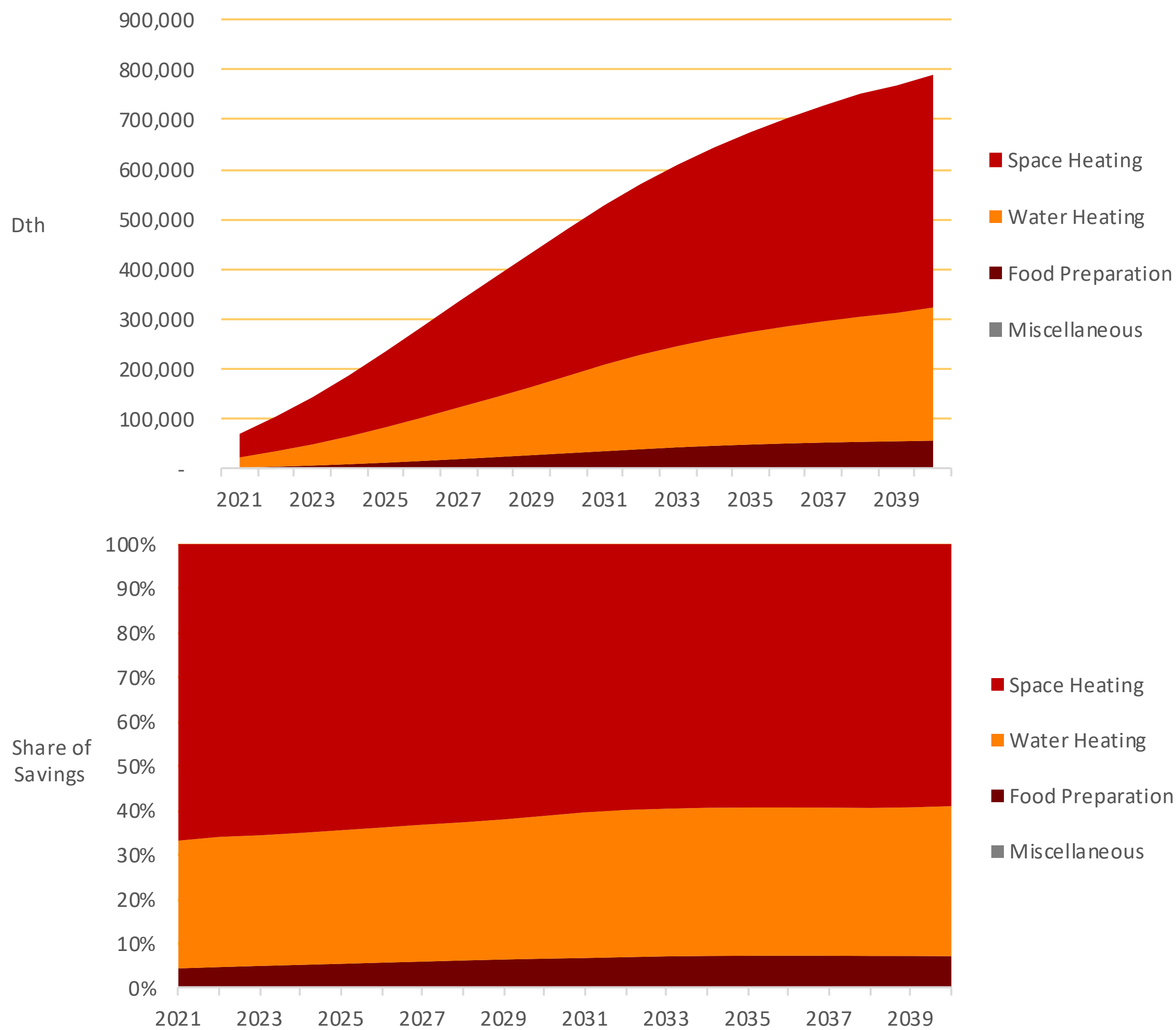


Table 6-8 identifies the top 20 commercial measures by cumulative savings in 2021 and 2022. Water Heaters are the top measure, followed by custom HVAC measures and insulation.

Table 6-8 Commercial Top Measures in 2021 and 2022, UCT Achievable Economic Potential, Idaho (dekatherms)

Rank	Measure / Technology	2021 Cumulative Potential Savings (dekatherms)	% of Total	2022 Cumulative Potential Savings (dekatherms)	% of Total
1	Water Heater - Gas-Fired Absorption HPWH	3,140	19%	9,188	23%
2	Space Heating - Heat Recovery Ventilator - HRV installed	2,806	17%	5,620	14%
3	Boiler - AFUE 97%	2,507	15%	6,733	17%
4	HVAC - Duct Repair and Sealing - 30% reduced duct leaking	1,454	9%	2,872	7%
5	Insulation - Wall Cavity - R-21	1,279	8%	3,464	9%
6	Gas Boiler - Insulate Steam Lines/Condensate Tank - Lines and condenstate tank insulated	1,062	6%	2,094	5%
7	Insulation - Roof/Ceiling - R-38	924	6%	2,506	6%
8	Gas Boiler - Hot Water Reset - Reset control installed	695	4%	1,526	4%
9	Water Heater - Central Controls - Central water boiler controls installed	634	4%	1,258	3%
10	Gas Boiler - High Turndown - Turndown control installed	465	3%	915	2%
11	Fryer - ENERGY STAR	458	3%	1,145	3%
12	Building Automation System - Automation system installed and programmed	230	1%	676	2%
13	Water Heater - Faucet Aerator - 1.5 GPM faucet	218	1%	477	1%
14	Kitchen Hood - DCV/MUA - DCV/HUA vent hood	214	1%	426	1%
15	HVAC - Demand Controlled Ventilation - DCV enabled	142	1%	334	1%
16	Furnace - AFUE 96%	89	1%	304	1%
17	Gas Furnace - Maintenance - General cleaning and maintenance	78	0%	132	0%
18	Double Rack Oven - FTSC Qualified (>50% Cooking Efficiency)	67	0%	186	0%
19	Steam Trap Maintenance - Cleaning and maintenance	55	0%	109	0%
20	Oven - ENERGY STAR (>42% Baking Efficiency)	52	0%	141	0%
Subtotal		**16,567**	**99%**	**40,107**	**99%**
Total Savings in Year		**16,775**	**100%**	**40,676**	**100%**

Industrial Sector

Washington Potential

Table 6-9 and Figure 6-9 summarize the energy conservation potential for the core industrial sector. In 2021, UCT achievable economic potential is 2,206 dekatherms, or 0.6% of the baseline projection. By 2040, cumulative savings reach 24,876 dekatherms, or 8.5% of the baseline. Industrial potential is a lower percentage of overall baseline compared to the residential and commercial sectors. While large, custom process optimization and controls measures are present in potential, these are not applicable to all processes which limits potential at the technical level. Additionally, since the largest customers were excluded from this analysis due to their status as transport-only customers making them ineligible to participate in energy efficiency programs for the utility, the remaining customers are smaller and tend to have lower process end-use shares, further lowering industrial potential. As seen in the figure below, industrial potential is substantially lower due to the smaller sector size and process uses.

Table 6-9 Industrial Energy Conservation Potential Summary, Washington (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (dekatherms)	341,870	338,961	331,037	317,863	291,665
Cumulative Savings (dekatherms)					
UCT Achievable Economic Potential	2,206	4,424	11,200	19,428	24,876
TRC Achievable Economic Potential	321	669	1,899	4,508	7,639
Achievable Technical Potential	2,616	5,219	13,165	23,081	29,280
Technical Potential	3,226	6,425	16,116	28,082	35,546
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.6%	1.3%	3.4%	6.1%	8.5%
TRC Achievable Economic Potential	0.1%	0.2%	0.6%	1.4%	2.6%
Achievable Technical Potential	0.8%	1.5%	4.0%	7.3%	10.0%
Technical Potential	0.9%	1.9%	4.9%	8.8%	12.2%

Figure 6-9 Industrial Energy Conservation Potential, Washington (dekatherms)

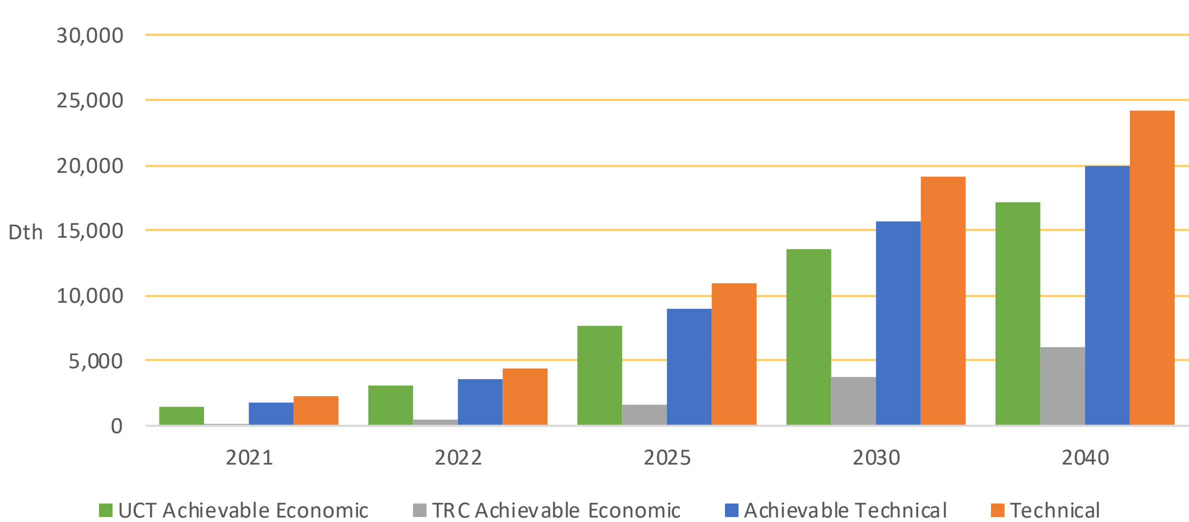


Figure 6-10 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings.

Figure 6-10 Industrial UCT Achievable Economic Potential – Cumulative Savings by End Use, Washington (dekatherms, % of total)

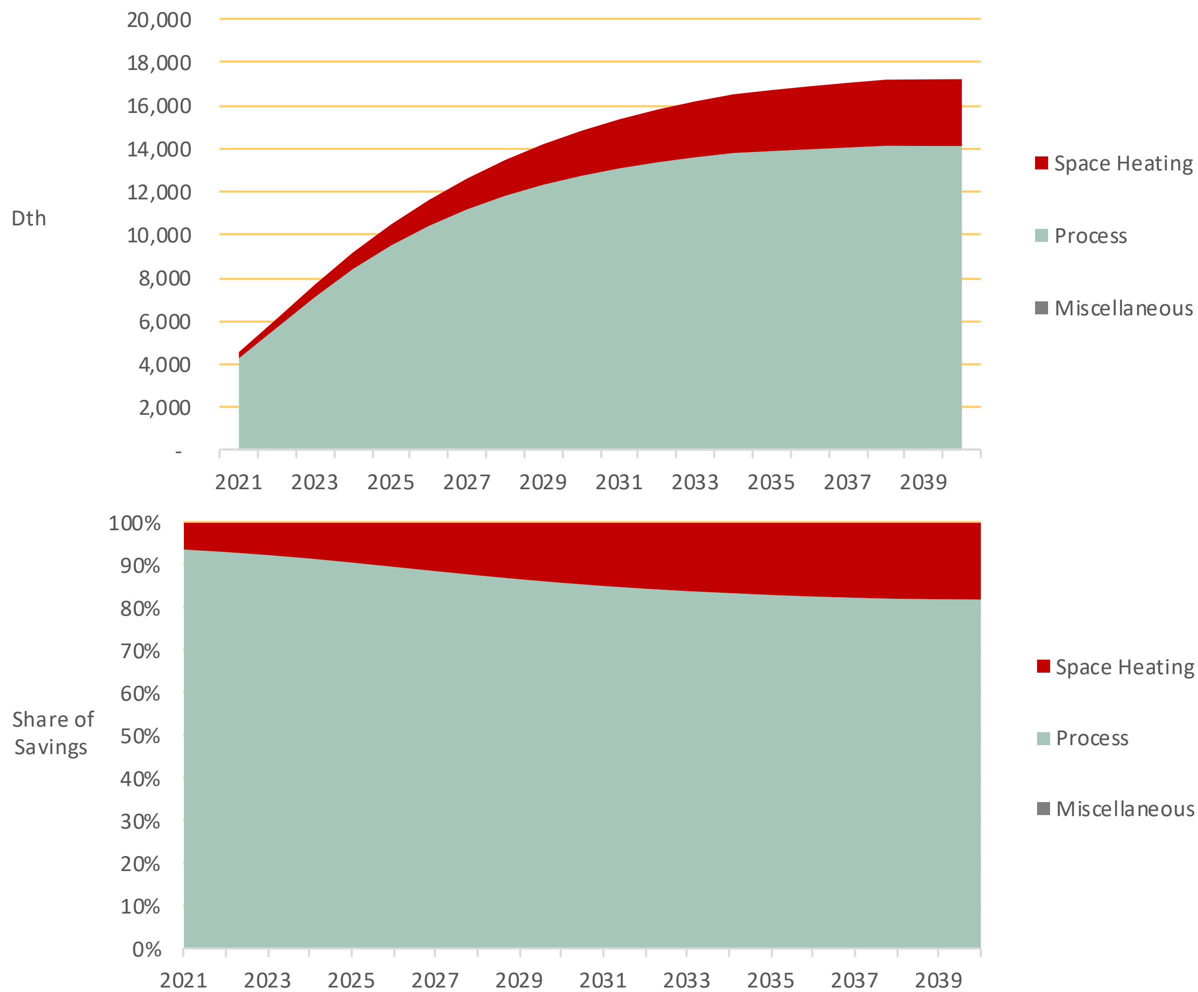


Table 6-10 identifies the top 20 industrial measures by cumulative 2021 and 2022 savings. Process Heat Recovery and Retrocommissioning optimization measures have the largest potential savings. Process Heat Recovery alone accounts for more than 70% of 2021-2022 industrial potential in Washington.

Table 6-10 Industrial Top Measures in 2021 and 2022, UCT Achievable Economic Potential, Washington (dekatherms)

Rank	Measure / Technology	2021 Cumulative Potential Savings (dekatherms)	% of Total	2022 Cumulative Potential Savings (dekatherms)	% of Total
1	Process Heat Recovery - HR system installed	1,691	72%	3,366	71%
2	Retrocommissioning - Optimized HVAC flow and controls	156	7%	306	6%
3	Retrocommissioning - Optimized process design and controls	156	7%	306	6%
4	Gas Boiler - High Turndown - Turndown control installed	112	5%	222	5%
5	Gas Boiler - Hot Water Reset - Reset control installed	111	5%	244	5%
6	Destratification Fans (HVLS) - Fans installed	40	2%	79	2%
7	Gas Boiler - Insulate Steam Lines/Condensate Tank - Lines and condenstate tank insulated	28	1%	55	1%
8	Gas Boiler - Insulate Hot Water Lines - Insulated water lines	19	1%	37	1%
9	ENERGY STAR Connected Thermostat - Wi-Fi/interactive thermostat installed	17	1%	34	1%
10	Space Heating - Heat Recovery Ventilator - HRV installed	15	1%	30	1%
11	Boiler - AFUE 97%	5	0%	14	0%
12	Insulation - Wall Cavity - R-21	4	0%	10	0%
13	Furnace - AFUE 96%	3	0%	10	0%
14	Gas Furnace - Maintenance - General cleaning and maintenance	2	0%	4	0%
15	Thermostat - Programmable - Programmable thermostat installed	2	0%	4	0%
16	Steam Trap Maintenance - Cleaning and maintenance	1	0%	1	0%
17	Unit Heater - Infrared Radiant	0	0%	1	0%
18	Insulation - Roof/Ceiling - R-38	0	0%	0	0%
Subtotal		**2,362**	**100%**	**4,725**	**100%**
Total Savings in Year		**2,362**	**100%**	**4,730**	**100%**

Idaho Potential

Table 6-11 and Figure 6-11 summarize the energy conservation potential for the core industrial sector. In 2021, UCT achievable economic potential is 1,512 dekatherms, or 0.6% of the baseline projection. By 2040, cumulative savings reach 19,908 dekatherms, or 10.3% of the baseline. Industrial potential is a lower percentage of overall baseline compared to the residential and commercial sectors. While large, custom process optimization and controls measures are present in potential, these are not applicable to all processes which limits potential at the technical level. Additionally, since the largest customers were excluded from this analysis due to their status as transport-only customers making them ineligible to participate in energy efficiency programs for the utility, the remaining customers are smaller and tend to have lower process end-use shares, further lowering industrial potential. As seen in the figure below, industrial potential is substantially lower due to the smaller sector size and process uses.

Table 6-11 Industrial Energy Conservation Potential Summary, Idaho (dekatherms)

Scenario	2021	2022	2025	2030	2040
Baseline Forecast (dekatherms)	234,049	232,058	225,549	214,701	193,107
Cumulative Savings (dekatherms)					
UCT Achievable Economic Potential	1,512	3,030	7,703	13,477	17,202
TRC Achievable Economic Potential	220	463	1,557	3,767	6,036
Achievable Technical Potential	1,791	3,573	8,996	15,731	19,908
Technical Potential	2,209	4,398	11,000	19,113	24,123
Energy Savings (% of Baseline)					
UCT Achievable Economic Potential	0.6%	1.3%	3.4%	6.3%	8.9%
TRC Achievable Economic Potential	0.1%	0.2%	0.7%	1.8%	3.1%
Achievable Technical Potential	0.8%	1.5%	4.0%	7.3%	10.3%
Technical Potential	0.9%	1.9%	4.9%	8.9%	12.5%

Figure 6-11 Industrial Energy Conservation Potential, Idaho (dekatherms)

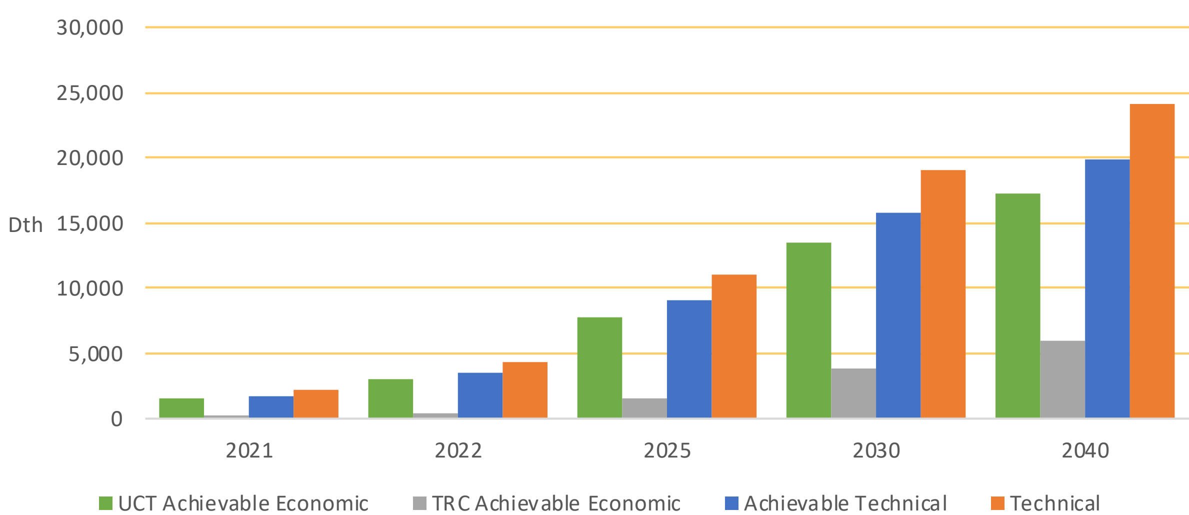
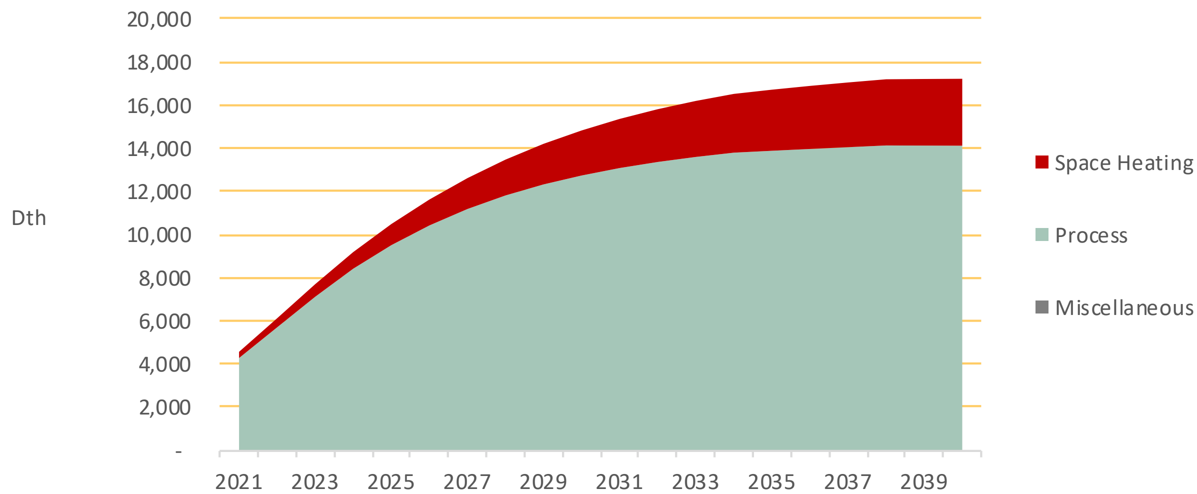


Figure 6-12 presents forecasts of energy savings by end use as a percent of total annual savings and cumulative savings.

Figure 6-12 Industrial UCT Achievable Economic Potential – Cumulative Savings by End Use, Idaho (dekatherms, % of total)



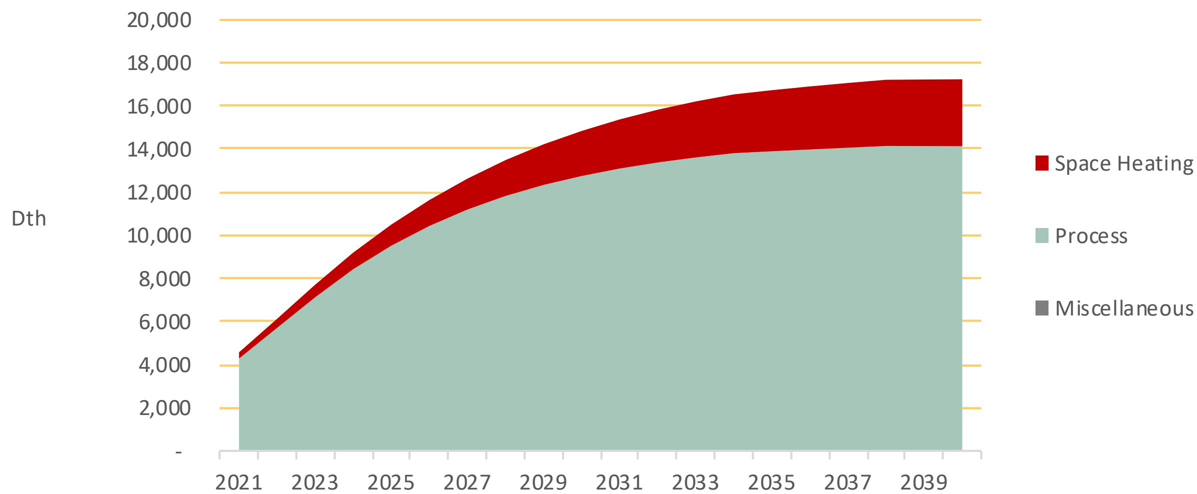


Table 6-12 identifies the top 20 industrial measures by cumulative 2021 and 2022 savings. Much like Washington, Process Heat Recovery is the largest measure by far, accounting for more than 70% of total industrial potential in Idaho.

Table 6-12 Industrial Top Measures in 2018 and 2019, UCT Achievable Economic Potential, Idaho (dekatherms)

Rank	Measure / Technology	2021 Cumulative Potential Savings (dekatherms)	% of Total	2022 Cumulative Potential Savings (dekatherms)	% of Total
1	Process Heat Recovery - HR system installed	1,158	72%	2,304	71%
2	Retrocommissioning - Optimized HVAC flow and controls	107	7%	210	6%
3	Retrocommissioning - Optimized process design and controls	107	7%	210	6%
4	Gas Boiler - High Turndown - Turndown control installed	77	5%	152	5%
5	Gas Boiler - Hot Water Reset - Reset control installed	76	5%	167	5%
6	Destratification Fans (HVLS) - Fans installed	27	2%	54	2%
7	Gas Boiler - Insulate Steam Lines/Condensate Tank - Lines and condenstate tank insulated	19	1%	38	1%
8	Gas Boiler - Insulate Hot Water Lines - Insulated water lines	13	1%	25	1%
9	ENERGY STAR Connected Thermostat - Wi-Fi/interactive thermostat installed	12	1%	23	1%
10	Space Heating - Heat Recovery Ventilator - HRV installed	10	1%	21	1%
11	Boiler - AFUE 97%	3	0%	10	0%
12	Insulation - Wall Cavity - R-21	3	0%	7	0%
13	Furnace - AFUE 96%	2	0%	7	0%
14	Building Automation System - Automation system installed and programmed	2	0%	5	0%
15	Gas Furnace - Maintenance - General cleaning and maintenance	2	0%	3	0%
16	Thermostat - Programmable - Programmable thermostat installed	1	0%	3	0%
17	Steam Trap Maintenance - Cleaning and maintenance	1	0%	1	0%
18	Unit Heater - Infrared Radiant	0	0%	1	0%
Subtotal		**1,619**	**100%**	**3,240**	**100%**
Total Savings in Year		**1,619**	**100%**	**3,240**	**100%**

Incorporating the Total Resource Cost Test

In addition to the UCT, LoadMAP has been configured to evaluate potential using the TRC. This test focuses on impacts for both the utility and customer, which is an alternative frame of reference from the UCT. The TRC includes the full measure cost (incremental for lost opportunities, full cost for retrofits), which is generally substantially higher than the incentive cost included within the UCT. The TRC does include one additional value stream that the UCT does not, non-energy impacts. This test is fully incorporated into LoadMAP and prepared for Avista to use in the event the Company feels a "fully balanced" TRC is identified.

In accordance with Council methodology, these impacts must be quantified and monetized, meaning impacts such as personal comfort, which are difficult to assign a value to, are not included. What this does include are additional savings including water reductions due to low-flow measures or reduced detergent requirements to wash clothes in a high-efficiency clothes washer. AEG has incorporated these impacts as they are available in source documentation, such as RTF UES workbooks.

Some impacts are already included within Avista's avoided costs. These include the 10% conservation credit applied by the Council for infrastructure benefits of efficiency. The future prices of carbon are also included. Per TRC methodology, as these impacts are already captured within the avoided costs provided to AEG, we did not incorporate them a second time outside the costs.

Another set of impacts captured within Council methodology include the Simplified Energy Enthalpy Model (SEEM) "calibration credits". The Council calibrates this energy model using metered end-use energy consumption to reflect actual conditions. While these are technically energy impacts, they are not captured as a benefit to a natural-gas utility as they are instead an impact on the customer. The Council then assumes the difference between the uncalibrated and calibrated models represents the impacts of secondary heating by different fuels present in the home. In the Council's case, these could be small gas heaters or wood stoves present alongside an electric forced-air furnace. For Avista, AEG followed a similar methodology, but instead applied the calibration percent impact to estimated gas-heating savings rather than electric. To monetize these impacts, we incorporated the latest Mid C energy prices, including carbon impacts, from the RTF's website, adjusted for differences in efficiency between electric and natural gas heating equipment (e.g. converted therm savings from an AFUE 80% baseline to kWh savings from an EF 0.97 resistance heater baseline). We applied these impacts to many non-equipment measures with space heating impacts in all sectors as well as to residential space heating equipment, which was the primary use for the Council.

Finally, AEG identified additional non-gas end uses which may be impacted by gas efficiency measures. These include impacts from other end uses, such as cooling savings due to efficient shell measures or lighting savings due to a comprehensive retrocommissioning or strategic energy management program. Like the calibration credit above, these do not have a benefit to a natural-gas utility but do to the customer. It is worth a note of caution when incorporating these impacts. Certain comprehensive building measures, such as retrocommissioning and strategic energy management have very large electric impacts that may be greater than the original estimated gas impacts. LED lighting is a very popular technology within electric utility-programs and can have massive impacts. Commercial HVAC retrocommissioning (RCx) includes both cooling and ventilation electric impacts, which could outweigh the gas space heating impacts. To realize these cost-effective savings, Avista would need to offer a comprehensive RCx program affecting both electric and natural gas end uses.

7

COMPARISON WITH CURRENT PROGRAMS

One of the goals of this study is to inform targets for future programs. As such, AEG conducted an in-depth comparison of the CPA's 2021 UCT Achievable Economic Potential with Avista's 2019 accomplishments at the sector-level. This involved assigning each measure within the CPA to an existing Avista program.

Washington Comparison with 2019 Programs

Residential Sector

Table 7-1 summarizes Avista's 2019 residential accomplishments and the 2021 UCT Achievable Economic potential estimates from LoadMAP. The LoadMAP estimate of 32,164 dekatherms is lower than Avista's 2019 accomplishments at 49,161 dekatherms.

Table 7-1 Comparison of Avista's Washington Residential Programs with 2018 UCT Achievable Economic Potential (dekatherms)

Program Group	2019 Accomplishments (dekatherms)	LoadMAP 2021 UCT (dekatherms)
Furnace	31,172	21,548
Boiler	433	51
Water Heater	3,303	1,901
ENERGY STAR Homes	67	47
Smart Thermostat	3,822	4,435
Ceiling Insulation	3,762	3,611
Wall Insulation	447	333
Floor Insulation	342	0
Doors	93	0
Windows	5,556	0
Air Sealing	134	163
Duct Insulation	10	0
Duct Sealing	21	0
Showerheads	0	75
Miscellaneous	1	0
Program Total	**49,161**	**32,164**

The main reason that potential is lower is that the baseline assumed for forced-air furnaces is adjusted in the following ways.

- The 2015 Washington State Energy Code (WSEC) prescribes very efficient building shell requirements, which substantially reduces the consumption of a new home. Since every new home requires a lost opportunity purchasing decision when constructed, they make up a large portion of the potential. The lower unit energy savings in new homes due to lower heating requirements reduces the unit energy savings (UES) from this measure.
- Another reason is the incorporation of a market baseline, which assumes not everyone purchases the minimum federal standard in the absence of efficiency programs. This results in approximately 20% of customers purchasing an AFUE 90% and 5% purchasing an AFUE 92% in the baseline, which reduces the average unit energy consumption upon which savings for an AFUE 95% are based,

Additional descriptions for other measure differences are provided below:

- Potential for ENERGY STAR Homes has been reduced due to WSEC 2015. The efficient shell requirements lower space heating savings from the prior estimate, which was made before this code went into effect.
- The most recently updated savings and cost characterizations for water heater and windows are reducing their cost effectiveness in some or all segments.

Commercial and Industrial Sectors

Table 7-2 summarizes Avista's 2019 commercial and industrial accomplishments and the 2021 UCT Achievable Economic potential estimates from LoadMAP. The LoadMAP estimate of 22,537 dekatherms is much higher than Avista's 2019 accomplishments at 7,902 dekatherms.

Table 7-2 Comparison of Avista's Washington Nonresidential Accomplishments with 2021 UCT Achievable Economic Potential (dekatherms)

Program Group	2019 Accomplishments (dekatherms)	LoadMAP 2021 UCT (dekatherms)
HVAC	1,786	11,683
Weatherization	0	3,711
Food Preparation	3,547	1,044
Custom	2,569	6,099
Program Total	**7,902**	**22,537**

The following are key drivers in commercial potential:

- The HVAC category includes both efficient equipment (e.g. boilers) as well as custom HVAC measures.
- Fryer and convection oven potential is substantial due to the high gas consumption of restaurants and Avista's current success with this program. This measure was heavily accelerated in LoadMAP.

Idaho Comparison with 2019 Programs

Residential Sector

Table 7-3 summarizes Avista's 2019 residential accomplishments and the 2021 UCT Achievable Economic potential estimates from LoadMAP. The LoadMAP estimate of 17,117 dekatherms is lower than Avista's 2019 accomplishments at 23,667 dekatherms.

Table 7-3 Comparison of Avista's Idaho Residential Programs with 2021 UCT Achievable Economic Potential (dekatherms)

Program Group	2019 Accomplishments (dekatherms)	LoadMAP 2021 UCT (dekatherms)
Furnace	17,308	14,054
Boiler	247	0
Water Heater	1,735	1,053
ENERGY STAR Homes	40	32
Smart Thermostat	1,931	0
Ceiling Insulation	722	1,643
Wall Insulation	55	142
Floor Insulation	21	0
Doors	4	0
Windows	1,579	0
Air Sealing	21	79
Duct Insulation	1	0
Duct Sealing	2	0
Showerheads	-	114
Miscellaneous	-	0
Program Total	**23,667**	**17,117**

Cost effective measures in LoadMAP show similar potential to Avista's programs, however some measures, such as Smart Thermostats and HE Windows, are not showing as cost effective in 2021 forward in LoadMAP. This is offset somewhat by the fact that, in contrast to Washington, Idaho's energy code does not cannibalize a large portion of the HVAC-related savings, resulting in a much steadier range of potential.

Commercial and Industrial Sectors

Table 7-4 summarizes Avista's 2019 commercial and industrial accomplishments and the 2021 UCT Achievable Economic potential estimates from LoadMAP. The LoadMAP estimate of 14,023 dekatherms is substantially higher than Avista's 2017 accomplishments at 3,024 dekatherms.

Table 7-4 Comparison of Avista's Idaho Nonresidential Accomplishments with 2021 UCT Achievable Economic Potential (dekatherms)

Program Group	2019 Accomplishments (dekatherms)	LoadMAP 2021 UCT (dekatherms)
HVAC	1,337	7,068
Weatherization	0	2,241
Food Preparation	1,273	638
Custom	414	4,075
Program Total	**3,024**	**14,023**

Similar to Washington, many custom HVAC measures were included within the HVAC category to reflect actual accomplishments.

8

COMPARISON WITH PREVIOUS STUDY

Residential Comparison with 2018 CPA

Table 8-1 compares first-year residential potential between Avista's 2018 and 2020 Natural Gas CPAs conducted by AEG. For both states, first year savings are marginally lower (for program categories).

Table 8-1 Comparison of Avista's Residential UCT Achievable Economic Potential between the 2016 and 2018 CPAs (dekatherms)

Program Group	Washington 2018	Washington 2020	Idaho 2018	Idaho 2020
Furnace	19,091	21,548	11,816	14,054
Boiler	619	51	307	0
Water Heater	4,257	1,901	2,014	1,053
ENERGY STAR Homes	294	47	146	32
Smart Thermostat	1,344	4,435	664	0
Ceiling Insulation	1,072	3,611	534	1,643
Wall Insulation	904	333	452	142
Floor Insulation	1,135	0	774	0
Doors	0	0	0	0
Windows	9,426	0	820	0
Air Sealing	0	163	0	79
Duct Insulation	367	0	181	0
Duct Sealing	0	0	0	0
Showerheads	575	75	286	114
Miscellaneous	893	0	362	0
CPA Total	**39,979**	**32,164**	**18,354**	**17,117**

The slight decrease in potential is due to a few factors:

- Baseline efficiency has been improving
- Some measures are no longer cost effective as a result of updates to characterization of costs and savings

Nonresidential Comparison with 2018 CPA

Table 8-2 compares first-year nonresidential potential between Avista's 2018 and 2020 Natural Gas CPAs conducted by AEG. In Washington, the potential is similar, while it is higher in Idaho.

Table 8-2 Comparison of Avista's Nonresidential UCT Achievable Economic Potential between the 2016 and 2018 CPAs (dekatherms)

Program Group	Washington		Idaho	
	2018	2018	2017	2018
HVAC	11,925	11,683	3,769	7,068
Weatherization	1,694	3,711	941	2,241
Food Preparation	2,761	1,044	1,045	638
Custom	4,082	6,099	2,033	4,075
CPA Total	**21,300**	**22,537**	**7,986**	**14,023**

Applied Energy Group, Inc.
500 Ygnacio Valley Road, Suite 250
Walnut Creek, CA 94596

P: 510.982.3525