2015 Electric Integrated Resource Plan

Appendix C – AEG Studies

- Demand Response Study
- Conservation Potential Assessment

Avista Corporation
Commercial & Industrial Demand Response Potential Study

Final Report

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SECTION 1

Introduction

Avista Corporation commissioned Applied Energy Group (AEG), with subcontractor the Brattle Group, to provide an assessment of demand response potential within its commercial and industrial (C&I) sectors in Washington and Idaho. The purpose of this study was to help Avista gain a better understanding of implementing demand response programs in the commercial and industrial sectors, and the corresponding cost and benefits.

This study provides demand response potential and cost estimates, including supply curves, for the 20-year planning horizon of 2016–2035 to inform the development of Avista's 2015 Integrated Resource Plan (IRP). It primarily seeks to develop reliable estimates of the magnitude, timing, and costs of DR resources likely available to Avista over the 20-year planning horizon. The study focuses on resources assumed achievable during the planning horizon, recognizing known market dynamics that may hinder resource acquisition. Study results will be incorporated into Avista's 2015 IRP and subsequent DR planning and program development efforts.

This study focused on developing DR potential and cost estimates for C&I customers only. Avista had recently offered two residential demand response pilot programs that have helped gain a good understanding of residential demand response programs and their costs and benefits in Avista's service territory. Additional assessment of demand response potential for residential customers was outside the scope of the current study. However, as part of this study, Avista was interested in obtaining information from a national review of DR programs offered to residential customers.

This document is organized as follows:

- Section 2 describes the analysis approach and the data sources used to develop potential and cost estimates.
- Section 3 presents market characterization data used for our analysis.
- Section 4 identifies and describes relevant DR programs and presents assumptions on key program parameters.
- Section 5 presents potential and cost results from our analysis.

Analysis Approach

This section describes our analysis approach and the data sources used to develop potential and cost estimates.

The following three steps broadly outline our analysis approach:

1. Segment C&I customers for DR analysis and develop market characteristics (customer count and coincident peak demand values) by segment for the base year and planning period.
2. Identify and describe relevant DR programs and develop assumptions on key program parameters for potential and cost analysis.
3. Assess achievable potential by DR program for the 2016-2035 planning period and estimate program budgets and levelized costs.

We describe these analysis steps throughout the remainder of this chapter.

Market Characterization

The first step in the DR analysis was to segment C&I customers and develop characteristics for each segment.[1] The two relevant characteristics for DR potential analysis are the number of eligible customers in each market segment and their coincident peak demand values.

Segmentation Basis

We used Avista's rate schedules as the basis for C&I customer segmentation. We segmented C&I customers into General Service, Large General Service, and Extra Large General Service classes.[2] Customers in rate schedule no. 11 belong to the "General Service" class, customers in rate schedule no. 21 belong to the "Large General Service" class and customers in rate schedule no. 25 belong to the "Extra Large General Service" class.

We selected 2013 to be the base year for the study since it the latest year for which complete customer count and electricity sales data are available.

Key Market Data

Once the customer segments were defined and the base year was selected, we developed customer count and coincident peak demand values for the three C&I segments. We developed these estimates separately for Washington and Idaho.

We obtained the 2013 customer count and electricity sales data by rate schedule from Avista. We used the electricity sales data to derive coincident peak demand estimates by segment. We did this by calculating load factors for each segment. In order to calculate these load factors, we relied on electricity sales and coincident peak demand values provided in the 2010 load research study conducted by Avista. The study provided electricity sales and coincident peak demand values for General Service, Large General Service, and Extra Large General Service customers for Washington and Idaho, for the year 2010. We used this data to calculate load factors by segment and by state and applied this to the 2013 electricity sales to derive coincident peak demand estimates.

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[1] This study estimates DR potential for C&I customers only. Residential DR potential estimates are outside the scope of this study.

[2] We excluded two largest industrial customers from our analysis. Avista may wish to engage with these two customers directly to gauge their interest in participating in a DR program.

Baseline Projection

Once the base year market characteristics were defined, we developed customer count and coincident peak demand projections by state and segment for the period 2014-2035.

Avista provided customer count and electricity sales projections by rate schedules for Washington and Idaho over the 2014-2019 timeframe. We used this data to calculate the average annual growth in customer count and sales. We then applied these same average annual growth rates to develop customer count and sales projections over the 2020-2035 timeframe. For General Service customers, however, this method produced an inaccurate growth rate due to near-term changes in the customer mix. We therefore developed a more reasonable growth rate in collaboration with Avista to project the trends for 2020-2035.

Once the electricity sales projections were developed, we applied the calculated load factors from the earlier step to develop coincident peak demand projections by segment and by state. We assumed that load factor for a particular customer segment in a state remains unchanged from the 2010 value for the 2016-2035 planning period.

End Use Saturation

Another key component of market characterization for DR analysis is electric space heating and water heating saturation data. This is required to further segment the market and identify eligible customers for direct control of electric space heating and water heating equipment. We obtained saturation data from the Conservation Potential Assessment study conducted by Avista in 2013. We assumed water heating and electric space heating saturation values remain constant over the analysis timeframe.

Section 3 of the report presents customer count, coincident peak demand and saturation data by customer segment.

DR Program Descriptions

Once we completed the market characterization, we focused on identification of relevant DR programs for Avista’s commercial and industrial customers.

In order to conduct this task, we initially prepared a universal list of DR programs that could be considered relevant for Avista. This initial list was based on a national review of different DR program types currently offered in the industry. We used the 2012 national DR program survey database, published by FERC, to conduct this task.

We selected representative program examples within each type of program and further researched these programs. We presented the universal list of relevant DR programs in a memo to Avista and followed it up with a research report that summarized key findings from our research.

Subsequently, our team (AEG and Brattle) participated in a workshop with Avista to discuss these options and obtain Avista’s feedback. Based on guidance received from Avista, we modified our programs list and proceeded to develop detailed descriptions of programs included in that list.

Key Program Parameters

We developed assumptions on key program parameters used to estimate DR programs savings and costs. These parameters include program participation rates, per participant load reductions, and program costs.

We relied on secondary data sources and the AEG-Brattle team’s collective experience to develop these assumptions. The primary data source for DR programs was the 2012 FERC national DR program survey database. We combined the FERC survey data with other relevant data source from EIA Form 861 and FERC Form 1 to develop data on key program parameters.

We also used individual program evaluation reports, wherever available. For pricing programs, we relied on Brattle’s extensive database that includes information compiled from a very large number of national and international pricing programs and pilots.

We developed detailed itemized assumptions on various fixed and variable cost components including program development costs, annual program administration costs, marketing and recruitment costs, costs for purchase and installation of enabling technology, annual O&M costs, and participant incentives. These cost assumptions are informed by our team's consultation with industry experts involved in actual program implementation. We also relied heavily on inputs provided by Avista to develop these assumptions.

Appendix A summarizes the key findings from our review of DR programs. Section 4 provides detailed descriptions of key program features and presents assumptions on key program parameters that are used to develop potential and cost estimates.

Participation Rates

The steady-state participation assumptions are based on an extensive database of existing program information and insights from market research results, and represent "best-practices" estimates for participation in these programs. This approach is commonly followed in the industry for arriving at achievable potential estimates. However, practical implementation experience suggests that uncertainties in factors such as market conditions, regulatory climate, and economic environment are likely to influence customer participation in DR.

Once initiated, DR options require a time period to ramp up and reach a steady state because customers need time for education, marketing, and recruitment, in addition to the physical implementation and installation of any hardware, software, telemetry, or other equipment. You cannot merely flip a switch on human behavior, so the customer engagement aspect of these options must be carefully considered.

In this analysis, we model programs as ramping up generally in a three-year to five-year timeframe to their steady state, which is typical of industry experience. For direct load control and pricing options, participation is assumed to ramp up following an "S-shaped" diffusion curve over a five-year timeframe. The rate of participation growth accelerates over the first half of the five-year period, and then slows over the second half. For the Firm Curtailment option, which is typically third-party delivered over shorter contract periods of three to five years, participation is assumed to ramp up linearly within a three-year timeframe. An annual attrition rate of 1% is uniformly applied to participants across all options to account for customers dropping out of the programs.

Potential and Cost Estimates

The last step in our analysis was to calculate savings from DR programs and estimate costs for achieving these savings. We conducted our analysis in two stages. We developed savings and cost estimates for individual DR programs considered on a standalone basis. This does not take into consideration any participation overlap that may occur if Avista were to implement multiple programs simultaneously. Therefore, the potential and cost estimates for individual DR options are not additive as there would be some amount of overlap among the target market of participating customers. We expect this effect to be relatively small among customers.

We then used itemized cost assumptions to estimate total and annual program budgets, calculate levelized costs for DR programs, and develop resource supply curves.

Section 5 presents potential and cost analysis results.

Market Characterization

The first step in the DR analysis was to segment C&I customers and develop customer count and peak demand values for the base year and the 2016-2035 planning period. This section presents the C&I segments selected for our analysis and shows the customer count and coincident peak demand values for these segments. We have also included electric space heating and water heating saturation values that are relevant for the DR analysis.

Market Segmentation

We segmented C&I customers into two dimensions: by state and customer class. Table 3-1 summarizes the market segmentation we developed for this study.

Table 3-1 Market Segmentation

Market Dimension	Segmentation Variable	Description
1	State	Idaho, Washington
2	Customer Class	By rate schedule: General Service: Rate Schedule 11 Large General Service: Rate Schedule 21 Extra Large General Service: Rate Schedule 25 [3]

We excluded Avista's two largest industrial customers from our analysis. To accurately estimate demand reduction potential for these customers, we would need to develop a detailed understanding of their industrial processes and associated possibilities for load reduction and develop specific DR potential estimates for each customer. The common approach followed to estimate potential for other customers does not apply to these extremely large customers, and therefore we did not include them in the analysis. However, Avista may wish to engage with these two customers directly to gauge their interest in participating in a DR program.

Customer Count by Segment

Once we segmented the market, we developed customer counts for the base year and forecast years included in the analysis. We considered 2013 as the base year for the study, since this is the most recent year with 12 months of available customer data, and 2016 to 2035 as the forecast years.

Avista provided us with actual customer counts by rate schedule for 2013 and forecasts for 2014 to 2019. We calculated the average annual growth rate for each customer class over that period and used the average to project the number of customers in 2020-2035.

Table 3-2 below shows customer count data by state for the base year and selected future years.

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

Table 3-2 Baseline C&I Customer Forecast by State and Customer Class

Customer Class	2013	2016	2020	2025	2030	2035
Washington						
General Service	20,983	22,309	23,517	25,515	27,683	30,035
Large General Service	1,983	1,954	1,949	1,925	1,901	1,877
Extra Large General Service	20	20	20	20	20	19
Total C&I	**22,987**	**24,283**	**25,486**	**27,459**	**29,603**	**31,931**
Idaho						
General Service	15,532	15,991	16,946	18,158	19,457	20,849
Large General Service	1,127	1,127	1,126	1,117	1,109	1,101
Extra Large General Service	9	9	9	9	9	9
Total C&I	**16,531**	**16,893**	**18,081**	**19,285**	**20,575**	**21,959**

System and Coincident Peak Demand by Segment

The next step in market characterization was to define peak forecasts for each customer segment. Avista provided us with 2013 system peak demand value and peak forecasts for 2015 through 2035. Table 3-3 shows the system peak demand for the base year and selected future years. The overall system peak demand values in the table represent the total demand on Avista's system. The "weather sensitive" peak represents the overall system peak demand minus the demand for Avista's two largest industrial customers.

Table 3-3 Baseline System Peak Forecast (MW @Generator)[4]

Peak Demand	2013	2016	2020	2025	2030	2035
Overall System Peak	1,669	1,718	1,768	1,828	1,891	1,995
Weather-sensitive Peak	1,569	1,590	1,640	1,700	1,763	1,827

To develop the coincident peak forecast for each segment, we started with electricity sales by customer class. Avista provided electricity sales by rate schedule for the 2013 through 2019. For General Service customers, Avista provided projected average annual sales growth for Washington and Idaho.[5] For Large General Service and Extra Large General Service customers, we projected electricity sales for 2019 through 2035 using the average annual growth rate over the 2014-2019 timeframe.

Next, we applied load factors by customer class and state to the electricity sales forecast to calculate coincident peak demand. To estimate the load factors, we used data from Avista's 2010 load research study which provided coincident peak demand and electricity sales by state and customer class. Table 3-4 below shows the load factors and coincident peak values for the base year and selected future years.

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

[5] Based on information from Avista, we directly used an average of 0.8% sales growth for GS customers in Washington and an average 1.4% sales growth for GS customers in Idaho for the 2019-2035 period

Table 3-4 Load Factors and Baseline Coincident Peak Forecast by Segment (MW @Meter)

Segment Level Coincident Peaks	*Load Factor*	2013	2016	2020	2025	2030	2035
Washington							
General Service	*0.64*	75	76	78	81	85	88
Large General Service	*0.75*	193	193	193	188	184	179
Extra Large General Service	*0.79*	86	89	93	92	90	89
Total C&I	***n/a***	**354**	**359**	**364**	**361**	**358**	**356**
Idaho							
General Service	*0.80*	60	60	64	69	74	79
Large General Service	*0.82*	105	103	103	102	101	100
Extra Large General Service	*0.79*	43	48	51	57	64	72
Total C&I	***n/a***	**207**	**211**	**218**	**227**	**238**	**251**

Saturation Assumptions for Relevant End-Uses

Another important factor in Avista market characterization is the saturation level of relevant end uses included in the DR analysis: electric space heating and water heating. The two relevant space heating equipment for DR analysis are central furnaces and heat pumps. The saturations are relevant for estimating savings from direct-load control programs which are applicable to General Service and Large General Service customers (see Section 4). Table 3-5 below shows saturation estimates by state and customer class. We obtained all saturation values from the Conservation Potential Assessment study conducted by Avista in 2013.

Table 3-5 Electric Space Heating and Water Heating Saturation by State and Customer Class

End-use Saturation by Equipment Type	General Service	Large General Service
Space Heating Saturation for Washington		
Heat Pump	3.6%	9.1%
Central Furnace	17.7%	12.7%
Total (Applicable for DR Analysis)	*21.3%*	*21.8%*
Space Heating Saturation for Idaho		
Heat Pump	3.6%	9.1%
Central Furnace	17.7%	12.7%
Total (Applicable for DR Analysis)	*21.3%*	*21.8%*
Water Heating Saturation for Washington		
All equipment	63.0%	54.2%
Water Heating Saturation for Idaho		
All equipment	54.2%	54.2%

DR Program Descriptions

This section identifies and describes the relevant Demand Response programs for Avista. It highlights the key features for each program and presents assumptions on program parameters that are required for potential and cost calculations. Program features describe characteristics such as targeted customer segment, typical end-uses controlled, available hours, event notification and duration, type of response, incentive levels to participants, metering requirements and mechanisms for program delivery. These characteristics will help support future DR program design by Avista. In addition to these characteristics, this section presents participation, impact, and cost assumptions for individual DR programs and provides detailed documentation for these assumptions. These assumptions serve as a foundation for potential and cost analysis results presented in Section 5.

Relevant DR Programs

Table 4-1 presents the DR programs included in our analysis, which we developed in consultation with Avista staff. There were other options we considered but the final set is shown below. The different types of DR programs can be broadly classified into two types: non-pricing programs and pricing programs

- Non-pricing programs represent firm, dispatchable resources that Avista could count on to fulfill system resource requirements when needed. The two types of non-pricing programs included in our analysis are Direct Load Control (DLC) and Firm Curtailment (FC) program. DLC programs target space heating and water heating, as described below.
- Dynamic pricing options, on the other hand, represent non-firm resources that may not be available for dispatch when needed. The pricing option considered to be relevant for Avista is Critical Peak Pricing (CPP).

Table 4-1 Relevant DR Programs for Avista

Category	Program	Applicable Customer Class
Non-pricing	Direct Load Control	General Service (GS)
		Large General Service (LGS)
	Firm Curtailment	Large General Service (LGS)
		Extra Large General Service (XLGS)
Pricing	Critical Peak Pricing	General Service (GS)
		Large General Service (LGS)
		Extra Large General Service (XLGS)

In addition to the above options included in the study, we considered three additional options that were qualitatively screened out of the potentials analysis. A listing of these options and the rationale for ultimately not including each is below.

- **Thermal Energy Storage (TES)**. Thermal energy storage technologies are a relatively mature technology that is worthwhile in some niche applications and climates. Otter Tail Power has a successful TES program. However, this option is not well-suite to Avista’s relatively mild climate.

- **Conservation Voltage Reduction (CVR)**. We screened CVR out of the analysis here because Avista is already doing this.
- **DR providing ancillary services (Fast DR).** DR resources for providing ancillary services such as frequency regulation or spinning reserves need to be Auto-DR enabled and possess very fast response times. They need to be available 24x7 with a high degree of reliability. Fast DR is well suited to a number of industries, such as mechanical digesters at paper-pulp mills and rock crushers. The potential for this program option would likely be captured by customers who would enroll in the Firm Curtailment program.

Additional information about TES and Fast DR is provided in Appendix A.

Direct Load Control Program

A DLC program would target Avista's General Service and Large General Service customers in Washington and Idaho. This program would directly control electric space heating load in winter and water heating load throughout the year for these customers through a load control switch or a programmable thermostat for space heating. The two types of space heating equipment that could be controlled are central electric furnaces and heat pumps, which would be cycled on and off during the events. Water heaters would be completely turned off during the DR event period. Water heaters of all sizes are eligible for control. Avista could offer this program beginning in 2016. Typically a DLC program takes five years to ramp up to maximum participation levels. Therefore, it is likely that by 2020 the full potential of this program would be realized. Table 4-2 below describes key DLC program attributes.

Table 4-2 Direct Load Control Program Features

Program Attributes	Description	Comments
Targeted Segment	General Service and Large General Service customers in WA and ID with eligible electric space heating and water heating equipment.	Only heat pumps and central furnaces are eligible for DLC. The combined saturation is the same for Washington and Idaho at 21.3%. Electric water heating saturation is 63% in Washington and 54% in Idaho.
Resource Availability	Space heating is controlled during the winter months (October-April). Most events are likely to be called during the months of December-February when demand is high. Water heating is controlled throughout the year.	October through April are the winter months for Avista. System peak usually occurs in December and demand is significantly high during January and February. Therefore most events are likely to be called during December to February.
Event Notification	Day ahead event notification via email, phone, or SMS.	Avista peaks happen during the early morning hours so participants need to be provided with day-ahead notification.
Maximum Annual Event Hours	60 hours	Based on Duke Energy Carolinas DLC program.
Event Duration	Event duration can range from 4 to 6 hours.	Based on Duke Energy Carolinas and Florida Power and Light's DLC program information.
Type of Response	Space heaters can be cycled or completed turned off during the event period or the temperature can be set using a Programmable Communicating Thermostat. Water heaters are completely shut off during the event period.	

Delivery Mechanism	Avista is responsible for delivering the program.	Most DLC programs in the industry are delivered directly by the utility.
Participant Incentive	$60 annual payment for space heating control during the winter; $50 annual payment for water heating control throughout the year.	Incentive payments to DLC customers are typically in the $20-$100 range. Our assumption is at the midpoint of this range for space heating control. For water heating control, we assumed $4/month incentive for control all year round.
Metering Requirements	Customers can participate with existing meters.	Interval meters are not required to participate.

Direct Load Control Program Assumptions

The key parameters required to estimate potential for a DLC program are participation rate, per participant load reduction and program costs. We have described below our assumptions of these parameters.

Participation Rate

Avista could offer this program from 2016 to General Service and Large General Service customers with eligible space heating and water heating equipment. We used information from the most successful programs identified in the FERC survey to develop these assumptions. Based on industry experience, we estimated that the program would follow an S-shaped ramp and reach steady-state participation level by 2020. Table 4-3 below shows participation rates assumptions.

Table 4-3 DLC Participation Rates (% of eligible customers)

Assumption	Unit	2016	2017	2018	2019	2020-35
Participation Rates	% of eligible customers	1.5%	4.5%	9.0%	13.5%	15.0%

Table 4-4 below describes the basis for the steady-state participation rate and program ramp up period assumptions.

Table 4-4 Basis for Direct Load Control Program Participation Assumptions

Assumption	Unit	Value	Basis for Assumptions
Steady-state Participation Rate	% of eligible customers	15%	Assumed to be slightly larger than the weighted average participation rate of 23 C&I DLC programs reported in the FERC survey database.[6]
Ramp Rate	No. of years required to attain steady-state participation level	5	Interviews with utility program managers; FERC National Assessment of DR Potential database.

DLC Load Reduction

Table 4-5 presents per-participant load reduction for space heating and water heating control and explains the basis for these assumptions.

Table 4-5 Per Participant Impact Assumptions for Direct Load Control Program

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[6] http://www.ferc.gov/industries/electric/indus-act/demand-response/2012/survey.asp

End use and Customer Class	Value (kW)	Basis for Assumptions
Space Heating Control		
General Service	1.50	Values are assumed to be 25% higher than residential impacts from Puget Sound Energy (PSE) residential DLC pilot.
Large General Service	15.0	Assumed to be 15% of the class average coincident demand of 100 kW.
Water Heating Control		
General Service	0.47	Values are assumed to be 25% higher than residential impacts from Puget Sound Energy (PSE) residential DLC pilot.
Large General Service	10.0	Assumed to be 10% of the class average coincident demand of 100 kW.

Program Costs

Table 4-6 presents itemized cost assumptions for the DLC program and the basis for the assumptions.

Table 4-6 DLC Program Cost Assumptions

Assumption	Unit	Value	Basis for Assumption
Program Development Cost	$/program	$150,000	We assumed that 1 FTE (@$150,000 annual cost) is required to develop the DLC program for both WA and ID and the cost is equally split between the two customer classes for each state.
Program Administration Cost	$/year	$150,000	We assumed 1 FTE annual cost for DLC program administration for WA and ID, split equally between the two customer classes.
Annual Marketing and Recruitment Costs (GS)	$/new participant	$100	Standard assumption for residential customers is $50. For small commercial customers, we assumed costs to be 25% higher than the costs for residential.
Annual Marketing and Recruitment Costs (Large GS)	$/new participant	$133	We assumed 33% higher costs for Large General Service customers than comparable costs for General Service customers.
Cost of Equip + Install for Space Heating Control (GS)	$/new participant	$375	Load control switch capital cost = $100. Average of 1.25 control units per customer. Implies capital cost per participant = $125. Switch installation cost = $125. License and permit-related costs = $125 per participant (25% higher than equivalent cost for residential customers at $100).
Cost of Equip + Install for Space Heating Control (Large GS)	$/new participant	$550	Control switch capital and installation cost = $200. License and permit related costs = $150 per participant.
Cost of Equip + Install for Water Heating Control (GS)	$/new participant	$350	Load control switch capital cost= $100. Switch installation cost = $125. One water heating control unit per participant. Implies cost per participant is $225. License and permit related costs = $125 per participant (25% higher than equivalent cost for residential customers at $100).
Cost of Equip + Install for Water Heating Control (Large GS)	$/new participant	$450	Load control switch capital and installation cost = $150 each. License and permit related costs = $150 per participant (50% higher than equivalent cost for residential customers at $100).
Annual O&M cost (GS)	$/participant per year	$15	Annual O&M cost = 10% of the control equipment cost.
Annual O&M cost (Large GS)	$/participant per year	$20	Annual O&M cost = 10% of the control equipment cost.
Per participant annual incentive for Space Heating (GS)	$/participant per year	$60	Incentive payments to DLC customers are typically in the $20-$100 range. Assumed values are at the midpoint of this range.
Per participant annual incentive for Space Heating control (Large GS)	$/participant per year	$160	$1.5/kW monthly incentive payment. For an average 15 kW of reduction per participant, this translates into $160 total incentive payment over seven winter months.
Per participant annual incentive for Water Heating control	$/participant per year	$50	$4/month incentive payment to participants. Water heaters are controlled throughout the year.

Other Assumptions

The other key parameters needed for potential and cost analysis are program life and capacity derating factor. Table 4-7 below describes these assumptions for DLC.

Table 4-7 Direct Load Control Program Lifetime and Capacity Derating Factor

Assumption	Unit	Value	Basis for Assumption
Program Life	Years	8	The DLC program life is tied to the life of the switch. We assumed the control switch life to be 8 years.
Capacity derating factor	Factor	0.8	Capacity derating values generally range from 0.6 to 1.0. We assumed the de-rating factor to be at the midpoint of this range, with a value of 0.8.

Firm Curtailment Program

A Firm Curtailment program would target Large General Service and Extra Large General Service customers in Avista's service territory. Under this program, participating customers agree to reduce demand by a specific amount or curtail their consumption to a pre-specified level. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year). Customers are paid to be on-call even though actual load curtailments may not occur. The amount of capacity payment typically varies with the firm reliability-commitment level. In addition to the fixed capacity payment, participants receive a payment for energy reduction. Because the program includes a contractual agreement for a specific level of load reduction, enrolled loads represent a firm resource and can be counted toward installed capacity (ICAP) requirements. Penalties may be are assessed for under-performance or non-performance.

Industry experiences shows that typically customers with greater than 200 kW demand participate in this type of program. However, there are a few programs where customers with 100 kW maximum demand participate. In Avista's case, we have lowered the demand threshold level to include Large General Service customers with an average demand of 100 kW.

Avista could offer this program from 2016 to eligible customers in Washington and Idaho. Customers with flexibility in their operations are attractive candidates for participation. Examples of customer segments with high participation possibilities include large retail establishments, grocery chains, large offices, refrigerated warehouses, water- and wastewater-treatment plants, and industries with process storage (e.g. pulp and paper, cement manufacturing). Customers with 24x7 operations/continuous processes or with obligations to continue providing service (such as schools and hospitals) are not often good candidates for this option.

Typically Firm Curtailment programs in the industry are delivered through third parties who are responsible for all aspects of program implementation including program marketing and outreach, customer recruitment, technology installation, and incentive payments to participants. Avista would enter into a contract with a third party to deliver a fixed amount of capacity reduction over a certain specified timeframe. The payment to the third party would be based on the contracted capacity reduction and the actual energy reduction during DR events.

Table 4-8 below describes the key attributes for a Firm Curtailment program that could help guide future program design by Avista.

Table 4-8 Firm Curtailment Program Features

Program Attributes	Description	Comments
Targeted Segment	Large General Service and Extra Large General Service customers.	C&I customers with a minimum load of 100 kW are suitable for participation.
Resource Availability	Program is available year round.	Firm curtailment programs are available all year round.
	During the winter months of October to April, events can be called anytime between 6 AM to 10 AM and 4 PM to 8 PM on weekdays.	Events can be called to address dual peak during the winter season.
	During the summer months of May to September, events can be called anytime between 12 noon to 7 PM on weekdays.	Events can be called to address the late afternoon and early evening peak during summer.
Event Notification	Day ahead notification via email, phone or SMS.	Typically, events are called either a day in advance or 30 minutes prior to the event. Participants prefer day-ahead notification.
Maximum Annual Event Hours	60 hours	Typical specification in the industry.
Event Duration	Events can range from 1-8 hours.	Typical specification in the industry.
Type of Response	Non-essential load is curtailed; participants can also shift their usage to backup generators. Participants can either respond manually or have automated response strategies.	Program implementation experience.
Delivery Mechanism	The program is delivered through a third party.	Most utilities deliver Firm Curtailment programs through third parties.
Delivery Cost	Delivery cost consists of two components: 1) $/kW-year capacity payment to the third-party at $70/kW-year 2)Energy payment to the third-party at $110/MWh; Internal program administration cost for Avista is assumed to be approximately 10% of the capacity delivery cost. This increases the overall per-kW delivery cost to $77/kW-year.	Based on third-party program implementation experience, capacity delivery cost is in the $60-80/kW range and energy delivery cost is in the $75-150/MWh range. We are using the midpoint of the ranges. We also assume additional utility administrative costs to account program management, regulatory filings, internal book keeping, etc. These costs are estimated to be 10% of the capacity delivery cost.
Participant Incentive	The third party is responsible for payment of incentives to participants, so incentive cost is part of the delivery cost.	
Metering and Communication Requirements	Preferable to have 5-minute interval data but 15-minute or hourly data are sufficient. Participants should be able to receive and confirm curtailment requests in real time.	Typical specification for this type of program.

Firm Curtailment Program Assumptions

The key parameters required to estimate potential for a Firm Curtailment program are participation rate, per participant load reduction and program costs.

Program Participation Rate

Table 4-9 below shows Form Curtailment program participation assumptions. Based on industry experience, we estimate the program will ramp up to a steady-state participation level over three years, which is the typical contract duration for third-party delivered programs.

As noted in the table above, customers may use back-up generation to achieve load reduction under this program. We estimate that roughly one fourth of the load reduction achieved through this option would be provided by customers with backup generation.

To gain a better understanding of customer generation capabilities, Avista is conducting a separate analysis to estimate the amount of back-up generation in the service area. The results of this analysis may be useful to better understanding the overlap between programs targeted at customers with backup-generation and response to a Firm Curtailment program, should Avista offer these in the future.

Table 4-9 Firm Curtailment Program Participation Rates (% of eligible customers)

Customer Segment	2016	2017	2018	2019	2020-35
Large General Service and Extra Large General Service	7.4%	14.9%	22.3%	22.3%	22.3%

Table 4-10 below describes the basis for the steady-state participation rate and program ramp up assumptions.

Table 4-10 Basis for Firm Curtailment Program Participation Assumptions

Assumption	Unit	Value	Basis for Assumptions
Steady-state participation	% of eligible customers	22.3%	Steady-state participation is the average of 50th and 75th percentile values from a dataset of 7 programs listed in the FERC 2012 DR Program Survey database.[7] We applied a 5% de-rating factor to the average participation level to account for the fact that some facilities with backup generators may not be eligible for participation due to RICE/NESHAP regulations.
Program Ramp Rate	No. of years required to attain steady-state participation level	3	Program implementation experience. This is based on the typical contract duration for a third-party delivered program.

Per Participant Load Reduction

Table 4-11 below presents the assumed per-participant load reduction for a Firm Curtailment program and explains the basis for this assumption. Customer respond by curtailing a variety of end uses customized for their circumstances. Some customers also use back-up generators to achieve the load shed. Therefore, the estimates we present here may overlap with peak-load reduction estimates Avista is developing in a separate study.

Table 4-11 Per Participant Load Reduction Assumption for the Firm Curtailment Program

Assumption	Unit	Value	Basis for Assumption

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[7] http://www.ferc.gov/industries/electric/indus-act/demand-response/2012/survey.asp.
Note that Firm Curtailment programs, primarily delivered by load aggregators, are relatively new and fewer in number than legacy DLC programs. Therefore, the dataset size for these programs is relatively small. Also, participation data is not available for all programs listed in the survey database, which further restricted our choice set for developing participation estimates.

Per-participant load reduction for Large General Service & Extra Large General Service	% of enrolled load	21%	Weighted average impact estimates from aggregator DR programs administered by CA utilities (Ref: 2012 Statewide Load Impact Evaluation of California Aggregator Demand Response Programs Volume 1: Ex post and Ex ante Load Impacts; Christensen Associates Energy Consulting; April 1, 2013). We combined these estimates with data from the 2012 FERC National Survey database of DR programs.

Program Costs

Table 4-12 presents cost assumptions for the Firm Curtailment program. We developed these cost assumptions in consultation with industry experts. The delivery cost shown in the table represents Avista's all-in payment to the contracted third party for delivering a fixed amount of load reduction. It consists of two components: a capacity component and an energy component. The third party is responsible for all program costs including incentive payments to participants. Typically, 50 percent of the delivery cost is passed through as incentive payment to participants. Other than the third-party delivery costs, we assumed that Avista would incur additional internal administration costs for deploying this program.

Table 4-12 Firm Curtailment Program Cost Assumptions

Assumption	Unit	Value	Basis for Assumption
Program Delivery Cost (administered by third party)	$/kW-year	$77	Based on third-party program implementation experience, delivery cost is expected to be in the range of $60-80/kW and we assumed the midpoint This is inclusive of all costs to run the program, including equipment purchase and installation costs, maintenance costs, network communications costs, sales and marketing costs, and payments to the customer. Avista would also incur administrative costs for program management, regulatory filings, internal book keeping, etc. These costs were estimated to be 10% of the capacity delivery costs.
Payment for energy delivery	$/kWh	$0.11	Based on third-party program implementation experience, energy dispatch prices typically fall in the $75-150/MWh range. Our assumed price level is at the midpoint of this range.

Other Assumptions

The other key parameters needed for potential and cost analysis are program life and capacity derating factor. Table 4-13 below describes these assumptions for the Firm Curtailment program.

Table 4-13 Firm Curtailment Program Lifetime and Capacity Derating Factor

Assumption	Unit	Value	Basis for Assumption
Program Life	Years	3	Typical contract duration for third-party delivered Firm Curtailment programs.
Capacity derating factor	Factor	0.8	Capacity derating values generally range from 0.6 to 1.0. We assumed the de-rating factor to be at the midpoint of this range, with a value of 0.8.

Critical Peak Pricing

We considered Critical Peal Pricing (CPP) in our analysis. The CPP option involves significantly higher prices during relatively short critical peak periods on event days only to encourage customers to reduce their usage. CPP is usually offered in conjunction with a time-of-use rate, which implies at least three time periods: critical peak, on peak and off peak. The customer incentive is a more heavily discounted rate during off-peak hours throughout the year (relative to a standard TOU rate). Event days are dispatched on relatively short notice (day ahead or day-of) typically for a limited number of days during the year. Over time, event-trigger criteria become well-established so that customers can expect events based on hot weather or other factors. Events can also be called during times of system contingencies or emergencies. The CPP rate included here is based on a 6:1 peak to off-peak price ratio assumption. We assumed that this rate is offered to all three C&I classes.

We considered two types of offers for CPP. With an **opt-in** rate**,** participants voluntarily enroll in the rate. With an **opt-out** rate, all customers are placed on the time-varying rate but they may oft-out and select another rate if they so desire.

Participation in CPP rates requires AMI. At this time, Avista’s Extra Large General Service customers have sophisticated telemetry and communications infrastructure in place and may be offered CPP rates beginning in 2016. For the other two customer classes, CPP is not available until the AMI rollout is completed in 2020. Therefore, we assumed that CPP rates can be offered to General Service and Large General Service customers starting in 2021.

Studies have shown that impacts from dynamic pricing program vary according to whether customers have enabling technology to automate their response. For General Service and Large General Service customers, the enabling technology is a programmable communicating thermostat (PCT). For Extra Large General Service customers, the enabling technology is Automated Demand Response (Auto-DR), implemented through energy management and control systems.

Table 4-14 describes the features of a CPP rate. If Avista were to offer these rates, it would need to undertake a formal rate design analysis using customer billing data to specify peak and off-peak price levels and define the periods during which these rate would be available. Design of these rates is outside the scope of the current study.

Table 4-14 Critical Peak Pricing Program Features

Program Attributes	Description	Comments
Targeted Segment	General Service, Large General Service and Extra Large General Service customers.	Customers of all sizes are eligible to participate in a CPP program.
Type of Offer	Two types of offers are possible: 1. CPP is offered as a voluntary rate to all customer classes with opt-in provision. 2. CPP is offered as a default rate to all customer classes with opt-out provision.	
Resource Availability	CPP events can be called any time during the year, based on system requirements.	
Event Notification	Day ahead event notification via email, phone, or SMS.	Participants can be notified on either a day-ahead or day-of basis, but day-ahead is preferred.
Maximum Number of CPP Events in a Year	10 to 15	Avista can choose to call more events during winter and fewer or none during summer, as needed.
Maximum Annual Event Hours	60 hours	Industry experience.
Event Duration	Typical event duration is 4 hours.	
Type of Response	Load curtailment and shifting to backup generators. Enabling technology can enhance response. For GS and LGS, enabling technology is assumed to PCT. For Extra Large General Service, enabling technology is assumed to be Auto-DR.	
Delivery Mechanism	Avista is responsible for delivering the program.	
Participant Incentive	The critical peak to off-peak price differential induces participant to reduce usage during critical peak periods. The off-peak rate is lower than the participant's standard rate.	
Metering Requirements	AMI is required for metering and settlement.	

Critical Peak Pricing Assumptions

The key parameters required to estimate potential for CPP are participation rate, per participant load reduction and costs for deploying these rates. We have described below our assumptions for these parameters.

Program Participation Rate

We have defined participation rates for two pricing options, assuming independent offers of CPP rates: voluntary, opt-in CPP rates to all customers and default CPP rates with opt-out.

All participation assumptions are based on Brattle’s extensive database on pricing program and pilot experiences.

Table 4-15 presents assumed participation rates for C&I customers in independent CPP rate offers. Table 4-15 presents assumed participation rates in independent default rate offers for these two options. We assumed that participation ramps up over a five-year timeframe to reach a steady-state level. For the opt-in offer, ramp up to steady-state participation follows an "S-shaped" diffusion curve, in which the participation growth rate accelerates over the first half of the five year period and then slows over the second half. A similar but inverse S-shaped diffusion curve is used to account for the rate at which customers opt-out of the default rate. CPP rates could be offered to Extra Large General service customers in 2016. For the other two classes, these rate are offered after AMI has been fully deployed by 2021.

Table 4-15 Opt-in CPP Participation Rates (% of eligible customers)

Option	Start Yr.	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yrs. 5-19	Comments
Opt-in							Standalone participation estimates represent average enrollment rates in independent rate offerings across full scale deployments and market research studies. (Source: Brattle's Pricing Program Database)
General Service & Large General Service	2021	1.8%	5.4%	10.8%	16.2%	18.0%	
Extra Large General Service	2016	1.8%	5.4%	10.8%	16.2%	18.0%	
Opt-out							
General Service & Large General Service	2021	100%	96.0%	85.7%	65.8%	63.0%	
Extra Large General Service	2016	100%	96.0%	85.7%	65.8%	63.0%	

Percentage of Customers with Enabling Technology in CPP Rates[8]

Earlier we mentioned that the load reductions from CPP participants could be enhanced through the use of enabling technology. Table 4-16 shows the percentage of total CPP participants equipped with enabling technology for the opt-in and opt-out cases. Enabling technology is defined as Programmable Communicating Thermostat (PCT) for General Service and Large General Service customers, and Auto-DR for Extra Large General Service customers.

Table 4-16 Percentage of CPP Participants with Enabling Technology (% of total participants)

Option	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yrs. 5-19
Opt-in CPP	25%	25%	25%	25%	25%
Opt-out CPP	2%	4%	6%	8%	10%

Per Participant Load Reduction

Table 4-17 below presents assumed per participant load reduction in CPP rates by customer class. The assumed impact values are based on a 6:1 critical peak to off-peak price ratio. Estimated load reductions with enabling technology are significantly higher than those achieved without enabling technology use.

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[8] Enabling technology is not included with TOU because the peak period price signal is non-dispatchable.

Table 4-17 Per-Participant Load Reduction in CPP Rates by Customer Class

Customer Class	Value	Comments
GS without enabling technology	0.6%	These impacts assume 6:1 critical peak to off-peak price ratio. Source: Brattle's Database on Pricing Programs.
GS with enabling technology	12.5%	
Large GS without enabling technology	7.3%	
Large GS with enabling technology	11.7%	
Extra Large GS without enabling technology	8.4%	
Extra Large GS with enabling technology	15.6%	

Program Costs

The major cost components for implementation of time varying rates are the fixed annual costs for administering the rates and providing billing analysis. For an opt-out offer, additional call center staff may be required during the initial program years to handle the relatively large volume of calls from customers defaulted to these rates.

Table 4-18 below shows cost assumptions for deployment of opt-in and opt-out CPP rates. The cost items for CPP are similar to those for TOU rates. A major portion of CPP program costs is enabling technology purchase and installation for a fraction of the total participants.

Table 4-18 CPP Program Cost Assumptions for Opt-in and Opt-out Offers

Item	Unit	Value	Comments
Costs Applicable to Opt-in and Opt-out:			
Program Development Cost	$/program	$170,000	One FTE at $170,000 annual cost for program development.
Annual Program Administration Cost	$/year	$170,000	One FTE at $170,000 annual cost to administer the CPP rates
Billing Analyst Cost	$/year	$105,000	One billing analyst at $105,000 in the call center to provide customer service.
Enabling Technology Cost	$/GS participant	$375	We assumed per participant PCT capital and installation cost is the same as DLC.
	$/LGS participant	$550	We assumed per participant PCT capital and installation cost is the same as DLC.
	$/kW load reduction for XLGS	$200	Based on Auto-DR enablement costs from a CA utility.
Billing system upgrade	$	$7.5 million	Avista provided this estimate
Additional costs applicable to Opt-in:			
Per Customer Annual Marketing/Recruitment Cost	$/new GS participant	$100	Same as DLC Program marketing cost.
	$/new LGS participant	$133	For LGS customers, costs are assumed to be a third higher than costs for GS customers.
	$/new XLGS participant	$250	For XLGS customers, costs are assumed to be approximately double the costs for LGS customers.
Additional costs applicable to Opt-out:			
Additional call center staff	$/yr. for first two program years	$255,000	We assumed that 3 additional call center staff at $85,000 each annual cost to handle customer calls for an opt-out rate.
Per Customer Annual Marketing/Recruitment Cost	$/new GS participant	$10	For opt-out CPP rates, these costs are assumed to be one-tenth of the costs for opt-in CPP rates.
	$/new LGS participant	$15	
	$/new XLGS participant	$25	

Other Assumptions

The other key parameters needed for potential and cost analysis are program life and capacity derating factor. Table 4-19 below describes these assumptions for the pricing options.

Table 4-19 Program Lifetime and Capacity Derating Factor for Pricing Options

Item	Unit	Value	Basis for Assumption
Program Life	Years	20	Program life is tied to the life of the interval meter.
Capacity derating factor	Factor	0.5	Load reductions from pricing options are less firm than load reductions from non-pricing options. Therefore we assumed capacity derating factor to be lower at 0.5.

Other Cross-cutting Assumptions

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

- **Discount rate**. We used a nominal discount rate of 7% to calculate the net present value (NPV) of costs over the useful life of each DR program. All cost results are shown in nominal dollars. We assumed 1.86% inflation rate for escalating costs.
- **Line losses**. Avista provided a line loss factor of 6.5% to convert estimated demand savings at the customer meter level to demand savings at the generator level. In the next section, we report our analysis results at the generator level.
- **Snapback**. In this context, snapback refers to the amount of energy savings that result from DR programs. We have assumed in this analysis that the amount of kWh savings from DR programs is negligible since most of the reduction during events is typically shifted to other times of day, either before or after the event.

SECTION 5

DR Potential and Cost Estimates

This section presents analysis results on demand savings and cost estimates for DR programs. We conducted an independent assessment of DR options which considered each option as a standalone offering. As such, this approach does not account for participation overlaps among DR options targeted at the same customer segment and therefore savings and cost results for individual DR options are not additive. The standalone analysis results help provide a comparative assessment of individual DR options and costs and are useful for selection of DR options in a program portfolio.

At the very end of this section, we present high-level results in 2035 after considering integrated effects that occur if more than on DR option is offered to Avista customers.

All potential results presented in this section represent capacity savings in terms of equivalent generation capacity after derating factors have been applied.

Potential Results

Figure 5-1 and Table 5-1 show demand savings from individual DR options for selected years of the analysis. These savings represent combined savings from DR options in Avista's Washington and Idaho service territories.

Key findings include:

- The firm curtailment option has highest savings potential at approximately 2.7-2.8% of estimated C&I peak demand from 2020 onward. We assumed that Avista offers this option to Large General Service and Extra Large General Service customers in 2016 and participation ramps up to a steady state by 2019. Therefore potential remains almost steady from that time onward.
- An opt-out CPP offer has second highest savings potential at approximately 2% of C&I peak demand from 2025 onward. We assumed that Avista could offer this as a default rate to all customer classes after AMI deployment is completed in 2020. Participation ramps up over a five-year time frame and reaches a steady state by 2025. Only Extra Large General Service customers are assumed to have the necessary metering infrastructure in place and could be offered a CPP rate from 2016.
- DLC for General Service and Large General Service customers provides third highest savings potential at approximately 1% of C&I peak demand from 2020 onward. This is offered in 2016 and ramps up to steady-state participation levels by 2020.
- Savings potential from opt-in CPP are approximately 0.7% of the system peak from 2025.

Figure 5-1 Summary Potential Analysis Results for Avista (MW @Generator)

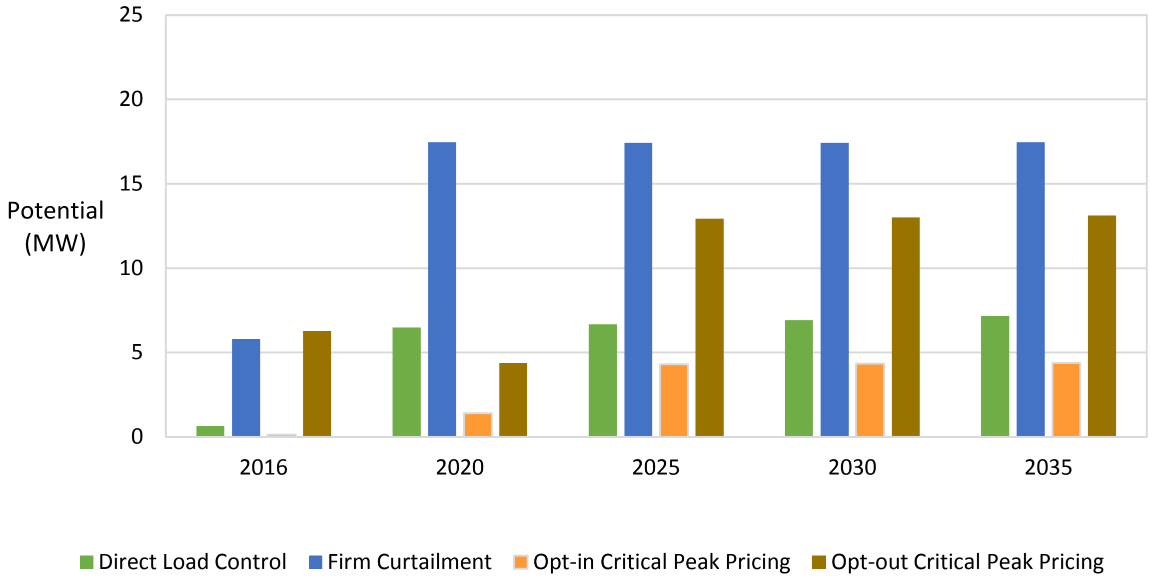

Table 5-1 Achievable DR Potential by Option for Avista (MW @Generator)

	2016	2020	2025	2030	2035
Total System Peak (MW)	**1,718**	**1,768**	**1,828**	**1,891**	**1,995**
Weather Sensitive Peak (MW)	**1,590**	**1,640**	**1,700**	**1,763**	**1,827**
Estimated C&I Peak (MW)	**610**	**622**	**630**	**638**	**649**
Achievable Potential (MW)					
Direct Load Control	0.64	6.48	6.68	6.91	7.16
Firm Curtailment	5.80	17.46	17.42	17.42	17.46
Opt-in Critical Peak Pricing	0.13	1.40	4.30	4.33	4.38
Opt-out Critical Peak Pricing	6.27	4.38	12.93	13.01	13.12
Achievable Potential (% of C&I Peak)					
Direct Load Control	*0.10%*	*1.04%*	*1.06%*	*1.08%*	*1.10%*
Firm Curtailment	*0.95%*	*2.81%*	*2.77%*	*2.73%*	*2.69%*
Opt-in Critical Peak Pricing	*0.02%*	*0.23%*	*0.68%*	*0.68%*	*0.68%*
Opt-out Critical Peak Pricing	*1.03%*	*0.70%*	*2.05%*	*2.04%*	*2.02%*

Table 5-2 and Table 5-3 show demand savings by individual DR option for Washington and Idaho.

Table 5-2 Achievable DR Potential by Option for Washington (MW @Generator)

	2016	2020	2025	2030	2035
Total System Peak (MW)	**1,718**	**1,768**	**1,828**	**1,891**	**1,995**
Weather Sensitive Peak (MW)	**1,590**	**1,640**	**1,700**	**1,763**	**1,827**
Estimated C&I Peak (MW)	**610**	**622**	**630**	**638**	**649**
Achievable Potential (MW)					
Direct Load Control	0.39	4.00	4.12	4.26	4.42
Firm Curtailment	3.78	11.36	11.11	10.87	10.63
Opt-in Critical Peak Pricing	0.09	0.91	2.69	2.65	2.61
Opt-out Critical Peak Pricing	4.08	2.83	8.15	8.01	7.87
Achievable Potential (% of C&I Peak)					
Direct Load Control	*0.06%*	*0.64%*	*0.65%*	*0.67%*	*0.68%*
Firm Curtailment	*0.62%*	*1.83%*	*1.76%*	*1.70%*	*1.64%*
Opt-in Critical Peak Pricing	*0.01%*	*0.15%*	*0.43%*	*0.41%*	*0.40%*
Opt-out Critical Peak Pricing	*0.67%*	*0.46%*	*1.29%*	*1.26%*	*1.21%*

Table 5-3 Achievable DR Potential by Option for Idaho (MW @Generator)

	2016	2020	2025	2030	2035
Total System Peak (MW)	**1,718**	**1,768**	**1,828**	**1,891**	**1,995**
Weather Sensitive Peak (MW)	**1,590**	**1,640**	**1,700**	**1,763**	**1,827**
Estimated C&I Peak (MW)	**610**	**622**	**630**	**638**	**649**
Achievable Potential (MW)					
Direct Load Control	0.24	2.48	2.56	2.64	2.74
Firm Curtailment	2.02	6.10	6.31	6.55	6.82
Opt-in Critical Peak Pricing	0.05	0.49	1.61	1.69	1.78
Opt-out Critical Peak Pricing	2.19	1.54	4.78	5.00	5.25
Achievable Potential (% of C&I Peak)					
Direct Load Control	*0.04%*	*0.40%*	*0.41%*	*0.41%*	*0.42%*
Firm Curtailment	*0.33%*	*0.98%*	*1.00%*	*1.03%*	*1.05%*
Opt-in Critical Peak Pricing	*0.01%*	*0.08%*	*0.26%*	*0.26%*	*0.27%*
Opt-out Critical Peak Pricing	*0.36%*	*0.25%*	*0.76%*	*0.78%*	*0.81%*

Cost Results

Table 5-4 presents total utility costs for deployment of individual DR options over the 2016-2035 timeframe. It also shows the average annual cost and the levelized costs per kW of equivalent generation capacity over 2016-2035. We show 2035 savings potential from DR options for reference purposes.

Table 5-4 DR Program Costs and Potential

DR Option	2035 MW Potential	2016 – 2035 Cumulative Utility Spend (Million $)	2016 – 2035	2016 – 2035
			Average Spend per Year (Million $)	Levelized Cost ($/kW-year)
Direct Load Control	7.16	$16.07	$0.80	$143.82
Firm Curtailment	17.46	$40.68	$2.03	$118.59
Opt-in Critical Peak Pricing	4.38	$25.61	$1.28	$432.65
Opt-out Critical Peak Pricing	13.12	$26.69	$1.33	$109.86

Key findings include:

- The Firm Curtailment option could deliver highest savings at approximately $118/kW-year cost. The cumulative costs to Avista over a 20 year planning periods for realizing 17 MW of savings in 2035 is around $40 million. Capacity-based and energy-based payments to the third party constitutes the major cost component for this option. In addition, Avista would incur a relatively small amount of internal administrative costs for managing the third party.
- Opt-out CPP has lowest levelized cost among all DR options. It could deliver 13 MW in 2035 at $109/kW-yr. We estimate that Avista would need to spend approximately $26 million over 2016-2035 to deploy a default CPP rate to all customer classes. Enabling technology purchase and installation costs for enhancing customer response is a large part of CPP deployment costs.
- Opt-in CPP has a cost of $432/kW-year and is significantly higher than opt-out CPP. The major cost component for an opt-in CPP offer cost is the annual fixed program administration cost for administering the rate. This cost is spread over the smaller number of customers who choose to participate in this rate.
- Direct load control provides the third highest savings, 7 MW in 2035, at a relatively high cost of $144/kW-year. The significant cost components for DLC program implementation are associated with purchase and installation of enabling technology and with program marketing and outreach activities. There are also additional permitting and licensing fees that Avista customers must incur.

Integrated Results

The above analysis assumes that the programs are offered on a stand-alone basis. That is, only one program, and not the others, is offered to Avista customers. If Avista offered more than one program, then the potential for double counting exists. To address this possibility, we created a participation hierarchy to define the order in which the programs are taken by customers. Then we computed the savings and costs under this scenario. We assumed the following hierarchy:

1. Direct load control
2. Firm curtailment
3. Opt-in CPP or Opt-out CPP

Table 5-5 shows the potential estimates in 2035, as well as the costs, if more than one program is offered. The savings and costs for DLC remain unchanged, since it is first in the hierarchy.

However, the savings for Firm Curtailment and CPP are slightly lower as are the cumulative and average program costs. Levelized costs for Firm Curtailment are slightly lower as well, but the levelized cost for CPP are higher because the program costs are spread across a smaller amount of savings.

Table 5-5 DR Program Costs and Potential - Interactive

DR Option	2035 MW Potential	2016 – 2035 Cumulative Utility Spend (Million $)	2016 – 2035 Average Spend per Year (Million $)	2016 – 2035 Levelized Cost ($/kW-year)
Direct Load Control	7.16	$16.07	$0.80	$143.82
Firm Curtailment	16.57	$38.65	$1.93	$118.52
Opt-in Critical Peak Pricing	3.35	$25.27	$1.26	$555.77
Opt-out Critical Peak Pricing	9.90	$26.32	$1.32	$141.03

Literature Review

Before we performed the analysis of demand response (DR) for the Avista service territory, we conducted a literature review to provide Avista with an overview of what is already being done in the industry on DR. This review was originally provided to Avista under separate cover.

Introduction

Over the past decade, DR has evolved in many ways and a review and research of DR programs will provide Avista with a good overview and basis for the remainder of the study.

We have reviewed information available from national surveys of DR programs, most notably the FERC DR program survey database[9]. This national survey database is the most comprehensive data source on DR programs available in the industry, with a list of more than 1,500 DR programs and rate options offered to residential, commercial and industrial (C&I) and irrigation customers. The database has information on type of DR program and rate option, the type of entities offering the program, end-use equipment being controlled, participation requirements, number of customers enrolled, and realized load reduction amounts. In our research, we have covered all types of DR programs offered to residential and C&I customers.

We have combined the information from this data source with other relevant national data sources to arrive at key program characteristics, including performance metrics such as program participation rates and load reduction impacts. These data sources include: EIA Form 861 database[10], FERC Form 1 filing data[11], and the FERC National Assessment of Demand Response Potential Study[12]. We have also reviewed program reports, evaluation studies, and other types of industry publications to collect information about the different DR program types.

We have subdivided the relevant program information into two broad categories of program types: non-pricing and pricing programs. Non-pricing programs include Direct Load Control (DLC), Firm Curtailment programs, and Non-Firm Curtailment programs. Pricing options include Critical Peak Pricing (CPP) and Real Time Pricing (RTP).

We have identified a list of DR programs that we consider relevant for Avista and from that list we have selected a number of programs for in-depth research. For these programs, we describe the key characteristics including targeted customer segments and loads, event trigger, notification process, response requirements, timing and frequency of events, event duration, type of enabling technology for response, incentive structure, metering and other infrastructure requirements.

In addition to specific program information, we discuss items constituting benefits and costs for DR programs and the overall approach used for assessing cost-effectiveness of programs. At the end, we also include descriptions on commonly used methods for estimating program impacts.

This appendix consists of the following parts:

- A description of the approach we followed to identify relevant DR programs and to select a list of programs for in-depth research.

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[9] 2012 Survey on Demand Response and Advanced Metering, available at http://www.ferc.gov/industries/electric/indus-act/demand-response/2012/survey.asp

[10] http://www.eia.gov/electricity/data/eia861/

[11] http://www.ferc.gov/docs-filing/forms/form-1/data.asp

[12] http://www.ferc.gov/legal/staff-reports/06-09-demand-response.pdf

- Program descriptions for each selected program type
- Cost-effectiveness approaches for DR
- Impact estimation for DR

Research Approach

We first developed a list of proposed DR options by customer class. Then we identified and described representative programs for each type of program.

Proposed List of DR Options by Customer Class

We developed a comprehensive list of DR options for Avista's consideration in Table A-1 below. The customer class definitions are based on Avista's rate schedule information taken from Avista's System Load Research project, dated March, 2010. We have included two broad categories of DR options: non-pricing options and pricing options. In addition, we have included DR options for providing ancillary/load following services.

Table A-6 Proposed List of DR Options

Category	Option	Applicable Customer Class
Non-pricing	Direct Load Control	Residential
		General Service (GS)
		Large General Service (LGS)
	Curtailment- Firm	Large General Service (LGS)
		Extra Large General Service (XLGS)
	Curtailment- Non-firm	Large General Service (LGS)
		Extra Large General Service (XLGS)
Pricing	Time-of-Use Rates	Residential
		General Service (GS)
		Large General Service (LGS)
		Extra Large General Service (XLGS)
	Critical Peak Pricing	Residential
		General Service (GS)
		Large General Service (LGS)
		Extra Large General Service (XLGS)
	Real Time Pricing	Extra Large General Service (XLGS)
Ancillary Services / Load Following	Ancillary Services / Load Following	Residential
		General Service (GS)
		Large General Service (LGS)
		Extra Large General Service (XLGS)

Approach for Selecting Representative Programs for Further Research

To develop the list of programs, we followed the steps listed below:

1. Identify the universe of relevant DR programs,
2. Develop criteria for selecting representative programs to research in depth, and
3. Apply selection criteria to develop the list of recommended programs for further research.

We describe each of these steps in detail below.

Identify a List of Relevant DR Programs

To identify relevant programs for Avista, we reviewed the DR program information available in the 2012 FERC National DR program survey database.[13] This is the most comprehensive national database of DR programs in the industry.

We prioritized our review to select winter-peaking utilities to align with Avista's demand reduction objectives during the winter season. Because these are relatively few, we also included summer-peaking utilities with significant winter demand. To help identify these utilities, we calculated the winter peak as a percentage of the summer peak, and selected those utilities for whom their winter peak was at least 65 percent of the summer peak.[14] We present the universe of relevant DR offerings in Table A-2 through Table A-7.

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[13] 2012 Survey on Demand Response and Advanced Metering, available at http://www.ferc.gov/industries/electric/indus-act/demand-response/2012/survey.asp

[14] We obtained summer and winter peak demand data, by utility, from EIA Form 861 for 2012.

Table A-2 Relevant Direct Load Control Programs

Offering Entity	State	Sector	Winter Peak as % of Summer Peak
Adams Electric Cooperative Inc.	PA	Residential	97.6%
BPA- City of Port Angeles	WA	Residential	120%
BPA- Emerald People's Utility District (EPUD)	OR	Residential	120%
BPA- Orcas Power and Light Coop	WA	Residential	120.3%
BPA-Central Electric Cooperative	OR	Residential	120.3%
Central Alabama Electric Coop	AL	Residential	105.5%
Connexus Energy	MN	Residential	65.3%
Crow Wing Cooperative Power & Light Comp	MN	Residential	68.1%
Duke Energy Carolinas, LLC	NC	Residential	90.4%
Florida Power & Light Co	FL	Residential	83.6%
Jackson Energy Coop Corp - (KY)	KY	Residential	120.6%
Kentucky Utilities Co	KY	Residential	97.0%
Lake Country Power	MN	Residential	185.8%
Minnesota Power Inc.	MN	Residential	99.8%
Northern Virginia Electric Coop	VA	Residential	70.6%
Otter Tail Power Co	ND	Residential	121.8%
Puget Sound Energy Inc.	WA	Residential	135.1%
Santee Electric Coop, Inc.	SC	Residential	101.9%
South Central Power Company	OH	Residential	89.3%
Southeastern Electric Coop Inc. - (SD)	SD	Residential	79.3%
United Electric Coop, Inc. - (PA)	PA	Residential	100.5%
Otter Tail Power Co	ND	C&I	121.8%
Duke Energy Carolinas, LLC	NC	C&I	90.4%
Clay-Union Electric Corp	SD	C&I	77.3%
Duke Energy Progress- SC	SC	C&I	-

Table A-3 Relevant Firm Curtailment Programs

Offering Entity	**State**	**Sector**	**Winter Peak as % of Summer Peak**
City of Burlington Electric - (VT)	VT	C&I	91.3%
Duke Energy-Carolinas	NC	C&I	-
Duke Energy-Kentucky	KY	C&I	-
Louisville Gas & Electric and Kentucky Utilities Company	KY	C&I	97.0%
PJM Demand Response	PA	C&I	-
PJM Demand Response	OH	C&I	-
Tampa Electric Co	FL	C&I	90.2%
Tennessee Valley Authority	AL	C&I	-
Tennessee Valley Authority	TN	C&I	90.1%

Table A-4 Relevant Non-Firm Curtailment Programs

Offering Entity	State	Sector	Winter Peak as % of Summer Peak
Duke Energy-Carolinas	NC	C&I	
Duke Energy-Kentucky	KY	C&I	-
New York State Electric and Gas	NY	C&I	87%
PJM Demand Response	PA	C&I	-
PJM Demand Response	OH	C&I	-

Table A-5 Relevant Critical Peak Pricing Programs

Offering Entity	State	Sector	Winter Peak as % of Summer Peak
Gulf Power Co[15]	FL	Residential	91%
Sioux Valley SW Electric Coop.	ND	Residential	94.5%
Southern California Edison Co.	CA	C&I	65.9%
Tampa Electric Co.	FL	R	90.2%

Table A-6 Relevant Real Time Pricing Programs

Offering Entity	State	Sector	Winter Peak as % of Summer Peak
Duke Energy Carolinas, LLC	NC	C&I	90.4%
Duke Energy Ohio, Inc.	OH	C&I	78.7%
Georgia Power Co	GA	C&I	85.8%
Gulf Power Co	FL	C&I	91.0%
Otter Tail Power Co	ND	C&I	121.8%
West Penn Power Company	PA	C&I	91.7%

Table A-7 Relevant Ancillary Services/Load Following Programs

Offering Entity	State	Sector	Winter Peak as % of Summer Peak
BPA- Mason County PUD No. 3	WA	Res	120%
BPA- City of Port Angeles	WA	C&I	120%
BPA-Eugene Water and Electric Board	OR	C&I	120%

Table A-8 below shows the number of programs included by DR option type.

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[15] Gulf Power Company's CPP program was not listed in the FERC survey database. Therefore we obtained program information from outside sources.

Table A-8 Number of Relevant DR Programs by Option

Category	Option	Number of Programs
Non-pricing	Direct Load Control	34
	Curtailment- Firm	6
	Curtailment- Non-firm	2
Pricing	Time-of-Use Rates	TOU rate offerings by various utilities[16]
	Critical Peak Pricing	4
	Real Time Pricing	6
Ancillary Services / Load Following	Ancillary Services / Load Following	3

Develop Criteria for Selecting Representative Programs

Once we identified the list of relevant programs, we developed criteria to select representative programs for detailed investigation. We considered the following criteria:

- Program size and maturity: We identified the size of the program in terms of number of customers enrolled, based on FERC 2012 DR survey data. We present available enrollment data in the "All Programs" worksheet. We considered only mature programs with a sizeable number of customers enrolled.
- Average retail rate of the utility relative to Avista's rate: We compared each utility's average retail rate with Avista's rate to screen out utilities with rates much higher than Avista's.
- Pacific Northwest region experience: We included all DR initiatives from the Pacific Northwest region, even though these were mostly pilots.

Apply Selection Criteria to Develop a List of Programs for Further Research

As a last step in the process, we applied the selection criteria outlined above to the list of relevant programs presented above. Table A-9 shows the selected programs by DR option type.

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[16] We found that a very large number of utilities across the states included in our list offered TOU tariffs. We did not explicitly record the number of TOU rate offerings by these utilities.

Table A-9 Selected Programs

Offering Entity	State	Sector	Scale	Winter Peak as % of Summer Peak	Retail Rate Difference with Avista (%)	No. of Customers Enrolled
Direct Load Control Programs						
BPA- City of Port Angeles	WA	Res	Pilot	120%	-	35
BPA- Emerald People's Utility District (EPUD)	OR	Res	Pilot	120%	-	200
Puget Sound Energy Inc	WA	Res	Pilot	135%	19.3%	528
Otter Tail Power Co	ND	Res	Program	122%	0.4%	6,479
Duke Energy Carolinas, LLC	NC	Res	Program	90.4%	17.7%	3,963
South Central Power Company	OH	Res	Program	89.3%	32.6%	20,000
Florida Power & Light Co	FL	Res	Program	83.6%	19.8%	799,812
Minnesota Power Inc.	MN	Res	Program	99.8%	5.7%	7,217
Crow Wing Cooperative Power & Light Company	MN	Res	Program	68.1%	23%	8,625
Clay Union Electric	SD	C&I	Program	77.3%	-	591
Otter Tail Power Co	ND	C&I	Program	121.8%	-23.3%	1,579
Firm Curtailment Programs						
Tampa Electric Co	FL	C&I	Program	90.2%	15.6%	94
Tennessee Valley Authority	TN	C&I	Program	90.1%	-	139[17]
Louisville Gas & Electric/ Kentucky Utilities Company	KY	C&I	Program	97%	-22.7%	-
Non-Firm Curtailment Programs						
New York State Electric and Gas	NY	C&I	Program	87%	0.4%	106
Critical Peak Pricing Programs						
Gulf Power Co[18]	FL	Res	Program	91%	39%	10,000
Southern California Edison Co.	CA	C&I	Program	65.9%	47.4%	3,255
Real Time Pricing Programs						
Georgia Power Company	GA	C&I	Program	85.8%	-9.1%	2,033
Ancillary Services/Load Following Pilots						
BPA-City of Port Angeles	WA	C&I	Pilot	120%	-	-
BPA-Mason County PUD No. 3	WA	Res	Pilot	120%	-	-

Table A-10 shows the number of selected programs by DR option.

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[17] TVA offers this program to its member utilities. Enrollment data presented here is for Memphis Light, Gas, and Water Division (MLGW), which has the highest enrollment level among all TVA members.

[18] Gulf Power Company's CPP program was not listed in the FERC survey database. Therefore we obtained program information from outside sources.

Table A-10 Number of Selected DR Programs by Option

Category	Option	Number of Programs
Non-pricing	Direct Load Control	11
	Firm Curtailment	3
	Non-firm Curtailment	1
Pricing	Critical Peak Pricing	2
	Real Time Pricing	1
Ancillary Services / Load Following	Ancillary Services/Load Following	3

Direct Load Control Programs

With Direct Load Control (DLC) programs, the utility directly controls specific end-uses such as electric space heating, cooling, water heating, and pool pumps. In exchange, the customer receives an incentive payment or bill credit. Operation of DLC typically occurs during times of high peak demand or supply-side constraints. During an event, participants' equipment is controlled either by a one-way remote load control switch or by a Programmable Communicating Thermostat (PCT).

General Program Characteristics

Most of the legacy DLC programs offered by utilities nationwide target summer cooling load. These programs target central air conditioning which has a fairly low saturation in the Avista service area. Programs that target space heating load during winter and water heating load throughout the year are much fewer in number than summer DLC programs. In our research, we have specifically included programs that target space heating and/or water heating loads, since Avista is primarily interested in DLC programs for addressing winter peak reduction.

We found a variety of DLC programs that control electric space heating and water heating, such as:

- Programs that cycle and shut off equipment during event hours.
- Programs that target space heating and water heating equipment with thermal storage capabilities that enable load shifting to off-peak hours.
- Programs that target specifically space heating and water heating systems with dual fuel backup that enable these systems to use alternate fuels for providing service during control periods.

Table A-11 below summarizes some of the characteristics of Direct Load Control programs that are common across program offerings.

Table A-11 Summary of Key Direct Load Control Program Characteristics

Program Attributes	Description
Targeted segments	• Residential • Small and medium sized C&I customers (typically customers with less than 100 kW maximum demand)
DR Strategies	• Cycling space heating equipment. • Turning off equipment (water heating and space heating) during control periods. • Shifting usage to off-peak hours using end-use devices with thermal storage features. • Shifting usage from electricity to natural gas using dual fuel backup for space heating and water heating
Enabling Technology	Load control switch or programmable thermostat
Event Notification	Event notification does not apply, since end-use equipment is directly controlled by the utility.
Event Duration	• Varies widely by program: from 4 to 14 hours. • Longer event duration found for programs that control equipment with thermal storage or dual fuel backup.
Incentive structure	• Participants are often offered a fixed annual bill credit for each type of equipment being controlled. • In cases where the equipment has dual fuel backup, participants are placed on a separate rider with discounted tariffs, as compared to their normal rates. • Participants sometimes receive a rebate for purchasing equipment with thermal storage features.

Specific Pilot and Program Examples

Below are summaries of the specific characteristics of the DLC pilots and programs we researched. We have included information from the Pacific Northwest pilot initiatives, since these are likely to be relevant for Avista. For all other areas, we have included only program experiences.

Puget Sound Energy's Direct Load Control Pilot

Puget Sound Energy conducted a residential DLC pilot during 2010-2011. The pilot was conducted on Bainbridge Island, located in the western portion of the utility's service area. Table A-12 below lists specific characteristics of the pilot program.

Table A-12 Puget Sound Energy's Residential DLC Pilot

Attributes	Description
Targeted Segment	Residential customers with electric space heating and cooling, and water heating.
Controlled End-uses	• Electric water heating and space heating equipment were controlled during winter. Space heating equipment included heat pumps, central electric furnaces, and baseboard wall heaters. • Electric water heating and heat pumps (in cooling mode) were controlled during summer.
Enabling Technology for Control	• Load control switches used for controlling water heaters. • Load control switches with adaptive algorithm used for controlling electric space heating. • Programmable communicating thermostat used for controlling space cooling.
Communication Infrastructure	Two way communication using broadband.
Incentive Payment	Participants received an annual $50 incentive, as long as they participated in more than 50% of curtailment events.
Impact Findings	Space heating • Among the three electric space heating technologies, controlling heat pumps provided the highest level of load reductions, especially during winter mornings. • Impacts per device for heat pumps ranged from 2.88 kW in the morning to 1.21 kW in the afternoon. • Impacts per device for electric furnaces ranged from 1.88 kW in the morning to 1.71 kW in the afternoon. • Impacts per device for baseboards ranged from 0.18 kW in the morning to 0 kW in the afternoon. Water heating • Water heater control was found to be the most effective means for achieving winter demand reduction, especially during winter mornings. During afternoon control, snapback impact was observed to be greater than DR impact. • Water heater winter impacts per device ranged from 0.77 kW in the morning to 0.49 kW in the afternoon.

Key Findings from the Pilot

- **Overall Customer Satisfaction.** Although overall customer satisfaction was reported to be high for the pilot, an evaluation study points to a number of factors that affected customer satisfaction. These factors include:
  - Highest level of customer dissatisfaction was related to equipment technical issues, such as:
    - Network connectivity problems
    - Difficulties in PCT operation and lack of "easy to use" features for the thermostat
    - Safety concerns related to the specific PCT brand used in the pilot, which faced a product recall
    - Equipment installation problems, especially with the digital gateway.
    - Technical difficulties related to operation of the load control device for space heaters.

  - Very few participants experienced discomfort when their devices were being controlled, except heat pump participants. More than half of the heat pump participants experienced discomfort and had to take alternative actions to stay warm during events. Snapback in demand, after the event, was observed for these participants.
  - Participants had low awareness of the opt-out feature and some expressed dissatisfaction with loss of control over heating.
  - Participants expressed dissatisfaction with aesthetic impacts resulting from the installation of control and communication hardware inside their homes.
  - Participants did not have sufficient instructions/guidance to operate the installed equipment.
  - Use of multiple control technologies complicated installation procedures and led to technical problems.
- **Program Marketing and Customer Communication.** Pilot promotional letter and newspaper articles were effective communication channels for informing participants about the pilot. Strong support of the pilot by local community groups, extensive local media promotion, and individual social networking contributed to a higher enrollment rate than typically experienced with utility pilots.
- **Motivation for Participation.** The strongest motivation for participation was environmental/altruistic reasons, rather than achieving monetary savings.
- **Level of Incentive Payment.** Participants perceived the annual incentive payment to be sufficient.

BPA- City of Port Angeles Voluntary Peak Power Project

The City of Port Angeles Voluntary Peak Power project in northern Washington constitutes one of several pilots that BPA is currently implementing to test Direct Load Control with multiple end-uses. The pilot incorporates a number of unique and innovative features and therefore, learning from the pilot experience is likely to be of significance for Avista.

The pilot involves control of multiple end-uses along with water heating and space heating equipment. The pilot is testing space heating equipment with thermal storage features. All pilot participants have AMI installed and therefore, control and communications techniques leverage the AMI backbone.

Table A-13 below lists specific characteristics of the pilot. Additional information on pilot performance was not available.

Table A-13 BPA-City of Port Angeles Voluntary Peak Power Project

Attributes	Description
Targeted Segment	Residential customers with electric space heating and water heating.
Controlled End-uses	• Electric water heating • Electric space heating along with multiple end-uses. Space heating equipment includes room heaters and central electric furnaces with thermal storage capability (ceramic bricks).
Enabling Technology for Control	• A load control device wired into the water heater's electrical control system is used for WH control. • A smart thermostat is used for controlling electric space heating. It is equipped with Home Area Network (HAN) connectivity and can be used to control multiple end-uses, such as appliances. • Control of electric space heating (room heaters or central electric furnaces) with thermal storage involves drawing electricity during low demand periods and storing it in ceramic bricks, which can heat over 1,500 degrees F and are sealed inside the unit. A variable speed fan automatically circulates heat throughout the room. Participants control the temperature using a programmable thermostat.
Metering and Communication Infrastructure	All pilot participants have AMI installed.
Incentive payment	Participants receive $120 for participation, along with free control devices.
Impact findings	NA

BPA- Emerald People's Utility District Direct Load Control Pilot

BPA is undertaking a DLC pilot with Emerald People's Utility District to test control of space heating and water heating technologies with thermal storage capabilities. The overall objective of the pilot is to develop load control strategies that can be used for integration with renewable resources. This is one of the few pilots that are being conducted to address renewable integration challenges. Learning from these pilot experiences is likely to be useful for Avista, since wind generation is a significant portion of its supply fleet.

Table A-14 below lists specific characteristics of the pilot program. Additional information on pilot performance was not available.

Table A-14 BPA-Emerald People's Utility District Direct Load Control Pilot

Attributes	Description
Targeted Segment	Residential customers with electric space heating and water heating.
Controlled End-uses	• Electric water heating with thermal storage capabilities • Electric space heating with thermal storage capabilities.
Enabling Technology	• Thermal storage systems store electrical energy in well insulated ceramic brick cores. • Built-in microprocessor-based control systems regulate the charging level and rate. • Storage occurs as utilities signal the unit to charge with available renewable, off-peak energy, or in response to other needs of the grid. Storage equipment has the ability to take on "extra" storage during periods when excess energy is available (e.g., when the wind fleet ramps up rapidly) or to turn off when the power supply is limited (e.g., when the wind fleet ramps down).
Metering and Communication Infrastructure	NA
Incentive Payment	NA
Impact Findings	NA

Otter Tail Power Company Direct Load Control Program

Otter Tail Power Company offers a direct control program for space heating and water heating loads with dual fuel during the winter season. The program also offers an option to control cooling loads on air-source heat pumps during summer. In addition, the utility controls water heaters without dual fuel backup by turning off the water heater during event hours.

Table A-15 below lists specific characteristics of the program.

Table A-15 Otter Tail Power Company's DLC Program

Attributes	Description
Targeted Segment	Residential and commercial customers with electric space heating and water heating.
Controlled End-uses	• Space heating and water heating with alternate fuel backup controlled during winter • Space cooling controlled during summer: air-source heat pumps in cooling mode. The units are cycled during summer with 50% control strategy (15 minutes on and 15 minutes off)
Enabling Technology	Load control switch
Event Duration	• Heating loads on dual fuel may be controlled up to 24 hours a day • Water-heating loads may be controlled up to 14 hours a day
Metering and Communication Infrastructure	NA
Incentive Payment	There is no separate incentive payment for participating in the program. Customers with dual fuel option are placed on a separate rider with the following components: • A fixed monthly charge of $7 • Summer electricity rate: 3.659 cents/kWh • Winter electricity rate: 3.451 cents/kWh • Penalties apply for not being able to shift load during control periods to alternate fuels. These are: ○ 38.61 c/kWh during summer months ○ 12.92 c/kWh during winter months Customers with water heater control only are placed on a separate rider with the following components: • A fixed monthly charge of $2 • Summer electricity rate: 5.773 cents/kWh • Winter electricity rate: 5.638 cents/kWh
Impact Findings	NA

Minnesota Power Direct Load Control Program

This program is similar to Otter Tail Power Company's Direct Load Control program with the dual fuel component. In addition, the company also offers an option for controlling electric space heating units with thermal storage. Table A-16lists specific characteristics of the program.

Table A-16 Minnesota Power's DLC Program

Attributes	Description
Targeted Segment	Residential and commercial customers with electric space heating and water heating.
Controlled End-uses	• Space heating and water heating with alternate fuel backup controlled during winter. • Space heating with thermal storage capability controlled during winter. Space heating equipment includes heat pumps, central furnaces, and a variety of room heating devices.
Enabling Technology	Load control switch
Event Duration	Not defined
Metering and Communication Infrastructure	NA
Incentive Payment	There is no separate incentive payment for participating in the program. Participants are placed on separate riders with differential rates.
Evaluation Findings	NA

Duke Energy Carolinas Direct Load Control Program

This is a winter load control program targeting electric space heating and water heating end-uses. Table A-17 lists specific characteristics of the program.

Table A-17 Duke Energy Carolinas' DLC Program

Attributes	**Description**
Targeted Segment	Residential customers with electric space heating and water heating.
Controlled End-uses	• Space heating - central electric heat pump units with strip heat • Water heating – water heaters with at least 30 gallons capacity
Enabling Technology	Load control switch
Event Duration	• Both space heating and water heating can be controlled up to 4 hours during an event. • Space heating can be controlled up to a maximum of 60 hours annually
Metering and Communication Infrastructure	NA
Incentive Payment	Customers receive an annual bill credit of $25 each for space heating and WH control, in addition to $25 for signing up (applied to each equipment).
Evaluation Findings	NA

Florida Power and Light's Direct Load Control Program

Florida Power and Light's "On Call" program is one of the largest DLC programs in the nation. The program controls multiple end-uses and targets both summer and winter loads. [19]

Table A-18 lists specific characteristics of the program.

Table A-18 Florida Power and Light's DLC Program

Attributes	Description
Targeted Segment	Residential customers with electric space hating and water heating.
Controlled End-uses	• Central heating • Electric water heating • Central air conditioning • Pool pumps
Enabling Technology	Load control switch
Event Duration	There are two options under the program. One is the "Cycle Option", and the other is the "Extended Option." The event duration differs for these two options. • Under the Cycle Option, the central heater is turned off for 15 minutes, every half hour. • Under the Extended Option, all controlled equipment can be turned off for up to 4 hours.
Metering and Communication Infrastructure	Power line communication with two-way communications feature.
Incentive Payment	• Under the Cycle Option, participants receive a $10 annual bill credit for controlling central heat. • Under the Extended Option, participants receive a $20 annual bill credit for controlling central heat, and an $18 annual credit for water heater control.
Evaluation Findings	NA

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[19] The Business On Call program targeting commercial customers controls cooling load only during the summer.

Crow Wing Cooperative's Direct Load Control Program

Crow Wing Electric Cooperative's direct load control program utilizes dual fuel backup for controlling electric heat during winter. The utility also controls water heaters and space heating equipment with thermal storage capability. Table A-19 lists specific characteristics of the program.

Table A-19 Crow Wing Power's Direct Load Control Program

Attributes	Description
Targeted Segment	Residential customers with electric space heating and water heating
Controlled End-uses	• Electric space heating with dual fuel backup (alternate fuels include natural gas, propane, or fuel oil) • Water heating for water heaters with at least 100 gallons of storage. • Electric heating system with thermal storage
Enabling technology for control	Load control switch
Event Duration	For electric space heating control with dual fuel, there is no limit on duration of individual events. However, electric space heaters with dual fuel can be controlled up to a maximum of 600 hours, per heating season.
Metering and Communication Infrastructure	NA
Incentive payment	Participants with dual fuel heating systems are offered the following incentives: • A discounted electricity rate of 5.3 cents/kWh. • In addition, participants receive a rebate for the purchase of qualifying control equipment. These are as follows: $200 for plenum heaters and electric boilers. $100/ton for a Ground Source Heat Pump (GSHP). $330 - $630 for an Air Source Heat Pump (ASHP). $100 for a whole house baseboard heating system. Participants with space and water heating systems with thermal storage are offered the following incentives: • A discounted electricity rate of 4.3 cents/kWh. • In addition, participants receive a rebate for purchase of qualifying control equipment. These are as follows: $25/kW of installed capacity for heating systems with storage. $200-300 rebate for water heater with storage.
Evaluation findings	NA

South Central Power Company Water Heater Switch Program

The Water Heater Switch program offered by South Central Power Company is a legacy water heater control program with a sizeable number of customers enrolled. Table A-20 below lists specific characteristics of the program.

Table A-20 South Central Power Company Water Heater Switch Program

Attributes	Description
Targeted Segment	Residential customers with electric water heating.
Controlled End-uses	Water Heaters with a capacity of 50 gallons or more.
Enabling technology for control	Radio controlled switch
Event Duration	NA
Metering and Communication Infrastructure	NA
Incentive payment	$15 annual payment, plus $1.25 off on monthly electricity bill.
Evaluation findings	NA

Clay Union Electric's Direct Load Control Program

The utility offers a direct load control program targeting water heaters for business customers. Other than the program participation and impact data in the FERC survey, we did not find any additional information for the program.

Firm Curtailment Programs

Firm Curtailment programs that were selected for further investigation are listed in Table A-21 below. The table includes two additional program characteristics that relate to program performance: participation rates and impact estimates. We will use these two characteristics along with customer enrollment values when conducting the potential study in a subsequent task. The data on these characteristics are taken from the FERC survey database, wherever available. We indicate "NA" for cases where the data are not available.

Table A-21 Selected Firm Curtailment Programs

Offering entity	State	Scale	Winter Peak as % of summer peak	Retail Rate Difference with Avista (%)	No. of customers enrolled	Participation Rate (% of eligible customers)	Unit Impact (% of enrolled load)
Tampa Electric Co	FL	Program	90.2%	15.60%	94	44%	100%[20]
Tennessee Valley Authority	TN	Program	90.1%	-	139[21]	NA	NA
Louisville Gas & Electric/Kentucky Utilities Company	KY	Program	97.0%	-22.74%	-	NA	NA

Below, we discuss some of the general program characteristics that are common across all programs of this type followed by specific program examples and their characteristics.

General Program Characteristics

Under the Firm Curtailment type of program, participating customers agree to reduce demand by a specific amount or curtail their consumption to a pre-specified level. In return, they receive a fixed incentive payment in the form of capacity credits or reservation payments (typically expressed as $/kW-month or $/kW-year). Customers are paid to be on call even though actual load curtailments may not occur. The amount of capacity payment typically varies with the firm reliability-commitment level. In addition to the fixed capacity payment, participants receive a payment for energy reduction. Because the program includes a firm, contractual arrangement for a specific level of load reduction, enrolled loads represent a firm resource and can be counted toward installed capacity (ICAP) requirements. Penalties are assessed for under-performance or non-performance. Demand-reduction events may be called on a day-of or day-ahead basis as conditions warrant.

This program is typically third-party administered by load aggregators. It is most common in areas with deregulated wholesale electricity markets such as in PJM, New York ISO, and ISO-New England jurisdictions. However, increasingly utilities are directly offering this type of program to their large commercial and industrial customers.

The targeted segment typically includes customers with electricity demand greater than 200 kW, though individual program requirements may vary. Customers with flexibility in their operations are attractive candidates for participation. Examples of customer segments with high participation possibilities include large retail establishments, grocery chains, large offices, refrigerated warehouses, water- and wastewater-treatment plants, and industries with process

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[20] 100% load reduction implies that the load is shifted entirely to back up generators.

[21] TVA offers this program to its member utilities. Enrollment data presented here is for Memphis Light, Gas, and Water Division (MLGW), which has the highest enrollment level among all TVA members.

storage (e.g. pulp and paper, cement manufacturing). Customers with 24x7 operations/continuous processes or with obligations to continue providing service (such as schools and hospitals) are not often good candidates for this option.

Table A-22 below summarizes some of the characteristics of Firm Curtailment programs that are common across program offerings.

Table A-22 Key Firm Curtailment Program Characteristics

Program Attributes	Description
Type of Contract	Participants have a firm capacity reduction commitment. Therefore participation is mandatory.
Resource Reliability	Capacity reductions can be counted toward Installed Capacity (ICAP), since participants have a firm commitment for capacity reduction.
Targeted segment	Commercial and industrial customers, with maximum demand values typically greater than 200 kW. In some cases a lower maximum demand threshold of 100 kW may be used.
DR Strategies	Load reduction and shifting to backup generators.
Examples of Curtailable Processes	Examples of commercial and light industrial curtailable processes include: air handlers, anti-sweat heaters, chiller control, chilled water systems, defrost elements, elevators, escalators, external lighting, external water features, HAVC systems, internal lighting, irrigation pumps, motors, outside signage, parking lot lighting, production equipment, processing lines, pool pumps/heaters, refrigeration systems, and water heating.
Event Trigger	Event trigger is typically emergency system conditions, such as actual or forecasted operating reserves shortage.
Event Notification	30 minutes to day-ahead
Event Duration	Varying duration: typically ranges from 1 to 8 hours
Program Hours	Events are usually called during business hours on working days, therefore loads need to be available during that time.
Incentive structure	Participants are offered both capacity ($/kW-month) and energy ($/kWh) payments.
Penalties for non-performance	Participants are subjected to non-performance penalties for performance below pre-determined threshold levels.
Metering and Communication Systems	• These programs preferably require 5-minute interval data (although 15 minute or hourly interval data may be sufficient.) • Communication systems need to receive and confirm system operator requests, preferably in real-time.

Specific Program Examples

Below are summaries of the specific characteristics of the programs we researched.

Tennessee Valley Authority's Demand Response Program

This is a third-party administered program offered by TVA to its member utilities. The program was launched in 2008 and is currently in operation. It is administered by EnerNOC. Table A-23 below lists specific characteristics of the program.

Table A-23 TVA's Demand Response Program Characteristics

Program Attributes	Description
Targeted Segment	C&I customers with a minimum load reduction amount of 100 kW.
Resource Availability	• Program is available year round. • During the summer months of April to October, program hours are from 12 noon to 8 PM on weekdays. • During the winter months of November to March, program hours are from 5 AM to 1 PM on weekdays.
Event Notification	30 minutes. Notification is via email, phone, or SMS.
Maximum Annual Event Hours	40 hours.
Event Duration	Events can range from 2-8 hours; average event duration is 3.5 hours.
Maximum Number of Events	No more than 6 events can be called in a month; events cannot be called on more than 2 consecutive days.
Incentive Payment	Capacity payment is $22/kW-year; energy payments are $40-50/MWh; Participants are offered $225/MWh or more for emergency energy payments.
Type of Response	Both manual and Auto-DR strategies
Metering Requirements	All participating customers receive free, near real-time 5 minute interval metering.

Tampa Electric Company's Networked Demand Response Program

This is a third-party administered program offered by Tampa Electric Company in Florida. The program was launched in 2008, and the contract is active until 2016. It is administered by EnerNOC. Table A-24 below lists specific characteristics of the program.

Table A-24 Tampa Electric Company's Networked Demand Response Program Characteristics

Program Attributes	Description
Targeted Segment	Targeted customer segments include city and county agencies, telecommunication companies, big-box retailers, grocery stores, and others. No information available on minimum load reduction amount.
Resource Availability	• Program is available year round. • Program hours are from 7 AM to 7 PM on weekdays.
Event Notification	30 minutes.
Maximum Annual Event Hours	NA
Event Duration	Events can range from 1-8 hours.
Maximum number of events	NA
Incentive payment	NA
Type of Response	Both manual and Auto-DR strategies
Metering requirements	All participating customers receive free, near real-time 5 minute interval metering.

Louisville Gas and Electric and Kentucky Utilities Demand Response Program

This is a third-party administered program offered by Louisville Gas and Electric and Kentucky Utilities Company (LG&E and KU). The program was launched in 2012 and is currently operational. It is administered by EnerNOC. The program has a bilateral contract for delivering 10 MW of load reduction. Information on specific program characteristics was not available.

Non-Firm Curtailment Programs

The Non-Firm Curtailment program selected for further investigation is listed in Table A-25 below. The table includes two additional program characteristics that relate to program performance: participation rates and impact estimates. The data on these characteristics are taken from the FERC survey database, wherever available.

Table A-25 Selected Non-Firm Curtailment Programs

Offering entity	State	Scale	Winter Peak as % of summer peak	Retail Rate Difference with Avista (%)	No. of customers enrolled	Participation Rate (% of eligible customers)	Unit Impact (% of enrolled load)
New York State Electric and Gas	NY	Program	87%	0.43%	106	9%	30%

General Program Characteristics

Under the Non-firm Curtailment type of program, participants voluntarily reduce load when an emergency event is called. In contrast to the "Firm Curtailment" option, customers are not under contract to deliver a specific quantity of load reduction. There is usually no penalty for not being able to reduce load when events are called. Events may be called on a day-of or day-ahead basis, as conditions warrant. Participants are paid a credit for each kWh they reduce during the event. The $/kWh payment is typically based on Locational Marginal Prices (LMPs). There is no capacity payment associated with this option since it does not represent a firm resource. This option complements the firm capacity commitment contracts and offers a flexible option for customers that may not be able to provide firm capacity reduction commitments.

Table A-26 below summarizes characteristics of the Non-firm Curtailment program.

Table A-26 Key Non-Firm Curtailment Program Characteristics

Program Attributes	Description
Type of Contract	Participants do not have a firm capacity reduction commitment. Therefore, participation is voluntary.
Resource Reliability	Load reductions cannot be counted toward Installed Capacity (ICAP) requirements, since participants do not have a firm capacity reduction commitment.
Targeted segment	Commercial and industrial customers, with maximum demand values typically greater than 200 kW.
DR Strategies	Load reduction and shifting to backup generators.
Examples of Curtailable Processes	Examples of commercial and light industrial curtailable processes are: air handlers, anti-sweat heaters, chiller control, chilled water systems, defrost elements, elevators, escalators, external lighting, external water features, HAVC systems, internal lighting, irrigation pumps, motors, outside signage, parking lot lighting, production equipment, processing lines, pool pumps/heaters, refrigeration systems, and water heating.
Event Trigger	Event trigger is high Locational Marginal Prices (LMPs), especially during times of high system demand.
Event Notification	Varies from 30 minutes to day-ahead
Event Duration	Varies
Program Hours	Events are usually called during business hours on working days, therefore loads need to be available during that time.
Incentive structure	Participants are offered energy ($/kWh) payments.
Penalties for non-performance	No penalties exist, since participation is voluntary.
Metering and Communication Systems	• These programs preferably require 5-minute interval data (although 15 minute or hourly interval data may be sufficient). • Communication systems need to receive and confirm system operator requests, preferably in real-time.

Specific Program Examples

Below are summaries of the specific characteristics of the programs we researched.

New York ISO's Emergency Demand Response Program

New York ISO operates the Emergency Demand Response Program (EDRP), which is one of the largest and most successful non-firm curtailment type DR program. The program has been operational since 2001. New York State Electric and Gas is one among other New York state utilities that offer the ISO administered program to its retail customers. DR events are triggered whenever there is a need to address system reliability in the NYISO service area.

Table A-27 below lists specific characteristics of the program.

Table A-27 NYISO Emergency Demand Response Program Characteristics

Program Attributes	Description
Targeted Segment	C&I customers with a minimum load reduction amount of 100 kW.
Resource Availability	Program can be called at any time. Therefore, resources need to be available all year round.
Event Notification	2 hours
Event Duration	4 hours
Incentive Payment	Payment is based on real-time Locational Based Marginal Price (LBMP) and measured energy reduction during an event, with a minimum rate of $500/MWh.
DR Strategy	Load reduction and shifting to backup generators. Most of the load reduction achieved in the program has been through shifting to backup generators.
Metering Requirements	Hourly meter required for participation

Critical Peak Pricing Programs

Critical Peak Pricing programs that were selected for further are listed in Table A-28 below. The table includes two additional program characteristics that relate to program performance: participation rates and impact estimates. The data on these characteristics are taken from the FERC survey database, wherever available. We indicate "NA" for cases where the data are not available.

Table A-28 Selected Critical Peak Pricing Programs

Offering entity	State	Scale	Winter Peak as % of summer peak	Retail Rate Difference with Avista (%)	No. of customers enrolled	Participation Rate (% of eligible customers)	Unit Impact (% of enrolled load)
Gulf Power Company[22]	FL	Program	91%	39%	10,000	2.6%	NA
Southern California Edison Co.	CA	Program	65.9%	47.4%	3,255	~50%	6.3%[23]

General Program Characteristics

A CPP rate includes an extremely high peak price during specific critical demand periods of the year. The rate specifies the number of times CPP events can be called and the maximum duration of a single event. Participants enrolled on CPP have a lower off-peak rate than the class average retail tariff. CPP events can be called on a day-ahead or day-of basis. They can be offered either as a voluntary rate with opt-in or as a default rate with opt-out provision. The type of offering varies by customer class and utility.

Table A-29 below summarizes some of the characteristics of the CPP program that are common across program offerings.

Table A-29 Key Critical Peak Pricing Program Characteristics

Program Attributes	Description
Resource Reliability	Non-firm
Targeted segment	All residential and C&I customers.
DR Strategies	Load reduction and shifting to backup generators.
Event Trigger	Events can be triggered under system emergency situations or under high price conditions.
Event Notification	30 minutes to day-ahead
Event Duration	Varies by program
Incentive structure	No separate incentive payment. CPP participants are offered a discounted rate during off-peak periods.
Penalties for non-performance	Not applicable.
Metering and Communication Systems	AMI is preferred for metering and settlement purposes.

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[22] Gulf Power Company's CPP program was not listed in the FERC survey database. Therefore we obtained program information from outside sources.

[23] This is based on impact evaluation results from the "2012 California's Statewide Non-residential Critical Peak Pricing Evaluation Report".

Specific Program Examples

Below are summaries of the specific characteristics of the programs we researched.

Gulf Power Company's Residential CPP Program

Energy Select, Gulf Power's residential CPP program, is one of the oldest and most successful CPP programs offered to residential customers. The program was launched in 2000. Before launching the program, a two-year pilot was conducted to evaluate customer acceptance and equipment performance. The program attained an industry landmark in 2012 with 10,000 participants voluntarily enrolled in the program. There are plans to extend program participation to 16,000 participants by 2016. The program is administered by Comverge. Table A-30 below lists specific characteristics of the program.

Table A-30 Gulf Power Company's Residential CPP Program Characteristics

Program Attributes	Description
Targeted Segment	Residential customers.
Enabling Technology for Load Control	Programmable Communicating Thermostat (PCT)
CPP Rate Structure	The electricity price is four tiered: • Low- 7 cents/kWh • Medium- 8 cents/kWh • High- 15 cents/kWh • Critical- 58 cents/kWh Standard electricity price is around 10 cents/kWh.
Number of times events can be called annually	-
Event Notification	Day-ahead or day-of.
Event Duration	1-2 hours.
Metering Requirements	The program uses Broadband for communicating between the utility and the home, and Zigbee RF communication for communicating to devices within the home.

Since this is one of the leading examples of residential CPP programs in the country, learnings from program design and implementation experience are likely to be useful for Avista. Below, we summarize some of the key findings related to program deployment experience.

- **Program Planning**
    - Before designing a program, a pilot is essential to evaluate customer acceptance of rates and test equipment performance.
    - Regulatory approval process takes a very long time and therefore, a utility needs to plan ahead.
- **Technology Deployment**
    - A utility needs to focus on how the technology affects the customer. Technology changes rapidly and the utility needs to stay ahead of the game. This is one of the most important lessons learned from this program.
        - For example, switch to broadband communication from land line based communication can open up participation to many more customers.

        - In Gulf Power’s example, initially communication was based on land-lines telephones. But participation was affected as customers started dropping their land line phones. Switching to broadband communication helped increase participation levels dramatically.

- **Program Design and Development**
    - Education and training are key components of program development.
    - Offering the program to all residential customers, instead of restricting it to single family home customers, help increase enrollment levels.
    - Two key program design features that can help increase participation levels are shortening the event duration and avoiding monthly participation charges.
        - In Gulf Power’s case, shortening the high price period from nine to five hours in the summer and avoiding a monthly participation charge of $5 per month helped increase participation levels.
- **Marketing and Outreach**
    - During early stages of the program, cost effective channels for program marketing are direct mail, internet, TV, and outdoor advertising. Channels such as newspaper and radio are less effective.
    - After the program matures, internet can serve as the primary channel for program promotion.
        - In Gulf Power’s case, program enrollment is completely done online.
- **Program Participation**
    - Primary drivers for customer satisfaction are the following:
        - Simple rate design that participants can easily understand.
        - Perceived energy savings and control over energy use and savings opportunities.
        - Ability to program and control devices online.

Southern California Edison Company's C&I CPP Program

Southern California Edison, along with other utilities in California, has implemented critical peak pricing rates for non-residential customers. Table A-31 below lists specific characteristics of the program.

Table A-31 Southern California Edison's C&I CPP Program Characteristics

Program Attributes	Description
Targeted Segment	• Large C&I customers with maximum demand greater than 200 kW are defaulted to CPP rate. • Small C&I (with less than 20 kW demand), and medium C&I customers (with 20-200 kW demand) are offered CPP rates on a voluntary basis.
Enabling Technology for Load Control	Manual and Auto-DR strategies.
CPP Rate Structure[24]	1. TOU component during summer: Energy charges per kWh: On-peak: $0.124 Semi-peak: $0.091 Off-peak: $0.065 Demand charges per kW: On-peak: $12.96 Semi-peak: $3.08 Maximum: $13.3 2. CPP component during summer: CPP event adder (energy charges and credits per kWh): $1.362 Demand credit per kW: $11.62
Number of Times Events can be Called Annually	9 to 15 times. Maximum total CPP events per year is 60.
Event Notification	Day-ahead
Event Duration	4 hours
Metering Requirements	AMI is required

Key findings from impact evaluation studies of the 2012 SCE CPP program include:

- **Overall Demand Reductions.** In aggregate, participants reduced demand by 6.9% across the 2 to 6 PM event window for the average event day, delivering 32.9 MW of demand reduction.
- **Demand reductions are highly concentrated in specific industry segments.** Manufacturing and Wholesale, Transport and Other Utilities, and Agriculture accounted for the bulk of demand reductions. These customers made up 45% of program enrollment and 44% of program load at SCE, but accounted for 87% of overall demand reductions. Manufacturing and Wholesale, and Transport customers reduced a larger share of their demand than the average CPP customer, at 13.8% and 9.4% of enrolled load, respectively.

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[24] Based on 2012 Impact Evaluation Study

Real Time Pricing Programs

The Real Time Pricing programs that were selected for further investigation is listed in Table A-32 below. The table includes two additional program characteristics that relate to program performance: participation rates and impact estimates. The data on these characteristics are taken from the FERC survey database, wherever available. We indicate "NA" for cases where the data are not available.

Table A-32 Selected Real Time Pricing Programs

Offering entity	State	Scale	Winter Peak as % of summer peak	Retail Rate Difference with Avista (%)	No. of customers enrolled	Participation Rate (% of eligible customers)	Unit Impact (% of enrolled load)
Georgia Power Company	GA	Program	85.8%	-9.1%	2,033	~40%	NA

General Program Characteristics

A Real Time Pricing (RTP) rate, with prices varying by hour, is offered to large C&I customers. Hourly prices are often indexed to wholesale market prices. AMI is required for metering and settlement purposes.

Table A-33 below summarizes some of the characteristics of a RTP rate.

Table A-33 Summary of Program Characteristics

Program Attributes	Description
Resource Reliability	Non-firm.
Targeted segment	C&I customers.
DR Strategies	Load reduction and shifting to backup generators.
Event Trigger	No specific trigger, prices vary by the hour.
Event Notification	Day-ahead or hour-ahead.
Event Duration	Not applicable.
Incentive structure	Not applicable.
Penalties for non-performance	Not applicable.
Metering and Communication Systems	AMI for metering and settlement purposes.

Specific Program Examples

Below are summaries of the specific characteristics of the programs we researched.

Georgia Power Company's C&I RTP Program

Georgia Power has one of the largest Real Time Pricing (RTP) programs in the nation. The program offers two provisions for RTP rates: a day-ahead provision and an hour-ahead provision. The utility engages in a high level of customer education and outreach regarding the rate. This has been one of the most successful RTP program.

Table A-34 below lists specific characteristics of the program.

Table A-34 Georgia Power Company's C&I RTP Program Characteristics

Program Attributes	Description
Targeted Segment	Day-ahead provision: Large sized C&I customers with maximum demand greater than 250 kW. Hour-ahead provision: Large sized C&I customers with maximum demand greater than 5,000 kW.
Enabling Technology for Load Control	Manual and Auto-DR strategies.
Tariff structure	It has two parts: • Customer is billed for normal "baseline" usage at standard prices. • Any usage at the margin, above or below the baseline, is billed at the real time price.
Basis for Hourly Rates	Hourly prices are determined each day based on projections of the hourly running cost of incremental generation (including approved environmental costs), provisions for losses, projections of hourly transmission costs, reliability capacity costs for each day (when applicable), and a 3 mill/kWh recovery factor.
Number of times events can be called annually	Not applicable.
Event Notification	Day-ahead or hour ahead.
Event Duration	Not applicable.
Metering Requirements	AMI is required.

Ancillary Services / Load Following Pilots

Ancillary Services/Load Following pilots that were selected for further investigation are listed in Table A-35 below.

Table A-35 Selected Ancillary Services/Load Following Pilots

Offering entity	State	Scale	Winter Peak as % of summer peak	Retail Rate Difference with Avista (%)	No. of customers enrolled	Participation Rate (% of eligible customers)	Unit Impact
BPA-City of Port Angeles	WA	Pilot	120%	-	-	-	-
BPA-Mason County PUD No. 3	WA	Pilot	120%	-	-	-	-

Below, we discuss some of the general characteristics that are common for ancillary/load following services and then we provide descriptions of the selected pilots. We conclude by summarizing some of the important design and deployment aspects that any utility needs to keep in mind when considering DR resources to provide ancillary/load following services.

General Program Characteristics

For DR providing ancillary (spinning, non-spinning, regulation) and load following services, loads need to respond within a very short notification period, typically less than 10 minutes. This is often referred to as "Fast DR". DR providing load following services is relevant in the context of integrating intermittent renewable resources such a solar and wind. With increasing penetration of renewables, there is growing interest among utilities and system operators in this type of service.

Well-established programs exist in ERCOT, PJM, NYISO and HECO jurisdictions. BPA has launched pilots to specifically test DR integration with renewables.

Table A-36 below summarizes characteristics for DR providing ancillary/load following services.

Table A-36 Key Characteristics of Ancillary Services/Load Following Services Programs

Program Attributes	Description
Targeted Segments	Residential and C&I customers.
Event Notification	Less than or equal to 10 minutes.
Resource Availability	Resources need to be available all year round.
Annual Event Hours	• Typically range from 50-100 hours for providing ancillary services. • Events may be called with high frequency.
Typical Event Duration	• 10-60 minutes for providing ancillary services • Longer event hours, may be extending over a couple of hours or more, apply for providing load following services
DR Strategies	Load reduction and shifting to backup generators.
Event Trigger	• System contingency conditions requiring ancillary services. • Need for balancing intermittencies in renewable energy supply.
Incentive structure	Participants are offered both availability ($/kW-hr) and energy ($/kWh) payments.
Penalties for non-performance	Penalties apply for non-performance.
Customer segments and loads that could serve as good candidates	• Sites having flexibility in their operations, from having some sort of storage within the process (e.g. thermal energy) and production processes that are not adversely impacted by frequent starts and stops, are likely to be good candidates. • DR resources, without any energy storage component, have limited ability to provide regulation-down services, which is increasing load in response to sudden increase in supply. • Facilities with pumping loads often have storage capacity, which allows for load shifting without impacting production levels. Customer segments with pumping loads, such as water and wastewater treatment plants, municipal waterworks, and agricultural pumps, are likely to be good candidates. • Facilities with large thermal mass and refrigeration/compressor load are likely to be good candidates. These sites may be able to increase or decrease temperature set points, based on the facility load requirements. Examples of such facilities are food distribution warehouses and food processing plants, arenas/stadiums/convention centers, data centers, universities, hospitals. • Certain industrial processes with storage capacity can provide ancillary and flexible capacity products without disruptions in operations. Examples are pulp and paper, and cement. • Facilities with ventilating fan capacity can often reduce loads by cycling or turning off fans. Examples are manufacturing with volatile organic compounds or particulate processes, automobile painting.
Metering and Communication Systems	• Real time metering and communications required. • Meter data interval needs to be at 1 minute or less intervals.

Specific Examples

Below are brief descriptions of the pilots we researched.

BPA-City of Port Angeles C&I DR Pilot

This pilot was conducted during the period April to August 2012. The objective of this pilot was to test whether process storage could be used to support wind integration, with capabilities for both load curtailment and load increase. The technical infrastructure set up for monitoring load performance allowed visibility at one minute intervals.

Nine C&I sites were recruited for participation in the pilot, which included diverse customer types such as City Hall, waste water utility, housing authority, courthouse, library, medical center, and pulp and paper mill.

The pulp and paper mill exhibited greatest success in pilot performance. For the pulp and paper mill, DR signals were dispatched directly to the mill and all load response was directly controlled by mill personnel. The pulp and paper mill response was supported by inherent “process storage” capabilities in the production line.

Overall, the pilot was successful in demonstrating the technical feasibility of load response for integration with wind. Both load increase and load decrease could be attained with 10 minute response time. The next phase of this pilot is currently testing commercial feasibility of load response during the 2013-2014 time period.

BPA-Mason County PUD Pilot

This pilot tested water heater controls activated by a renewable energy signal, using Auto-DR technologies, for residential customers of Mason County Public Utility District No. 3. The pilot used a special device and an algorithm to allow water heaters to “sync” with wind turbines. The algorithm helped predict ahead of time when the wind power would be generated. The device, which was attached to the heaters, gave the utility the capability to turn them on and off during wind production cycles. Customers also had override switches. Overall, the pilot reported a high level of customer satisfaction with no impact on participant homes.

Cost Effectiveness Assessment for Demand Response

Below we describe what constitutes DR program costs and benefits and the overall approach used for assessing cost-effectiveness of DR programs.

DR Program Costs

Based on our experience with DR potential studies, we have constructed Table A-37 below that lists the cost components typically considered for a DR program. We briefly discuss these cost items and how they apply to the different program types included in our analysis.

An important aspect to consider in developing DR program costs is the underlying assumptions related to program delivery. A DR program can either be delivered by a utility or by a third-party. The allocation of costs across different types of programs in Table A-37 assumes in-house delivery across all program types, except for the Firm Curtailment program. For this particular program, based on commonly observed trends in the industry, we assume that it is delivered by a third party. Other types of programs, such as Non-Firm Curtailment programs and DLC programs can also be delivered by third parties. However, that is less commonly observed in the industry. Our delivery-mechanism assumptions for developing cost components are based on commonly observed industry trends.

Table A-37 Cost Components by DR Program Type

Cost Items	Unit	Type of Program				
		Direct Load Control	Firm Curtailment	Non-Firm Curtailment	Pricing Programs	Ancillary/ Load Following Services
Program Development Cost	$/program	x		x	x	x
Administration Cost	$/MW-year	x	x	x	x	x
Annual Marketing and Recruitment Costs	$/new participant	x		x	x	x
Equipment capital and installation costs	$/device installed	x			x	x
Annual O&M costs	$/year	x			x	x
Participant incentives	$/participant/ year	x				
	$/kW-year					x
	$/kWh			x		x
Third-party program delivery cost	$/kW-year		x			

A brief description of these cost items and how they are treated across programs follows.

- **Program Development Cost.** This is a one-time cost that is incurred for setting up a brand new program. This cost is usually specified in the number of FTEs required for setting a program up. It usually applies uniformly across all program types. The only exception could be a third-party delivered firm curtailment program, in which the utility itself does not incur any cost for setting up the program.

- **Annual Program Administration Cost.** This constitutes an annual recurring expense that is incurred for administering a DR program. It usually applies uniformly across all program types. It is common to specify this cost in terms of the unit load reduction amount ($/MW-year). There may be cases where the cost is specified as a fixed annual cost in terms of $/year.
- **Annual Marketing and Recruitment Costs.** This typically applies to all program types, except third-party delivered curtailment programs, in which case customer marketing and outreach activities are primarily undertaken by the third party. For pricing programs in particular, marketing and recruitment costs depend on whether a particular rate is offered on a voluntary basis with opt-in provision or as a default rate from which customers can opt-out. For a voluntary rate offer, per participant marketing and recruitment costs may be much higher than those incurred by defaulting all customers to a rate. Therefore, one needs to take into account the type of offer in developing costs for pricing options.
- **Equipment Capital and Installation Costs.** This usually refers to capital and installation costs for a load control switch or a thermostat in a DLC program. In pricing programs, this cost applies to the enabling technology used for achieving load reductions for residential and small commercial customers. For medium and large sized customers on DR programs, enabling technology costs commonly refer to costs for enabling Auto-DR on customer premises. Usually for third party delivered programs, the technology cost is rolled into a composite program delivery cost, especially where the third party is responsible for bearing technology costs.
- **Annual O&M Costs.** This is usually estimated as a fraction of the equipment capital cost and applies wherever specific enabling technology is deployed for load control.
- **Participant Incentives.** This applies to all DR programs that are non-price based. The structure of the incentive may differ, depending on the program type. For example, for DLC, incentives are usually structured as a fixed annual payment to the participant, irrespective of the load reduction amount. For other programs, incentive payments are based on actual performance. Although customer incentives do not apply to pricing options such as TOU, CPP and RTP rates, they apply to a Peak Time Rebate (PTR) type of offer.
- **Third-party Program Delivery Costs.** This constitutes the main cost item for a Firm Curtailment type program, delivered by a third party. The cost is specified in terms of unit annual capacity reduction ($/kW-year). Items such as customer incentive costs, program marketing and outreach, and equipment capital and installation costs, are all rolled into the program delivery cost.

There may be additional items that can be classified as DR program costs, but which may be difficult to estimate and quantify. Examples are increased costs of environmental compliance in cases where backup generators are operated for load shifting, costs arising out of "value of lost service", and other transaction costs associated with program participation. Therefore, these items cannot be included in assessing overall program costs.

DR Program Benefits

We discuss below items considered in estimation of DR program benefits.

- **Avoided Capacity Cost.** The primary component that is included in estimating benefits from DR programs is the avoided capacity cost. This is universally applied across all types of DR programs.
- **Avoided T&D Cost.** This item specifically applies to DR programs that address network congestion and are deployed to address transmission and distribution capacity constraints. It does not apply to programs that address only peak load reductions, since T&D capacity constraints are not a consideration for these programs.

- **Avoided Energy Benefits.** Unlike energy efficiency programs, energy savings benefits are typically not included in estimating DR program benefits. This is due to the small number of hours that are impacted by DR programs. When programs are called over extended periods of time, energy savings benefits may need to be included. However, one needs to take into consideration possible "snapback" effects that could arise after completion of a DR event, which effectively increases energy usage after DR events. Similarly, if any pre-cooling strategies are used prior to an event, increase in energy use for such behavior needs to be considered.
- **Avoided Ancillary Services Cost.** For DR programs providing ancillary/load following services, avoided ancillary services costs need to be estimated for calculating benefits. Ancillary services are valued differently than avoided capacity.

Additional benefits arising from DR programs that are usually difficult to estimate and quantify include items such as enhanced wholesale market competitiveness, reduced price volatility, and insurance against extreme events. However, since these are difficult to quantify, they are usually not included in overall benefit calculations.

Derating of Avoided Costs

One important consideration in estimating DR program benefits is the derating of avoided capacity benefits. The full value of the avoided costs is based on the performance of a peaking generator, which is not exactly equivalent to a DR program. For estimating DR benefits, a derating factor is often applied to the avoided capacity costs to reflect that DR programs typically supply a lower resource value than equivalent supply-side options. The lower resource value can be attributed primarily to the following factors:

- A DR program is not as dispatchable as a supply-side option, like a natural gas peaking generator. A peaking plant will run approximately 200 to 400 hours per year, while a DR program is typically constrained to run from 40 to 100 hours per year.
- Many DR programs are vested with a seasonal limitation, for example, one cannot exercise direct load control for Central AC in the middle of the winter.
- DR programs are also limited by constraints on human behavior and/or presence of automation systems.

Derating factors are often applied by utilities and grid operators to account for the reduced value of the different availability and dispatchability profiles. There are many ways to calculate the de-rating factor, based on program characteristics, value of load at certain hours, but there does not appear to be an industry-standard. Adjustment factors are developed at various levels of granularity, depending on what the state protocol specifies. For example, California protocols account for program limitations by applying multiple adjustment factors to the avoided cost of a new combustion turbine. These factors are determined and applied separately by each load serving entity in California and vary by program type, depending on the dispatchability and reliability of the resource. In certain other jurisdictions, a simpler approach may be followed by applying a common derating factor across all program types. A review of available literature on the topic indicated capacity derating values generally range from 0.60 to 1.00

Cost-effectiveness Assessment Framework

The Total Resource Cost (TRC) test is commonly followed for assessing cost-effectiveness of DR programs. Usually in DR programs, customers do not incur additional participation costs. Also, loss of revenue to the utility may be negligible. Under these conditions, the TRC formulation essentially becomes equivalent to the utility cost test (UCT) and the ratepayer impact measure (RIM) test. All of these tests use the same stream of benefits by default, and for DR, they reduce to the same stream of costs as well. However, there may be exceptions where program participation costs are significant and/or loss of revenue is substantial. Under such situations, one may need to consider additional tests other than TRC.

Additional Items for Assessing Cost-Effectiveness

Two additional items that are required for assessing cost-effectiveness of DR programs are program lifetime assumptions and discount rates. Lifetime assumptions vary by DR program. For example, DLC programs typically have a 10 to 15 year lifetime, depending on the life of the control technology (load control switch or thermostat). For pricing assumptions, program life is tied to the life of the meter, which is typically assumed to be 20 years. Curtailment Agreements, which are third-party-delivered capacity reductions, usually have a contract term of three to five years.

Impact Estimation Methods for Demand Response

This chapter discusses the commonly used approaches for estimating impacts from DR programs. It does not go into specifics of how impacts are estimated for a particular type of program. The discussion focuses on event-based DR programs. Therefore, the methods discussed in this chapter are likely to apply to all programs types included in this report, other than Real Time Pricing programs which are non-event based.

Types of Impact Estimation

Impact estimation can broadly be of two types: ex post or ex ante.

- **Ex post impact estimation** is required for assessing program performance and is also sometimes used for settlement purposes. However, most programs base settlement on calculated reductions from a program, which are calculated simply as the sum of demand reductions determined for each participant, using the program's settlement methods. Impact estimation for settlement purposes needs to be simple and produce rapid results. A more rigorous and accurate program level impact assessment is conducted in later stages to assess program performance, which may not be practical for settlement purposes.
- **Ex ante impact estimation** is required for projecting demand savings from future programs and cost-effectiveness of programs. It can also be used retrospectively for settlement purposes.

Baseline Calculation Methods[25]

The commonly followed approaches for calculating baseline load are briefly described below.

Baseline Window

The first step in calculating baseline load is to define the baseline window. This is the period of time preceding and optionally following a DR event over which electricity usage data is collected for establishing a baseline. Examples of baseline windows are:

- Last 10 non-holiday weekdays.
- 10 most recent program-eligible non-event days.
- 10 most recent program-eligible days beginning 2 days before the event.
- Last 45 calendar days.
- Previous year.

The common rules for excluding specific days from the baseline window are the following: exclude days with DR events, exclude days with outages, exclude days with extreme weather, and exclude days with highest or lowest loads.

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[25] "Measurement and Verification for Demand Response" prepared for the National Forum on the National Action Plan on Demand Response: Measurement and Verification Working Group". February, 2013.

Baseline Load Calculation

There are a number of methods for developing the baseline load value using load data from the baseline window. These are briefly discussed below.

- **Average Value Method.** This is the most commonly used method for baseline load calculation, where one simply calculates the average value of the load by hour, for the hours included in the baseline window.
- **Maximum Value Method.** This method takes the maximum load over the window period to calculate baseline load.
- **Regression Method.** This method calculates load by regressing the load from included days on weather and other variables, using separate regression coefficients for each hour of the day.
- **Rolling Average Method.** This method calculates the unadjusted baseline for an operating day as equal to 90 percent of the prior unadjusted baseline load, plus 10% of the load on the most recent included day.

Baseline Adjustments

Once the baseline load is calculated by one of the above methods, an adjustment factor is applied to align the baseline load with observed conditions during the event day. The baseline load calculated in the earlier step is referred to as the "unadjusted baseline". Adjustment factors may be based on variables such as temperature, humidity, and event day operating conditions.

The North American Energy Standards Board (NAESB) has set some guidelines that define the adjustment window, which is the timeframe that needs to be considered for baseline load adjustment. It specifies that the adjustment window should begin no more than four hours prior to the DR event. Commonly followed examples of adjustment windows are an hour before the event, two hours before the event, and the two hours that end two hours before the event.

Impact Estimation Methods[26]

Alternative methods used for estimating impacts from DR programs are briefly described below.

- **Individual regression analysis.** This method fits a regression model to an individual customer's load data over a year or a particular season. A common approach is to develop a model that describes a customer's load as a function of weather variables such as temperature and humidity. The model is developed to fit loads on non-event days and is used to estimate a customer's load that would have occurred absent a DR event. The impact is then calculated as the difference between the observed and modeled load over each event hour. The model can also be used to calculate post event rebound effects.
- **Pooled regression analysis.** This method uses a similar approach as the individual regression analysis, but fits a single model across a large group of participants and hours. A single set of coefficients is used to describe an average load pattern for all customers in the pool. This is a better method for estimating coefficients that may not be determined for an individual customer using individual regression analysis.
- **Match days**. This method first identifies one or more non-event days that are similar to each event day based on criteria such as similar temperature, temperature-humidity index, similar system load, or similar customer load during non-event hours. A particular customer's load on the match day, or the average of the loads across multiple match days, serves as the baseline or reference load. Demand reductions are calculated as the difference between the match day and event day hourly loads. However, estimating the accuracy of this method is

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[26] "Measurement and Verification for Demand Response" prepared for the National Forum on the National Action Plan on Demand Response: Measurement and Verification Working Group". February, 2013.

more difficult than accessing the precision of a regression model, and therefore, this method is not commonly used.

- **Experimental design.** This involves a random assignment of customers into two groups, one of which is the "treatment" group and the other is a "control" group. The treatment group is subjected to event dispatches while the control group is not. The average demand reduction per participant is calculated as the difference between the averages for the two groups. An alternative method for calculating impacts is to use the difference of differences method. In this method, baseline load is estimated separately for both treatment and control groups. The impact is then calculated as the difference between the treatment group's modeled and observed load, minus the corresponding difference for the control group.

  This method has been used for estimating impacts for large scale residential and/or commercial direct load control programs deployed by utilities, especially in California. It applies to customers who have interval metering data.

In addition to these approaches, end-use metering data can directly be used for estimating impacts, wherever interval meter data is available.

Time-of-Use Rates

Although TOU rates are out of scope for an analysis of demand response, AEG offered to perform an analysis of TOU rates so that Avista would have the information for future reference.

Program Description

A TOU rate is a time-varying rate. Relative to a revenue-equivalent flat rate, the rate during on-peak hours is higher, while the rate during off-peak hours is lower. This provides customers with an incentive to shift consumption out of the higher-price on-peak hours to the lower cost off-peak hours. TOU is not a demand-response option, per se, but rather a permanent load shifting opportunity. Large price differentials are generally more effective than smaller differentials. The TOU rate included here is based on a 2:1 on-peak to off-peak price ratio. We assumed that this rate is offered to all three C&I classes.

We considered two types of TOU pricing options. With an **opt-in** rate**,** participants voluntarily enroll in the rate. With an **opt-out** rate, all customers are placed on the time-varying rate but they may oft-out and select another rate if they so desire.

Participation in TOU rates requires interval meters. At this time, Avista’s Extra Large General Service customers have sophisticated telemetry and communications infrastructure in place and may be offered TOU beginning in 2016. For the other two customer classes, pricing options are not available until the AMI rollout is completed in 2020. Therefore, we assumed that TOU rates can be offered to General Service and Large General Service customers starting in 2021.

Table B-1 describes the features of a TOU rate.

Table B-1 Time of Use Rate Features

Program Attributes	Description	Comments
Targeted Segment	All C&I classes.	All customers are eligible to participate in a TOU rate.
Type of Offer	Two types of offers are possible: 1) TOU is offered as a voluntary rate to all customer classes with opt-in provision. 2) TOU is offered as a default rate to all customer classes with opt-out provision.	Based on program and pilot implementation experiences.
Resource Availability	TOU rates are available throughout the year. The peak period and off-peak period definitions can vary by season.	The peak and off-peak periods need to be defined based on Avista's specific requirements.
Delivery Mechanism	Delivered by Avista	Time varying rates are directly administered by the utility.
Type of Response	Load curtailment during peak period for a variety of end-uses and shifting of usage to off-peak periods.	
Participant Incentive	Peak to off-peak price differential induces participant to shift usage from peak period to off-peak periods. The off-peak rate is lower than the participant's standard rate	
Metering Requirements	Interval meter required for participation	Based on industry experience.

TOU Assumptions

The key parameters required to estimate potential for the two pricing options are participation rate, per participant load reduction and costs for deploying these rates. We have described below our assumptions on these parameters.

Program Participation Rate

We have defined participation rates for pricing options assuming independent offers of TOU, which results in voluntary, opt-in TOU rates to all customers and default TOU rates to all customers with opt-out.

All participation assumptions in pricing options are based on Brattle's extensive database on pricing program and pilot experiences.

Table B-2 presents assumed participation rates for C&I customers in independent TOU rate offers. We assumed that participation ramps up over a five-year timeframe to reach a steady-state level. For the opt-in offer, ramp up to steady-state participation follows an "S-shaped" diffusion curve, in which the participation growth rate accelerates over the first half of the five year period and then slows over the second half. A similar but inverse S-shaped diffusion curve is used to account for the rate at which customers opt-out of the default rate. TOU rates could be offered to Extra Large General service customers in 2016. For the other two classes, these rate are offered after AMI has been fully deployed by 2021.

Table B-2 TOU Participation Rates (% of eligible customers)

Option	Start Yr.	Yr. 1	Yr. 2	Yr. 3	Yr. 4	Yrs. 5-19	Comments
Opt-in							Standalone participation estimates represent average enrollment rates in independent rate offerings across full scale deployments and market research studies. (Source: Brattle's Pricing Program Database)
General Service & Large General Service	2021	1.3%	3.9%	7.8%	11.7%	13.0%	
Extra Large General Service	2016	1.3%	3.9%	7.8%	11.7%	13.0%	
Opt-out							
General Service & Large General Service	2021	100%	85.4%	78.9%	75.6%	74.0%	
Extra Large General Service	2016	100%	85.4%	78.9%	75.6%	74.0%	

Per Participant Load Reduction

Table B-3 below presents assumed per participant load reduction in TOU rates by customer class. The assumed impact values are based on a 2:1 peak to off-peak price ratio.

Table B-3 Per-Participant Load Reduction in TOU Rates by Customer Class

Customer Class	Value	Comments
General Service	0.2%	These impacts assume 2:1 peak to off-peak price ratio. Source: Brattle's Database on Pricing Programs.
Large General Service	2.6%	
Extra Large General Service	3.1%	

Program Costs

The major cost components for implementation of time varying rates are the fixed annual costs for administering the rates and providing billing analysis. For an opt-out offer, additional call center staff may be required during the initial program years to handle the relatively large volume of calls from customers defaulted to these rates. Table B-4 below shows itemized cost assumptions for opt-in and opt-out TOU offers. We developed these assumptions in consultation with the Avista team.

Table B-4 TOU Program Cost Assumptions for Opt-in and Opt-out Offers

Item	Unit	Value	Comments
Costs Applicable to Opt-in and Opt-out:			
Program Development Cost	$/program	$170,000	One FTE at $170,000 annual cost to design the TOU rates.
Annual Program Administration Cost	$/year	$170,000	One FTE at $170,000 annual cost to administer the TOU rates
Billing Analyst Cost	$/year	$105,000	One billing analyst at $105,000 in the call center to provide customer service.
Billing system upgrade	$	$7.5 million	Avista provided this estimate; Avista has no time-varying prices at the present time
Additional costs applicable to Opt-in:			
Per Customer Annual Marketing/Recruitment Cost	$/new participant/year	$10	Costs for TOU rates are assumed to be one fifth the costs for dynamic rates such as CPP. (Source: TVA Potential Study, 2011)
Additional costs applicable to Opt-out:			
Additional call center staff	$/year for first two program years	$255,000	We assumed that 3 additional call center staff @$85,000 each annual cost to handle customer calls for an opt-out rate.
Per Customer Annual Marketing/Recruitment Cost	$/new participant/year	$1	For opt-out TOU rates, these costs are assumed to be a tenth of the costs for opt-in TOU rates.

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Avista Electric Conservation Potential Assessment Study

Final Report

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SECTION 1

Introduction

Avista Corporation (Avista) engaged Applied Energy Group (AEG, formerly EnerNOC Utility Solutions) to conduct a Conservation Potential Assessment (CPA). The CPA is a 20-year study, performed in accordance with Washington Initiative 937 (I-937), that provides data on conservation resources to support development of Avista's 2013 Integrated Resource Plan (IRP). The study updates Avista's last CPA, which AEG performed in 2013.

This study provided enhanced analysis compared to the previous studies.

- The base-year for the analysis was brought forward from 2011 to 2013.
- For the residential sector, the study incorporated Avista's GenPOP residential saturation survey from 2012. This provided the foundation for the base-year market characterization and energy market profiles. The recently completed 2014 Residential Building Stock Assessment (RBSA) supplemented the GenPOP survey.
- For the commercial sector, the analysis was performed for the major building types in the service territory. Preliminary results from the 2015 Commercial Building Stock Assessment (CBSA) provided useful information for this characterization.
- This study also incorporated changes to the list of energy conservation measures, as a result of research by the Regional Technical Forum (RTF). In particular, LED lamps have dropped in price and now provide a significant opportunity for savings.
- The study incorporates updated forecasting assumptions that line up with the most recent Avista load forecast.
- Measure-adoption rates were developed using the Northwest Power and Conservation Council's (Council) ramp rates as a starting point and adjusted to reflect Avista program results in recent years.
- Finally, in addition to analyzing annual energy savings, the study also estimated the opportunity for reduction of summer peak demand. This involved a full characterization by sector, segment and end use of summer peak demand in the base year.

Compared to the previous study, potential savings decreased. The 10-year potential for Washington and Idaho in this CPA is 65.6 aMW, compared to 72.4 aMW from the previous study. This is a result of lower avoided costs, the expected impact of the most recent wave of appliance standards, the lighting standards in Energy Independence and Security Act (EISA) legislation, and Avista's recent capture of low-hanging fruit.

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
aMW	Average annual megawatt
ACS	American Community Survey
AEO	Annual Energy Outlook forecast developed by EIA
AHAM	Association of Home Appliance Manufacturers
AMI	Advanced Metering Infrastructure
AMR	Automated Meter Reading
Auto-DR	Automated Demand Response
B/C Ratio	Benefit to Cost Ratio
BEST	AEG’s Building Energy Simulation Tool
C&I	Commercial and Industrial
CAC	Central Air Conditioning
CBSA	Commercial Building Stock Assessment
CFL	Compact fluorescent lamp
CBECS	Commercial Buildings Energy Consumption Survey
CHP	Combined Heat and Power
Council	Northwest Power and Conservation Council
CPA	Conservation Potential Assessment
CPP	Critical Peak Pricing
CPUC	California Public Utilities Commission
DEEM	Database of Energy Efficiency Measures
DEER	Database for Energy Efficient Resources
DHW	Domestic Hot Water
DLC	Direct Load Control
DOE	Department of Energy
DR	Demand Response
DSM	Demand Side Management
EE	Energy Efficiency
EIA	Energy Information Administration
EISA	Energy Independence and Security Act
EPA	Environmental Protection Agency
EPRI	Electric Power Research Institute
EUL	Estimated Useful Life
EUI	Energy Use Intensity
FERC	Federal Energy Regulatory Commission
GWh	Gigawatt-hour
HH	Household
HID	High intensity discharge lamps
HVAC	Heating Ventilation and Air Conditioning
KWh	Kilowatt-hour
I-937	Washington Initiative 937
ICAP	Installed Capacity

Acronym	Explanation
IOU	Investor Owned Utility
IRP	Integrated Resource Plan
LED	Light emitting diode lamp
LoadMAP	AEG's Load Management Analysis and Planning^{TM} tool
MECS	Manufacturing Energy Consumption Survey
MW	Megawatt
NAPEE	National Action Plan for Energy-Efficiency
NEEA	Northwest Energy Efficiency Alliance
NOAA	National Oceanic and Atmospheric Administration
NPV	Net Present Value
NPCC	Northwest Power and Conservation Council
O&M	Operations and Maintenance
PCT	Programmable Communicating Thermostat
RBSA	Residential Building Stock Assessment
RECS	Residential Energy Consumption Survey
RTF	Regional Technical Forum
RTU	Roof top unit
SEER	Seasonal Energy Efficiency Ratio
SIC	Standard Industrial Classification
Sixth Plan	Sixth Northwest Conservation and Electric Power Plan
TRC	Total Resource Cost test
UEC	Unit Energy Consumption
WH	Water heater

SECTION | 2

Analysis Approach and Data Development

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

Overview of Analysis Approach

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

1. Perform a market characterization to describe sector-level electricity use for the residential, commercial, and industrial sectors for the base year, 2013.
2. Develop a baseline projection of energy consumption and peak demand by sector, segment, and end use for 2013 through 2035.
3. Define and characterize several hundred conservation measures to be applied to all sectors, segments, and end uses.
4. Estimate technical, economic, and achievable potential at the measure level in terms of energy and peak demand impacts from conservation measures for 2015-2035.

LoadMAP Model

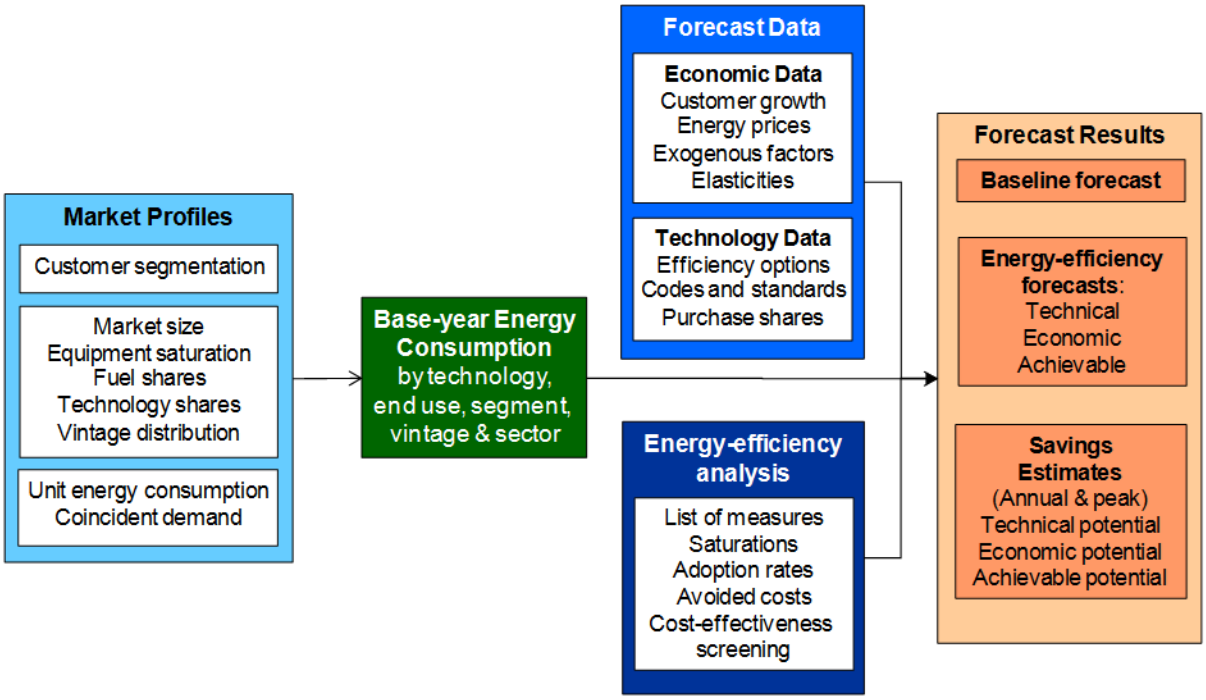
AEG used its Load Management Analysis and Planning tool (LoadMAP^{TM}) version 4.0 to develop both the baseline projection and the estimates of potential. AEG developed LoadMAP in 2007 and has enhanced it over time, using it for the Electric Power Research Institute (EPRI) National Potential Study and numerous utility-specific forecasting and potential studies since that time. Built in Excel, the LoadMAP framework (see Figure 2-1) is both accessible and transparent and has the following key features.

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

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

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

Figure 2-1 LoadMAP Analysis Framework



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

Definitions of Potential

In this study, the conservation potential estimates represent gross savings developed for three levels of potential: technical potential, economic potential, and achievable potential. These levels are described below.

- **Technical Potential** is defined as the theoretical upper limit of conservation potential. It assumes that customers adopt all feasible measures regardless of their cost. At the time of existing equipment failure, customers replace their equipment with the 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 applicable. For example, it includes installation of high-efficiency windows in all new construction opportunities and air conditioner maintenance in all existing buildings with central and room air conditioning. 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.
- **Economic Potential** represents the adoption of all ***cost-effective*** conservation measures. In this analysis, the cost-effectiveness is measured by the total resource cost (TRC) test, which compares lifetime energy and capacity benefits to the costs of the delivering the measure through a utility program, with incentives not included since they are a transfer payment. If the benefits outweigh the costs (that is, if the TRC ratio is equal to or greater than 1.0), a given measure is included in the economic potential. Customers are then assumed to purchase the most cost-effective option applicable to them at any decision juncture.
- **Achievable Potential** takes into account market maturity, customer preferences for energy-efficient technologies, and expected program participation. Achievable potential establishes a realistic target for the conservation savings that a utility can hope to achieve through its programs. It is determined by applying a series of annual market adoption factors to the economic potential for each conservation measure. These factors represent the ramp rates at which technologies will penetrate the market. To develop these factors, the project team reviewed Avista’s past conservation achievements and program history over the last five years, as well as the Northwest Power and Conservation Council’s (Council) ramp rates used in the Council’s Sixth Plan. Details regarding the market adoption factors appear in Appendix B.

Market Characterization

Now that we have described the modeling tool and provided the definitions of the potential cases, the first step in the analysis approach is market characterization. In order to estimate the savings potential from energy-efficient measures, it is necessary to understand how much energy is used today and what equipment is currently being used. This characterization begins with a segmentation of Avista’s electricity footprint to quantify energy use by sector, segment, end-use application, and the current set of technologies used. We rely primarily on information from Avista, Northwest Energy Efficiency Alliance (NEEA) and secondary sources as necessary.

Segmentation for Modeling Purposes

The market assessment first defined the market segments (building types, end uses, and other dimensions) that are relevant in the Avista service territory. The segmentation scheme for this project is presented in Table 2-1. Note that the low income segment is defined as 200% of the poverty level. Assuming 2.5 people per household, this is approximately annual household income of $35,000. The distribution to residential segment is based on the results of the Avista GenPOP survey.

Table 2-1 Overview of Avista Analysis Segmentation Scheme

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

With the segmentation scheme defined, we then performed a high-level market characterization of electricity sales in the base year to allocate sales to each customer segment. We used Avista data and secondary sources to allocate energy use and customers to the various sectors and segments such that the total customer count, energy consumption, and peak demand matched the Avista system totals from 2013 billing data. This information provided control totals at a sector level for calibrating the LoadMAP model to known data for the base-year.

Market Profiles

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

- **Market size** is a representation of the number of customers in the segment. For the residential sector, it is number of households. In the commercial sector, it is floor space measured in square feet. For the industrial sector, it is overall electricity use.
- **Saturations** define the fraction of homes or square feet with the various technologies. (e.g., homes with electric space heating).
- **UEC (unit energy consumption) or EUI (energy-use intensity)** describes the amount of energy consumed in 2013 by a specific technology in buildings that have the technology. For electricity, UECs are expressed in kWh/household for the residential sector, and EUIs are expressed in kWh/square foot for the commercial sector.
- **Annual Energy Intensity** for the residential sector represents the average energy use for the technology across all homes in 2013. It is computed as the product of the saturation and the UEC and is defined as kWh/household for electricity. For the commercial sector, intensity, computed as the product of the saturation and the EUI, represents the average use for the technology across all floor space in 2013.
- **Annual Usage** is the annual energy use by an end-use technology in the segment. It is the product of the market size and intensity and is quantified in gigawatt-hour (GWh).
- **Peak Demand** for each technology, summer peak and winter peak are calculated using peak fractions of annual energy use from AEG's EnergyShape library and Avista system peak data.

The market characterization results and the market profiles are presented in Chapter 3.

Baseline Projection

The next step was to develop the baseline projection of annual electricity use and summer peak demand for 2013 through 2034 by customer segment and end use without new utility programs. The end-use projection includes the relatively certain impacts of codes and standards that will unfold over the study timeframe. All such mandates that were defined as of December 2013 are included in the baseline. The baseline projection is the foundation for the analysis of savings from future conservation efforts as well as the metric against which potential savings are measured.

Inputs to the baseline projection include:

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

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

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

Conservation Measure Analysis

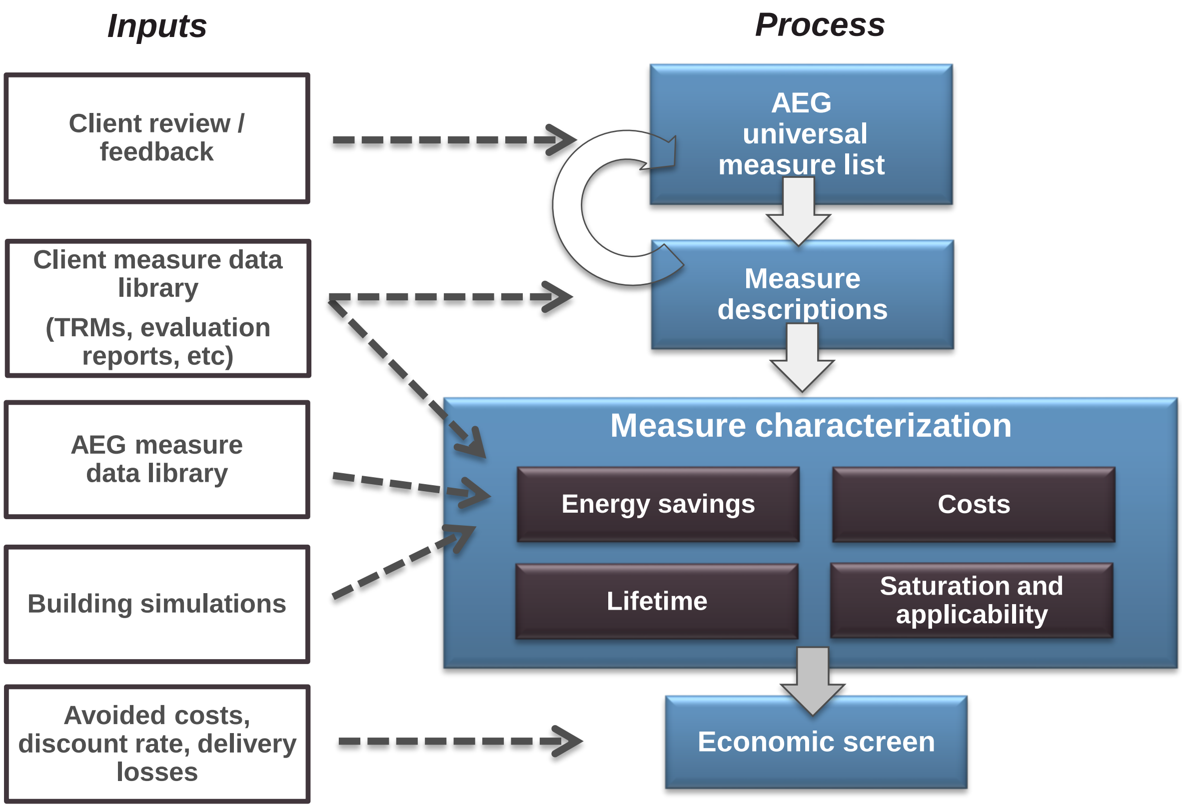
This section describes the framework used to assess the savings, costs, and other attributes of conservation measures. These characteristics form the basis for measure-level cost-effectiveness analyses as well as for determining measure-level savings. For all measures, AEG assembled information to reflect equipment performance, incremental costs, and equipment lifetimes. We used this information, along with Avista's avoided costs data, in the economic screen to determine economically feasible measures.

Conservation Measures

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

We compiled a robust list of conservation measures for each customer sector, drawing upon Avista's measure database, and the Regional Technical Forum (RTF) deemed measures databases, as well as a variety of secondary sources. This universal list of conservation measures covers all major types of end-use equipment, as well as devices and actions to reduce energy consumption. If considered today, some of these measures would not pass the economic screens initially, but may pass in future years as a result of lower projected equipment costs or higher avoided costs.

Figure 2-2 Approach for Conservation Measure Assessment



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

- **Equipment measures** are efficient energy-consuming pieces of equipment that save energy by providing the same service with a lower energy requirement than a standard unit. An example is an ENERGY STAR refrigerator that replaces a standard efficiency refrigerator. For equipment measures, many efficiency levels may be available for a given technology, ranging from the baseline unit (often determined by code or standard) up to the most efficient product commercially available. For instance, in the case of central air conditioners, this list begins with the current federal standard SEER 13 unit and spans a broad spectrum up to a maximum efficiency of a SEER 24 unit.
- **Non-equipment measures** save energy by reducing the need for delivered energy, but do not involve replacement or purchase of major end-use equipment (such as a refrigerator or air conditioner). An example would be a programmable thermostat that is pre-set to run heating and cooling systems only when people are home. Non-equipment measures can apply to more than one end use. For instance, addition of wall insulation will affect the energy use of both space heating and cooling. Non-equipment measures typically fall into one of the following categories:
    - Building shell (windows, insulation, roofing material)
    - Equipment controls (thermostat, energy management system)
    - Equipment maintenance (cleaning filters, changing setpoints)
    - Whole-building design (building orientation, passive solar lighting)
    - Lighting retrofits (included as a non-equipment measure because retrofits are performed prior to the equipment's normal end of life)

  - Displacement measures (ceiling fan to reduce use of central air conditioners)
  - Commissioning and retro commissioning (initial or ongoing monitoring of building energy systems to optimize energy use)

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

Once we assembled the list of conservation measures, the project team characterized measure savings, incremental cost, service life, and other performance factors, drawing upon data from the Avista measure database, the RTF deemed measure workbooks, and simulation modeling. Following the measure characterization, we performed an economic screening of each measure, which serves as the basis for developing the economic and achievable potential.

Representative Conservation Measure Data Inputs

To provide an example of the conservation measure data, Table 2-2 and Table 2-3 present examples of the detailed data inputs behind both equipment and non-equipment measures, respectively, for the case of residential central air conditioning (CAC) in single-family homes. Table 2-2 displays the various efficiency levels available as equipment measures, as well as the corresponding useful life, energy usage, and cost estimates. The columns labeled On Market and Off Market reflect equipment availability due to codes and standards or the entry of new products to the market.

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

Efficiency Level	Useful Life (yrs)	Equipment Cost	Energy Usage (kWh/yr)	On Market	Off Market
SEER 13	14 to 20	$2,549	1,466	2013	n/a
SEER 14 (Energy Star)	14 to 20	$3,072	1,344	2013	n/a
SEER 15 (CEE Tier 2)	14 to 20	$3,158	1,300	2013	n/a
SEER 16 (CEE Tier 3)	14 to 20	$3,148	1,262	2013	n/a
SEER 18	14 to 20	$3,708	1,203	2013	n/a
SEER 21	14 to20	$4,090	1,139	2013	n/a
SEER 24 (Ductless, Var. Ref. Flow)	14 to 20	$4,946	1,094	2013	n/a

Table 2-3 lists some of the non-equipment measures applicable to CAC 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 and costs are calculated for each year of the study and depend on the base year saturation of the measure, the applicability[2] of the measure, and the savings as a percentage of the relevant energy end uses.

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

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

End Use	Measure	Saturation in 2013[3]	Applica-bility	Lifetime (yrs)	Measure Installed Cost	Energy Savings (%)
Cooling	Insulation - Ceiling	35%	50.0%	45	$1,134	5%
Cooling	Insulation - Radiant Barrier	15%	75.0%	15	$1,245	13%
Cooling	Ducting - Repair and Sealing	15%	50.0%	20	$538	5%
Cooling	Windows - High Efficiency	20%	75.0%	45	$2,908	9%
Cooling	Thermostat - Clock/Programmable	30%	40.0%	15	$230	4%

Screening Measures for Cost-Effectiveness

Only measures that are cost-effective are included in economic and achievable potential. Therefore, for each individual measure, LoadMAP performs an economic screen. This study uses the TRC test that compares the lifetime energy and peak demand benefits of each applicable measure with its cost. The lifetime benefits are calculated by multiplying the annual energy and demand savings for each measure by all appropriate avoided costs for each year, and discounting the dollar savings to the present value equivalent. Lifetime costs represent incremental measure cost and annual operations and maintenance (O&M) costs. 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, taking into account changing savings and cost data over time. Thus, some measures pass the economic screen for some — but not all — of the years in the projection.

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 kilowatt-hour (kWh) savings potential of a measure, kWh consumption with the measure applied must be compared to the kWh 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 particular building type and vintage, it is excluded from the respective economic screen.
- If multiple equipment measures have benefit to cost ratios (B/C ratios) greater than or equal to 1.0, the most efficient technology is selected by the economic screen.

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

Table 2-4 Number of Measures Evaluated

Sector	Total Measures	Measure Permutations w/ 2 Vintages	Measure Permutations w/ Segments
Residential	60	120	480
Commercial	82	164	1,804
Industrial	57	114	114
Total Measures Evaluated	**199**	**398**	**2,398**

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[3] Note that saturation levels reflected for the base year change over time as more measures are adopted.

The appendix to this volume presents results for the economic screening process by segment, vintage, end use and measure for all sectors.

Conservation Potential

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

- **Technical potential** is a theoretical construct that assumes the highest efficiency measures that are technically feasible to install are adopted by customers, regardless of cost or customer preferences. Thus, determining the technical potential is relatively straightforward. LoadMAP "chooses" the most efficient equipment options for each technology at the time of equipment replacement. In addition, it installs all relevant non-equipment measures for each technology to calculate savings. For example, for central air conditioning, as shown in Table 2-2, the most efficient option is a SEER 24. The multiple non-equipment measures shown in Table 2-3 are then applied to the energy used by the SEER 24 system to further reduce air conditioning energy use. LoadMAP applies the savings due to the non-equipment measures one-by-one to avoid double counting of savings. The measures are evaluated in order of their B/C ratio, with the measure with the highest B/C ratio applied first. Each time a measure is applied, the baseline energy use for the end use is reduced and the percentage savings for the next measure is applied to the revised (lower) usage.
- **Economic potential** results from the purchase of the most efficient cost-effective option available for a given equipment or non-equipment measure as determined in the cost-effectiveness screening process described above. As with technical potential, economic potential is a phased-in approach. Economic potential is still a hypothetical upper-boundary of savings potential as it represents only measures that are economic, but does not yet consider customer acceptance and other factors.
- **Achievable potential** defines the range of savings that is very likely to occur. It accounts for customers' awareness of efficiency options, any barriers to customer adoption, limits to program design, and other factors that influence the rate at which conservation measures penetrate the market.

The calculation of technical and economic potential is a straightforward algorithm. To develop estimates for achievable potential, we develop market adoption rates for each measure that specify the percentage of customers that will select the highest–efficiency economic option. For Avista, the project team began with the ramp rates specified in the Sixth Plan conservation workbooks, but modified these to match Avista program history and service territory specifics. For specific measures, we examined historic program results for the most recent program results. We then adjusted the 2014 achievable potential for these measures to approximately match the historical results. This provided a starting for 2014 potential that was aligned to historic results. For future years, we increased the potential factors to model increasing market acceptance and program improvements. For measures not currently included in Avista programs, we relied upon the Sixth Plan ramp rates and recent AEG potential studies to create market adoption rates for Avista. The market adoption rates for each measure appear in Appendix B.

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

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

Data Development

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

Data Sources

The data sources are organized into the following categories:

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

Avista Data

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

- **Avista customer data:** Avista provided billing data for development of customer counts and energy use for each sector. We also used the results of the Avista GenPOP survey, a residential saturation survey.
- **Load forecasts:** Avista provided an economic growth forecast by sector; electric load forecast; peak-demand forecasts at the sector level; and retail electricity price history and forecasts.
- **Economic information:** Avista Power provided avoided cost forecasts, a discount rate, and line loss factor.
- **Avista program data**: Avista provided information about past and current programs, including program descriptions, goals, and achievements to date.

Northwest Energy Efficiency Alliance Data

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

- **Northwest Energy Efficiency Alliance, 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, 2011 Residential Building Stock Assessment: Manufactured Home**, Market Research Report, #E13-249, January, 2013. http://neea.org/docs/default-source/reports/residential-building-stock-assessment--manufactured-homes-characteristics-and-energy-use.pdf?sfvrsn=8
- **Northwest Energy Efficiency Alliance, Long-Term Northwest Residential Lighting Tracking and Monitoring Study**, Market Research Report, 11-228, August, 2011. http://neea.org/research/reports/E11-231_Combinedv2.pdf
- **Northwest Energy Efficiency Alliance, 2011 Residential Building Stock Assessment: Multifamily**, Market Research Report, #13-263, September, 2013. http://neea.org/docs/default-source/reports/residential-building-stock-assessment--multi-family-characteristics-and-energy-use.pdf?sfvrsn=4
- **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.

Conservation Measure Data

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

- **Northwest Power and Conservation Council Sixth Plan Conservation Supply Curve Workbooks.** To develop its Sixth Power Plan, the Council used workbooks with detailed information about measures, available at http://www.nwcouncil.org/energy/powerplan/6/supplycurves/default.htm .
- **Regional Technical Forum Deemed Measures.** The NPCC Regional Technical Forum maintains databases of deemed measure savings data, available at http://www.nwcouncil.org/energy/rtf/measures/Default.asp .

AEG Data

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

- **AEG Energy Market Profiles**: For more than 10 years, AEG staff has maintained profiles of end-use consumption for the residential, commercial, and industrial sectors. These profiles include market size, fuel shares, unit consumption estimates, and annual energy use by fuel (electricity and natural gas), customer segment and end use for 10 regions in the U.S. The Energy Information Administration surveys (RECS, CBECS and MECS) as well as state-level statistics and local customer research provide the foundation for these regional profiles.
- **Building Energy Simulation Tool (BEST)**. AEG's BEST is a derivative of the Department of Energy (DOE) 2.2 building simulation model, used to estimate base-year UECs and EUIs, as well as measure savings for heating, ventilation and air conditioning (HVAC)-related measures.
- **AEG's EnergyShape™:** This database of load shapes includes the following:
    - Residential – electric load shapes for ten regions, three housing types, 13 end uses
    - Commercial – electric load shapes for nine regions, 54 building types, ten end uses
    - Industrial – electric load shapes, whole facility only, 19 2-digit SIC codes, as well as various 3-digit and 4-digit SIC codes
- **AEG's Database of Energy Efficiency Measures (DEEM):** AEG maintains an extensive database of measure data for our studies. Our database draws upon reliable sources including the California Database for Energy Efficient Resources (DEER), the Energy Information Administration (EIA) Technology Forecast Updates – Residential and Commercial Building Technologies – Reference Case, RS Means cost data, and Grainger Catalog Cost data**.**
- **Recent studies**. AEG has conducted numerous studies of conservation potential in the last five years. We checked our input assumptions and analysis results against the results from these other studies, which include Tacoma Power, Idaho Power, PacifiCorp, Ameren Missouri, Vectren Energy, Indianapolis Power & Light, Tennessee Valley Authority, Ameren Missouri, Ameren Illinois, and Seattle City Light. In addition, we used the information about impacts of building codes and appliance standards from recent reports for the Edison Electric Institute[5].

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

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 2013 AEO.
- **Local Weather Data:** Weather from NOAA's National Climatic Data Center for Spokane, WA was used as the basis for building simulations.
- **EPRI End-Use Models (REEPS and COMMEND)**. These models provide the elasticities we apply to electricity prices, household income, home size and heating and cooling.
- **Database for Energy Efficient Resources (DEER).** The California Energy Commission and California Public Utilities Commission (CPUC) sponsor this database, which is designed to provide well-documented estimates of energy and peak demand savings values, measure costs, and effective useful life (EUL) for the state of California. We used the DEER database to cross check the measure savings we developed using BEST and DEEM.
- **Other relevant regional sources:** These include reports from the Consortium for Energy Efficiency, the Environmental Protection Agency (EPA), and the American Council for an Energy-Efficient Economy.

Data Application

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

Data Application for Market Characterization

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

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

Data Application for Market Profiles

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

1. Developed control totals for each segment. These include market size, segment-level annual electricity use, and annual intensity.
2. Used the Avista GenPOP Survey, NEEA's RBSA, NEEA's CBSA and AEG's Energy Market Profiles database to develop existing appliance saturations, appliance and equipment characteristics, and building characteristics.

3. Ensured calibration to control totals for annual electricity sales in each sector and segment.
4. Compared and cross-checked with other recent AEG studies.
5. Worked with Avista staff to vet the data against their knowledge and experience.

Data Application for Baseline Projection

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

Table 2-5 Data Applied for the Market Profiles

Model Inputs	Description	Key Sources
Market size	Base-year residential dwellings, commercial floor space, and industrial employment	Avista billing data Avista GenPOP Survey NEEA RBSA and CBSA AEO 2013
Annual intensity	**Residential**: Annual use per household **Commercial**: Annual use per square foot **Industrial**: Annual use per employee	Avista billing data AEG's Energy Market Profiles NEEA RBSA and CBSA AEO 2013 Other recent studies
Appliance/equipment saturations	Fraction of dwellings with an appliance/technology Percentage of C&I floor space/employment with equipment/technology	Avista GenPOP Survey NEEA RBSA and CBSA AEG's Energy Market Profiles Avista Load Forecasting
UEC/EUI for each end-use technology	UEC: Annual electricity use in homes and buildings that have the technology EUI: Annual electricity use per square foot/employee for a technology in floor space that has the technology	NPCC Sixth Plan and RTF data HVAC uses: BEST simulations using prototypes developed for Idaho Engineering analysis DEEM Recent AEG studies
Appliance/equipment age distribution	Age distribution for each technology	NPCC Sixth Plan and RTF data NEEA regional survey data Utility saturation surveys Recent AEG studies
Efficiency options for each technology	List of available efficiency options and annual energy use for each technology	AEG DEEM AEO 2013 DEER NPCC workbooks, RTF Previous studies
Peak factors	Share of technology energy use that occurs during the peak hour	EnergyShape database

Table 2-5 Data Needs for the Baseline Projection and Potentials Estimation in LoadMAP

Model Inputs	Description	Key Sources
Customer growth forecasts	Forecasts of new construction in residential and C&I sectors	Avista load forecast AEO 2013 economic growth forecast
Equipment purchase shares for baseline projection	For each equipment/technology, purchase shares for each efficiency level; specified separately for existing equipment replacement and new construction	Shipments data from AEO AEO 2013 regional forecast assumptions[6] Appliance/efficiency standards analysis Avista program results and evaluation reports
Electricity prices	Forecast of average energy and capacity avoided costs and retail prices	Avista forecast
Utilization model parameters	Price elasticities, elasticities for other variables (income, weather)	EPRI's REEPS and COMMEND models AEO 2013

In addition, we implemented assumptions for known future equipment standards as of December 2013, as shown in Table 2-6, Table 2-7 and Table 2-8. The assumptions tables here extend through 2025, after which all standards are assumed to hold steady.

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[6] We developed baseline purchase decisions using the Energy Information Agency's *Annual Energy Outlook* report (2013), which utilizes the National Energy Modeling System (NEMS) to produce a self-consistent supply and demand economic model. We calibrated equipment purchase options to match manufacturer shipment data for recent years and then held values constant for the study period. This removes any effects of naturally occurring conservation or effects of future EE programs that may be embedded in the AEO forecasts.

Table 2-6 Residential Electric Equipment Standards[7]

▭ 2013's Efficiency or Standard Assumption

🟦 1st Standard (relative to 2013's standard)

🟫 2nd Standard (relative to 2013's standard)

End Use	Technology	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cooling	Central AC	SEER 13												
	Room AC	EER 9.8	EER 11.0											
	Evaporative Central AC	Conventional												
	Evaporative Room AC	Conventional												
Cooling/Heating	Heat Pump	SEER 13.0/HSPF 7.7		SEER 14.0/HSPF 8.2										
Space Heating	Electric Resistance	Electric Resistance												
Water Heating	Water Heater (<=55 gallons)	EF 0.90		EF 0.95										
	Water Heater (>55 gallons)	EF 0.90		Heat Pump Water Heater										
Lighting	Screw-in/Pin Lamps	Incandescent	Advanced Incandescent - tier 1 (20 lumens/watt)						Advanced Incandescent - tier 2 (45 lumens/watt)					
	Linear Fluorescent	T8 (89 lumens/watt)					T8 (92.5 lumens/watt)							
Appliances	Refrigerator/2nd Refrigerator	NAECA Standard	25% more efficient											
	Freezer	NAECA Standard	25% more efficient											
	Dishwasher	14% more efficient than 2010 standard (307 kWh/yr)												
	Clothes Washer	Conventional (MEF 1.26 for top loader)		MEF 1.72 for top loader			MEF 2.0 for top loader							
	Clothes Dryer	Conventional (EF 3.01)		EF 3.73										
	Microwave Ovens	Conventional			1.0 Watts (maximum standby power)									
Miscellaneous	Furnace Fans	Conventional						40% more efficient						

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

Table 2-7 Commercial Electric Equipment Standards[8]

▢ 2013's Efficiency or Standard Assumption
🟦 1st Standard (relative to 2013's standard)
🟫 2nd Standard (relative to 2013's standard)

End Use	Technology	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cooling	Chillers	2007 ASHRAE 90.1												
	Roof Top Units	EER 11.0/11.2												
	Packaged Terminal AC/HP	EER 11.0/11.2												
Cooling/Heating	Heat Pump	EER 11.0/COP 3.3												
Ventilation	Ventilation	Constant Air Volume/Variable Air Volume												
Lighting	Screw-in/Pin Lamps	Incandescent	Advanced Incandescent - tier 1 (20 lumens/watt)						Advanced Incandescent - tier 2 (45 lumens/watt)					
	Linear Fluorescent	T8 (89 lumens/watt)					T8 (92.5 lumens/watt)							
	High Intensity Discharge	EPACT 2005 (Mercury Vapor Fixture Phase-out)				Metal Halide Ballast Improvement								
Water Heating	Water Heater	EF 0.97												
Refrigeration	Walk-in Refrigerator/Freezer	EISA 2007 Standard				10-38% more efficient								
	Reach-in Refrigerator	EPACT 2005 Standard				40% more efficient								
	Glass Door Display	EPACT 2005 Standard				12-28% more efficient								
	Open Display Case	EPACT 2005 Standard				10-20% more efficient								
	Vending Machines	33% more efficient than EPAC 2005 Standard												
	Ice maker	2010 Standard					15% more efficient							
Miscellaneous	Non-HVAC Motors	EISA 2007 Standards			Expanded EISA 2007 Standards									

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

Table 2-8 Industrial Electric Equipment Standards[9]

▢ 2013's Efficiency or Standard Assumption
▨ 1st Standard (relative to 2013's standard)
▩ 2nd Standard (relative to 2013's standard)

End Use	Technology	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Cooling	Chillers	2007 ASHRAE 90.1												
	Roof Top Units	EER 11.0/11.2												
	Packaged Terminal AC/HP	EER 11.0												
Cooling/Heating	Heat Pump	EER 11.0/COP 3.3												
Ventilation	Ventilation	Constant Air Volume/Variable Air Volume												
Lighting	Screw-in/Pin Lamps	Incandescent	Advanced Incandescent - tier 1 (20 lumens/watt)						Advanced Incandescent - tier 2 (45 lumens/watt)					
	Linear Fluorescent	T8 (89 lumens/watt)					T8 (92.5 lumens/watt)							
	High Intensity Discharge	EPACT 2005 (Mercury Vapor Fixture Phase-out)				Metal Halide Ballast Improvement								
Motors	Pumps, Fans & Blowers, Compressed Air, Material Handling and Processing	EISA 2007 Standards			Expanded EISA 2007 Standards									

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

Conservation Measure Data Application

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

Table 2-9 Data Needs for the Measure Characteristics in LoadMAP

Model Inputs	Description	Key Sources
Energy Impacts	The annual reduction in consumption attributable to each specific measure. Savings were developed as a percentage of the energy end use that the measure affects.	Avista measure data NPCC Sixth Plan conservation workbooks BEST AEG DEEM AEO 2013 DEER NPCC workbooks, RTF Other secondary sources
Peak Demand Impacts	Savings during the peak demand periods are specified for each electric measure. These impacts relate to the energy savings and depend on the extent to which each measure is coincident with the system peak.	Avista measure data NPCC Sixth Plan conservation workbooks BEST AEG DEEM EnergyShape
Costs	Equipment Measures: Includes the full cost of purchasing and installing the equipment on a per-household, per-square-foot, per employee or per service point basis for the residential, commercial, and industrial sectors, respectively. Non-equipment measures: Existing buildings – full installed cost. New Construction - the costs may be either the full cost of the measure, or as appropriate, it may be the incremental cost of upgrading from a standard level to a higher efficiency level.	Avista measure data NPCC Sixth Plan conservation workbooks RTF deemed measure database AEG DEEM AEO 2013 DEER RS Means Other secondary sources
Measure Lifetimes	Estimates derived from the technical data and secondary data sources that support the measure demand and energy savings analysis.	Avista measure data NPCC Sixth Plan conservation workbooks RTF deemed measure database AEG DEEM AEO 2013 DEER Other secondary sources
Applicability	Estimate of the percentage of dwellings in the residential sector, square feet in the commercial sector, or employees in the industrial sector where the measure is applicable and where it is technically feasible to implement.	Avista measure data NPCC Sixth Plan conservation workbooks RTF deemed measure database AEG DEEM DEER Other secondary sources
On Market and Off Market Availability	Expressed as years for equipment measures to reflect when the equipment technology is available or no longer available in the market.	AEG appliance standards and building codes analysis

Data Application for 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 2013 dollars. We applied a discount rate of 4% in in real dollars. All impacts in this report are presented at the customer meter, but electric energy delivery losses of 6.5% were provided by Avista in order to gross up impacts to the generator for economic analysis. The avoided costs provided by Avista were increased by 10% to account for the Power Act’s conservation preference.

Achievable Potential Estimation

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

- **Technical diffusion curves for non-equipment measures**. Equipment measures are installed when existing units fail. Non-equipment measures do not have this natural periodicity, so rather than installing all available non-equipment measures in the first year of the projection (instantaneous potential), they are phased in according to adoption schedules that generally align with the diffusion of similar equipment measures. The adoption rates for the Avista study were based on ramp rate curves specified in the NPCC Sixth Power Plan, but modified to reflect Avista program history. These adoption rates are used within LoadMAP to generate the Technical and Economic potentials for non-equipment measures.
- **Adoption rates**. Customer adoption rates or take rates are applied to Economic potential to estimate Achievable Potential. These rates were developed by mapping each measure to a ramp rate developed by the Northwest Power and Conservation Council for the Sixth Plan. These rates are then compared with the recent Avista program results and adjustments were made, if necessary. For example, if the program had been running for several years and had achieved higher results in the previous year, the ramp rate started further along in the curve. These rates represent customer adoption of economic 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. Adoption rates are presented in Appendix B.

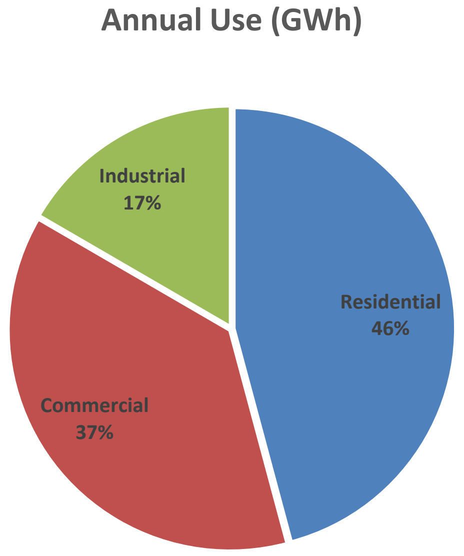
Market Characterization and Market Profiles

In this section, we describe how customers in the Avista service territory use electricity in the base year of the study, 2013. It begins with a high-level summary of energy use across all sectors and then delves into each sector in more detail.

Energy Use Summary

Total electricity use for the residential, commercial, and industrial sectors for Avista in 2013 was 8,081 GWh; 5,555 GWh (WA) and 2,526 GWh (ID). As shown in the tables below, in both states the residential sector accounts for over 45% of the annual energy use, followed by commercial with over 35% of the annual energy use. In terms of summer peak demand, the total system peak in 2013 was 1,459 MW; 1,017 MW (WA) and 442 MW (ID). The total system peak in the winter was 1,417 MW; 973 MW (WA) and 444 MW (ID). In both states, the residential sector contributes over 40% to peak.

Figure 3-1 Sector-Level Electricity Use in Base Year 2013, Washington



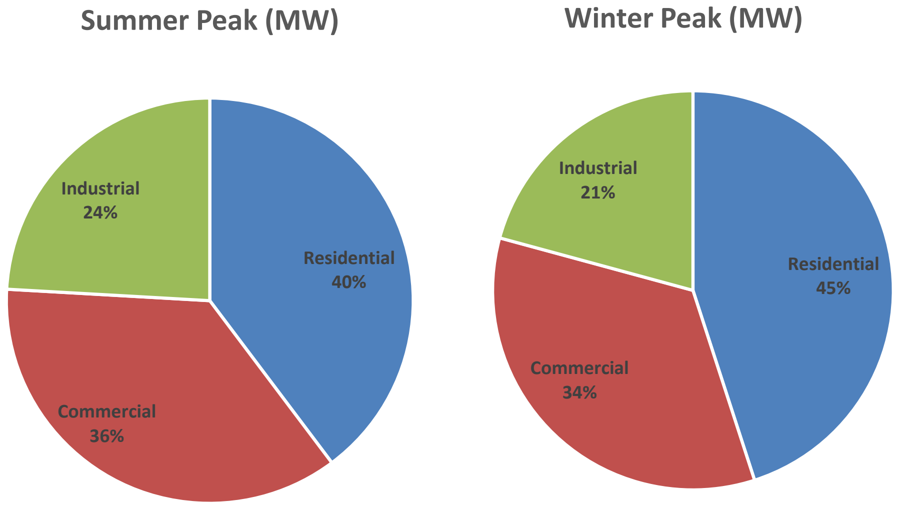


Table 3-1 Avista Sector Control Totals (2013), Washington

Sector	Annual Electricity Use (GWh)	% of Annual Use	Summer Peak Demand (MW)	% of Summer Peak	Winter Peak Demand (MW)	% of Winter Peak
Residential	2,546	46%	404	40%	438	45%
Commercial	2,086	38%	368	36%	333	34%
Industrial	922	17%	245	24%	202	21%
Total	**5,555**	**100%**	**1,017**	**100%**	**973**	**100%**

Figure 3-2 Sector-Level Electricity Use in Base Year 2013, Idaho

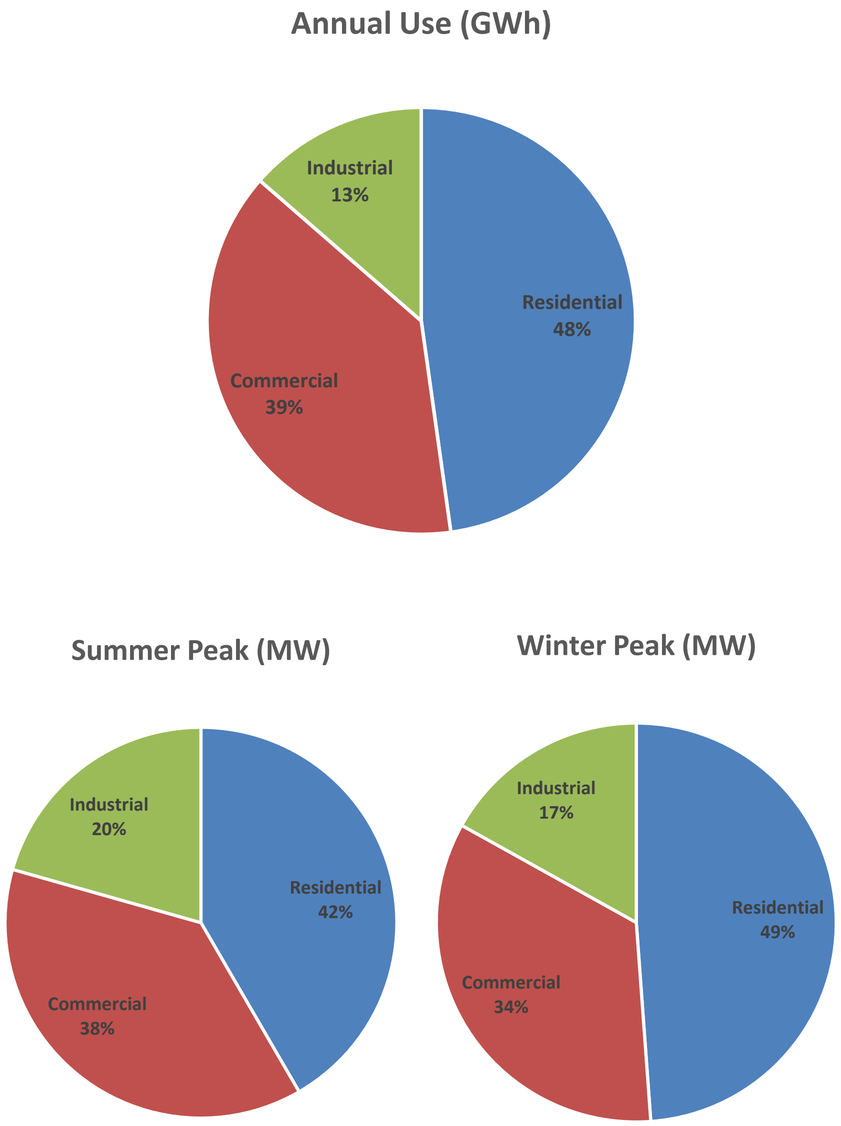


Table 3-2 Avista Sector Control Totals (2013), Idaho

Sector	Annual Electricity Use (GWh)	% of Annual Use	Summer Peak Demand (MW)	% of Summer Peak	Winter Peak Demand (MW)	% of Winter Peak
Residential	1,207	48%	184	42%	217	49%
Commercial	976	39%	167	38%	152	34%
Industrial	343	14%	91	21%	75	17%
Total	**2,526**	**100%**	**442**	**100%**	**444**	**100%**

Residential Sector

The total number of households and electricity sales for the service territory were obtained from Avista's customer database. In 2013, there were 213,640 households in the state of Washington that used a total of 2,546 GWh with a summer peak demand of 404 MW and a winter peak demand of 438 MW. Average use per customer (or household) at 11,919 kWh is about average compared to other regions of the country. We allocated these totals into four residential segments and the values are shown in Table 3-3.

Table 3-4 shows the total number of households and electricity sales in the state of Idaho. . In 2013, there were 107,449 households that used a total of 1,207 GWh with summer peak demand of 184 MW and winter peak demand of 217 MW. Average use per customer (or household) was 11,233.

Table 3-3 Residential Sector Control Totals (2013), Washington

Segment	Number of Customers	Electricity Use (GWh)	% of Annual Use	Annual Use/Customer (kWh/HH)	Summer Peak (MW)	Winter Peak (MW)
Single Family	129,893	1,783	70%	13,726	296	304
Multifamily	11,964	99	4%	8,236	13	22
Mobile Home	7,691	95	4%	12,354	13	16
Low Income	64,092	570	22%	8,892	82	96
Total	**213,640**	**2,546**	**100%**	**11,919**	**404**	**438**

Table 3-4 Residential Sector Control Totals (2013), Idaho

Segment	Number of Customers	Electricity Use (GWh)	% of Annual Use	Annual Use/Customer (kWh/HH)	Summer Peak (MW)	Winter Peak (MW
Single Family	65,329	843	70%	12,902	133	153
Multifamily	5,265	41	3%	7,733	6	9
Mobile Home	4,835	56	5%	11,599	8	10
Low Income	32,020	267	22%	8,349	38	46
Total	**107,449**	**1,207**	**100%**	**11,233**	**184**	**217**

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

Figure 3-3 (WA) and Figure 3-4 (ID) show the distribution of annual electricity use by end use for all customers. Two main electricity end uses —appliances and space heating— account for approximately 50% of total use. Appliances include refrigerators, freezers, stoves, clothes washers, clothes dryers, dishwashers, and microwaves. The remainder of the energy falls into the water heating, lighting, cooling, electronics, and the miscellaneous category – which is comprised of furnace fans, pool pumps, and other "plug" loads (all other usage not covered by those listed in Table 3-5 and Table 3-6 such as hair dryers, power tools, coffee makers, etc.).

The charts also show estimates of peak demand by end use. Appliances are the largest contributor to summer peak demand, followed by water heating. During the winter, heating is the largest contributor to peak demand, followed by appliances.

Figure 3-5 (WA) and Figure 3-6 (ID) present the electricity intensities by end use and housing type. Single family homes have the highest use per customer at 13,726 kWh/year (WA) and 12,902 kWh/year (ID).

Figure 3-3 Residential Electricity Use and Summer Peak Demand by End Use (2013), Washington

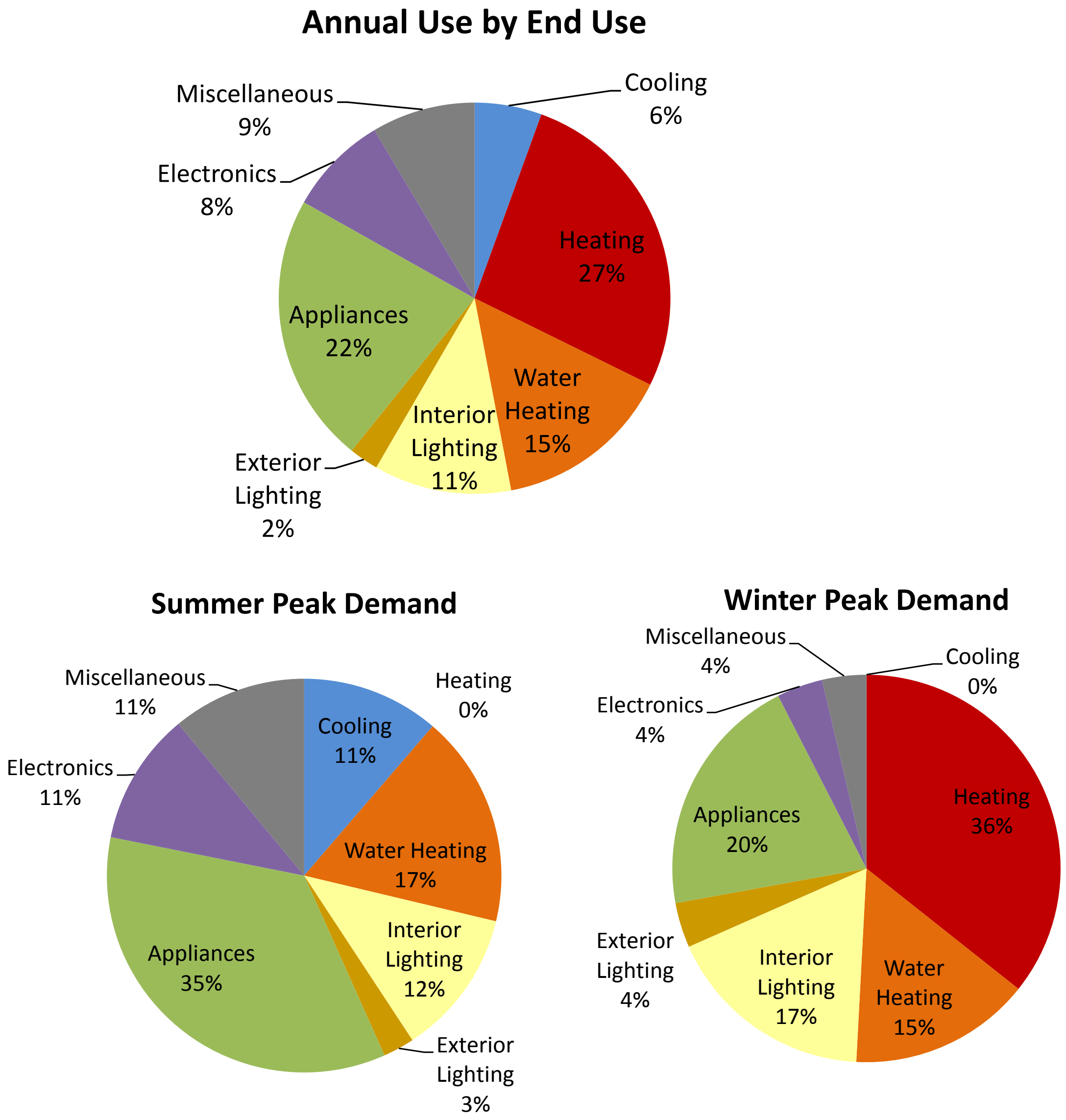


Figure 3-4 Residential Electricity Use and Summer Peak Demand by End Use (2013), Idaho

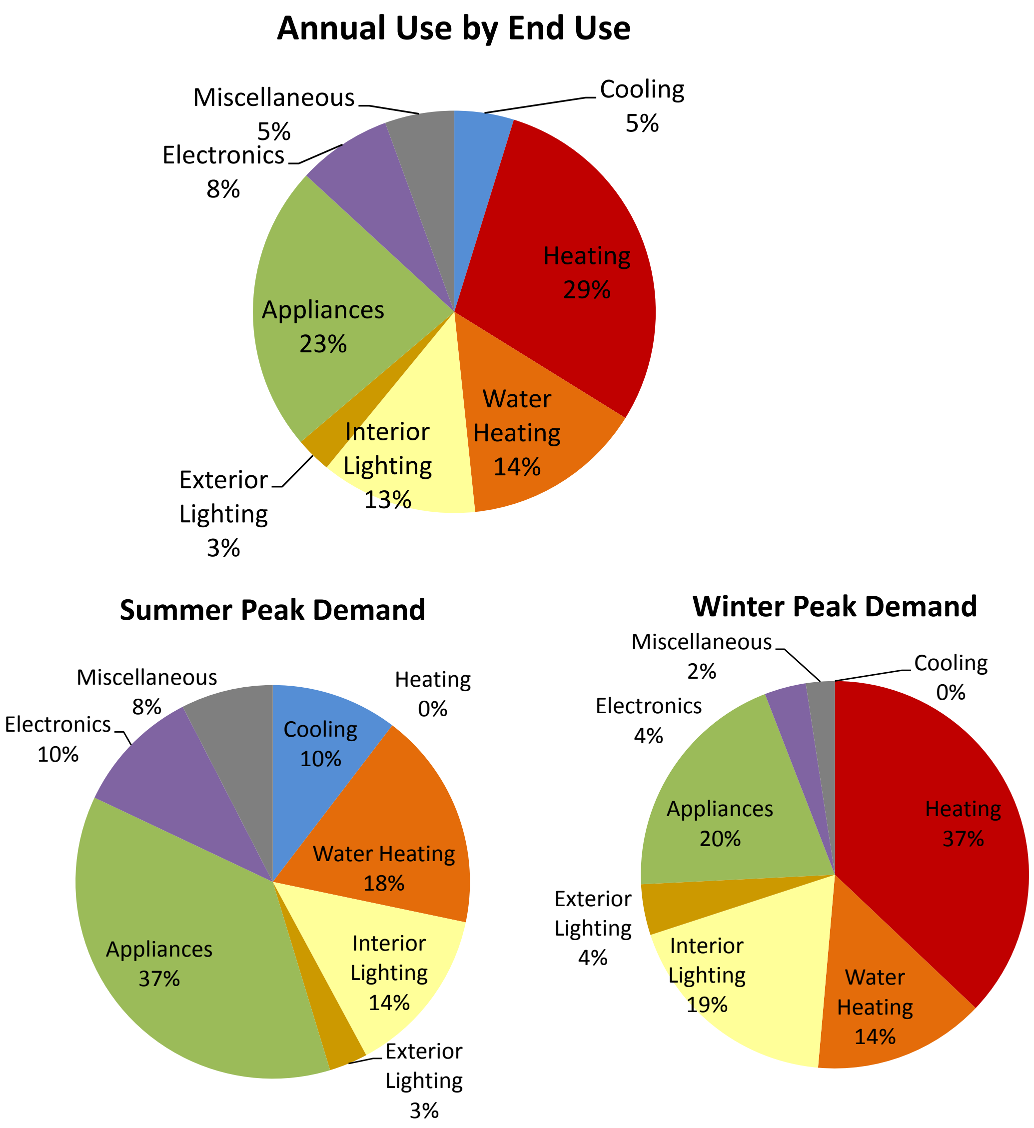


Figure 3-5 Residential Intensity by End Use and Segment (Annual kWh/HH, 2013), Washington

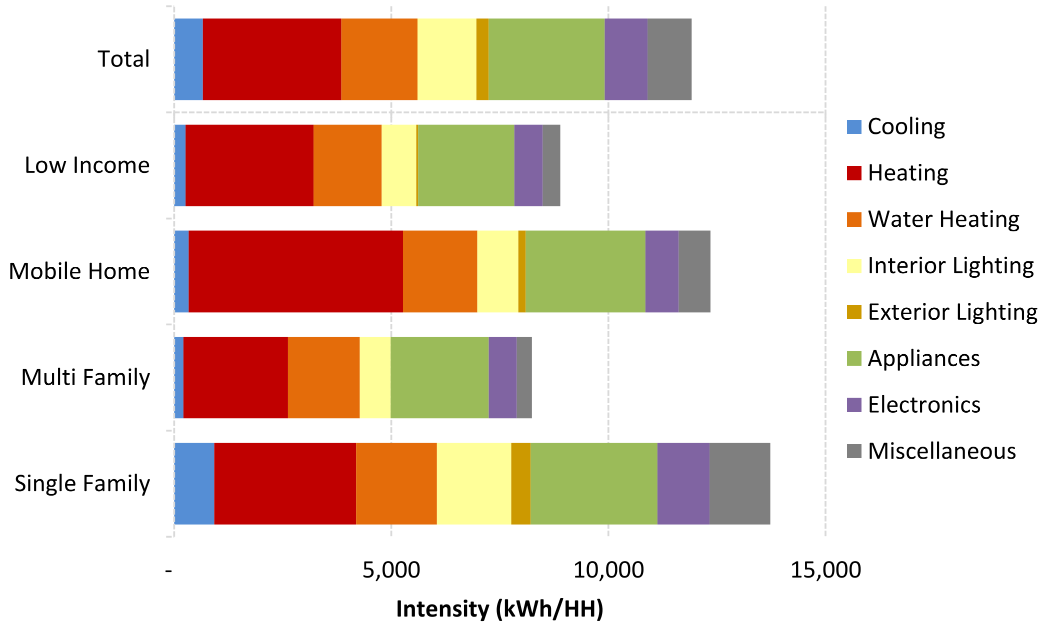


Figure 3-6 Residential Intensity by End Use and Segment (Annual kWh/HH, 2013), Idaho

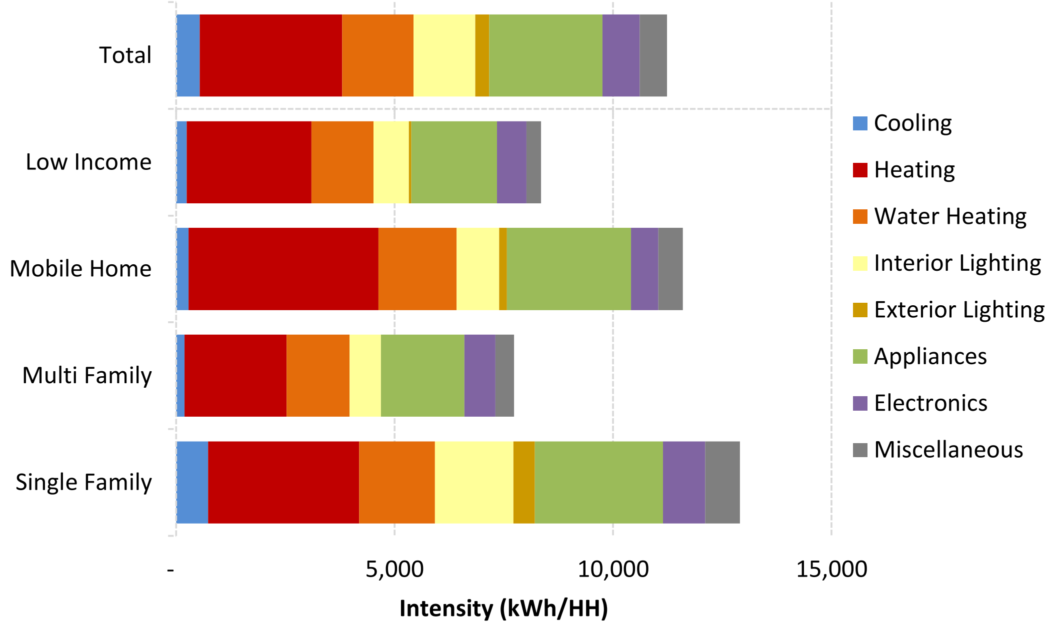


Table 3-5 Average Market Profile for the Residential Sector, 2013, Washington

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	36.9%	1,249	461	98
Cooling	Room AC	26.4%	402	106	23
Cooling	Air-Source Heat Pump	6.5%	1,268	82	17
Cooling	Geothermal Heat Pump	0.2%	1,326	2	0
Cooling	Evaporative AC	1.2%	809	10	2
Space Heating	Electric Room Heat	24.3%	5,302	1,288	275
Space Heating	Electric Furnace	13.4%	9,021	1,213	259
Space Heating	Air-Source Heat Pump	6.5%	10,487	677	145
Space Heating	Geothermal Heat Pump	0.2%	5,564	10	2
Water Heating	Water Heater (<= 55 Gal)	50.9%	3,025	1,539	329
Water Heating	Water Heater (55 to 75 Gal)	6.5%	3,145	203	43
Water Heating	Water Heater (> 75 Gal)	0.3%	4,209	12	3
Interior Lighting	Screw-in/Hard-wire	100.0%	955	955	204
Interior Lighting	Linear Fluorescent	100.0%	114	114	24
Interior Lighting	Specialty Lighting	100.0%	286	286	61
Exterior Lighting	Screw-in/Hard-wire	100.0%	289	289	62
Appliances	Clothes Washer	91.8%	104	95	20
Appliances	Clothes Dryer	49.9%	738	368	79
Appliances	Dishwasher	77.1%	447	345	74
Appliances	Refrigerator	100.0%	829	829	177
Appliances	Freezer	55.3%	669	370	79
Appliances	Second Refrigerator	20.7%	1,010	209	45
Appliances	Stove	70.3%	453	318	68
Appliances	Microwave	94.8%	139	132	28
Electronics	Personal Computers	64.3%	214	138	29
Electronics	Monitor	78.6%	91	71	15
Electronics	Laptops	76.3%	57	43	9
Electronics	TVs	177.4%	255	452	97
Electronics	Printer/Fax/Copier	72.6%	65	47	10
Electronics	Set top Boxes/DVRs	143.9%	128	184	39
Electronics	Devices and Gadgets	100.0%	54	54	11
Miscellaneous	Pool Pump	1.9%	2,514	49	10
Miscellaneous	Pool Heater	0.5%	4,025	19	4
Miscellaneous	Furnace Fan	58.7%	249	146	31
Miscellaneous	Well pump	9.3%	642	60	13
Miscellaneous	Miscellaneous	100.0%	744	744	159
Total				**11,919**	**2,546**

Table 3-6 Average Market Profile for the Residential Sector, 2013, Idaho

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	33.4%	1,134	379	41
Cooling	Room AC	18.6%	416	77	8
Cooling	Air-Source Heat Pump	5.3%	1,282	68	7
Cooling	Geothermal Heat Pump	0.0%	0	0	0
Cooling	Evaporative AC	1.5%	777	12	1
Space Heating	Electric Room Heat	24.2%	6,354	1,540	165
Space Heating	Electric Furnace	13.1%	8,904	1,168	126
Space Heating	Air-Source Heat Pump	5.3%	10,465	557	60
Space Heating	Geothermal Heat Pump	0.0%	0	0	0
Water Heating	Water Heater (<= 55 Gal)	49.2%	2,904	1,429	154
Water Heating	Water Heater (55 to 75 Gal)	6.2%	3,025	189	20
Water Heating	Water Heater (> 75 Gal)	0.3%	3,847	11	1
Interior Lighting	Screw-in/Hard-wire	100.0%	1,041	1,041	112
Interior Lighting	Linear Fluorescent	100.0%	129	129	14
Interior Lighting	Specialty Lighting	100.0%	243	243	26
Exterior Lighting	Screw-in/Hard-wire	100.0%	323	323	35
Appliances	Clothes Washer	85.1%	99	84	9
Appliances	Clothes Dryer	60.3%	754	454	49
Appliances	Dishwasher	77.6%	424	329	35
Appliances	Refrigerator	100.0%	789	789	85
Appliances	Freezer	52.3%	643	337	36
Appliances	Second Refrigerator	21.1%	945	199	21
Appliances	Stove	63.6%	433	275	30
Appliances	Microwave	91.2%	132	120	13
Electronics	Personal Computers	56.9%	200	114	12
Electronics	Monitor	69.6%	85	59	6
Electronics	Laptops	79.3%	53	42	5
Electronics	TVs	174.6%	248	434	47
Electronics	Printer/Fax/Copier	66.7%	61	41	4
Electronics	Set top Boxes/DVRs	92.5%	120	111	12
Electronics	Devices and Gadgets	100.0%	51	51	5
Miscellaneous	Pool Pump	1.6%	2,342	38	4
Miscellaneous	Pool Heater	0.4%	3,750	15	2
Miscellaneous	Furnace Fan	59.7%	239	142	15
Miscellaneous	Well pump	12.5%	598	75	8
Miscellaneous	Miscellaneous	100.0%	356	356	38
Total				**11,233**	**1,207**

Commercial Sector

The total electric energy consumed by commercial customers in Avista's service area in 2013 was 2,086 GWh (WA) and 976 GWh (ID). Summer peak demand was 368 MW (WA) and 167 MW (ID). Winter peak demand was 333 MW (WA) and 152 MW (ID). Avista billing data, CBSA and secondary data were used to allocate this energy usage to building type segments and to develop estimates of energy intensity (annual kWh/square foot). Using the electricity use and intensity estimates, we infer floor space which is the unit of analysis in LoadMAP for the commercial sector. The values are shown in Table 3-7 (WA) and Table 3-8 (ID).

Table 3-7 Commercial Sector Control Totals (2013), Washington

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity (Annual kWh/SqFt)	Summer Peak (MW)	Winter Peak (MW)
Small Office	280	13%	15.4	71	48
Large Office	106	5%	17.5	16	19
Restaurant	70	3%	42.4	11	11
Retail	285	14%	13.8	59	43
Grocery	209	10%	47.3	33	28
College	78	4%	13.9	13	14
School	117	6%	9.9	5	13
Health	271	13%	29.1	41	39
Lodging	112	5%	16.1	14	23
Warehouse	103	5%	7.5	12	17
Miscellaneous	455	22%	13.8	93	78
Total	**2,086**	**100%**	**15.9**	**368**	**333**

Table 3-8 Commercial Sector Control Totals (2013), Idaho

Segment	Electricity Sales (GWh)	% of Total Usage	Intensity (Annual kWh/SqFt)	Summer Peak (MW)	Winter Peak (MW)
Small Office	134	14%	15.4	35	23
Large Office	17	2%	17.5	3	3
Restaurant	12	1%	42.4	2	2
Retail	168	17%	13.8	35	25
Grocery	92	9%	47.3	14	12
College	73	7%	13.9	12	13
School	109	11%	9.9	4	12
Health	106	11%	29.1	16	15
Lodging	49	5%	16.1	6	10
Warehouse	47	5%	7.5	5	8
Miscellaneous	168	17%	13.8	34	29
Total	**976**	**100%**	**14.9**	**167**	**152**

Figure 3-7 (WA) and Figure 3-8 (ID) show the distribution of annual electricity consumption and peak demand by end use across all commercial buildings. Electric usage is dominated by cooling and lighting, which comprise almost 50% of annual electricity usage. Summer peak demand is dominated by cooling and winter peak demand is dominated by heating.

Figure 3-9 (WA) and Figure 3-10 (ID) presents the electricity usage in GWh by end use and segment. Small offices, retail, and miscellaneous buildings use the most electricity in the service territory. As far as end uses, cooling and lighting are the major uses across all segments. Office equipment is concentrated more in the larger customers.

Figure 3-7 Commercial Sector Electricity Consumption by End Use (2013), Washington

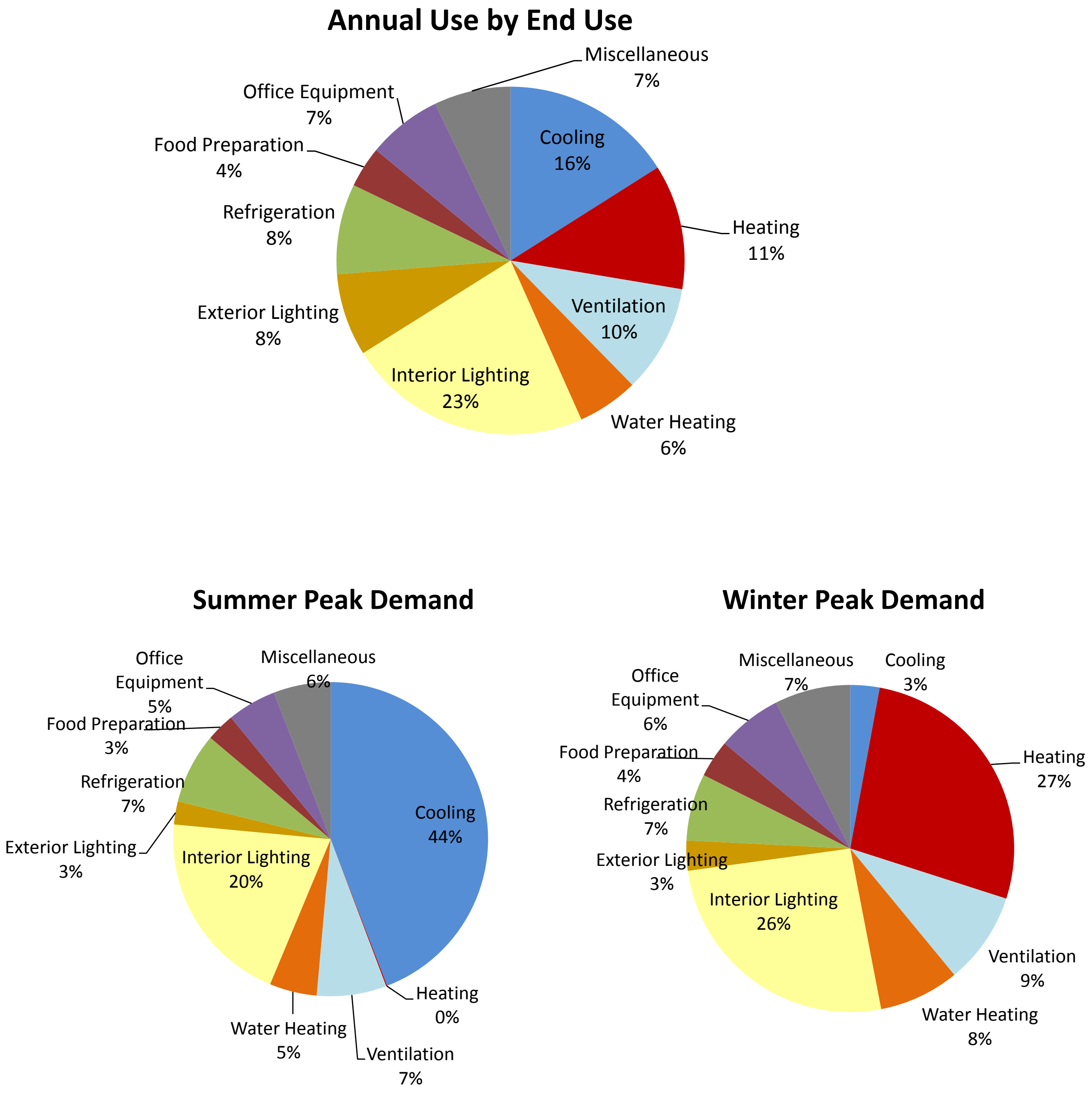
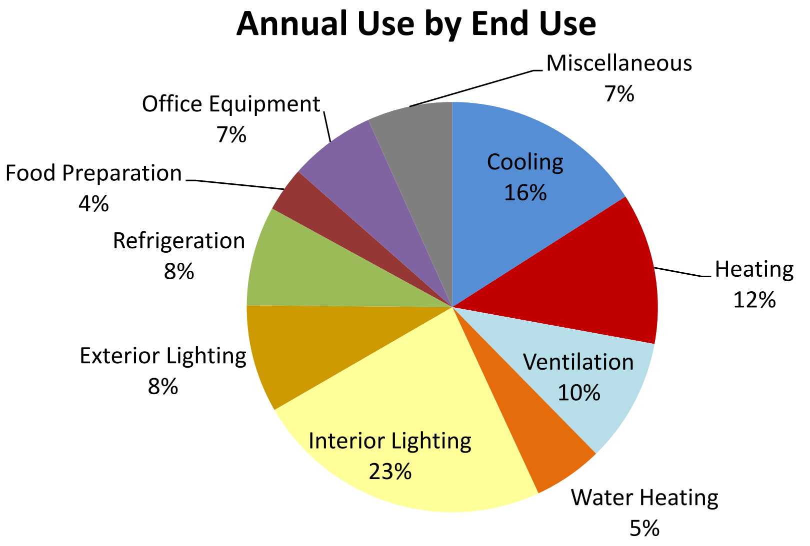
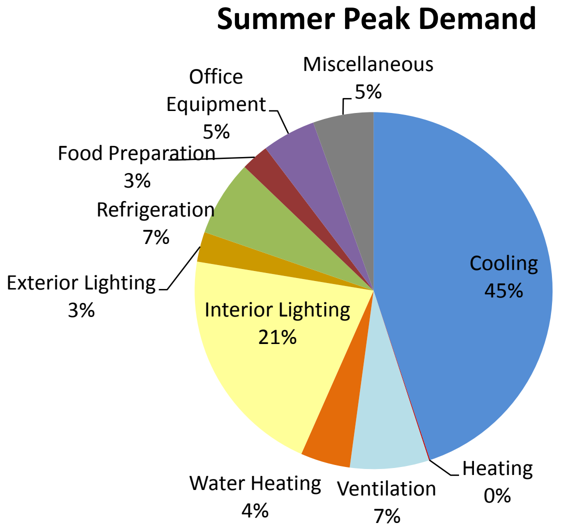


Figure 3-8 Commercial Sector Electricity Consumption by End Use (2013), Idaho





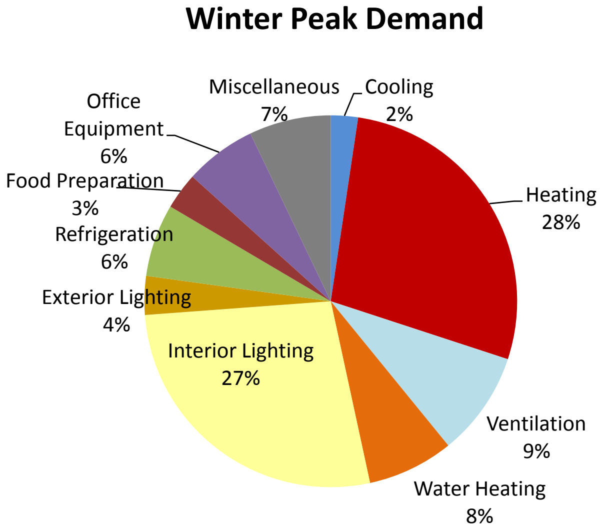


Figure 3-9 Commercial Electricity Usage by End Use Segment (GWh, 2013), Washington

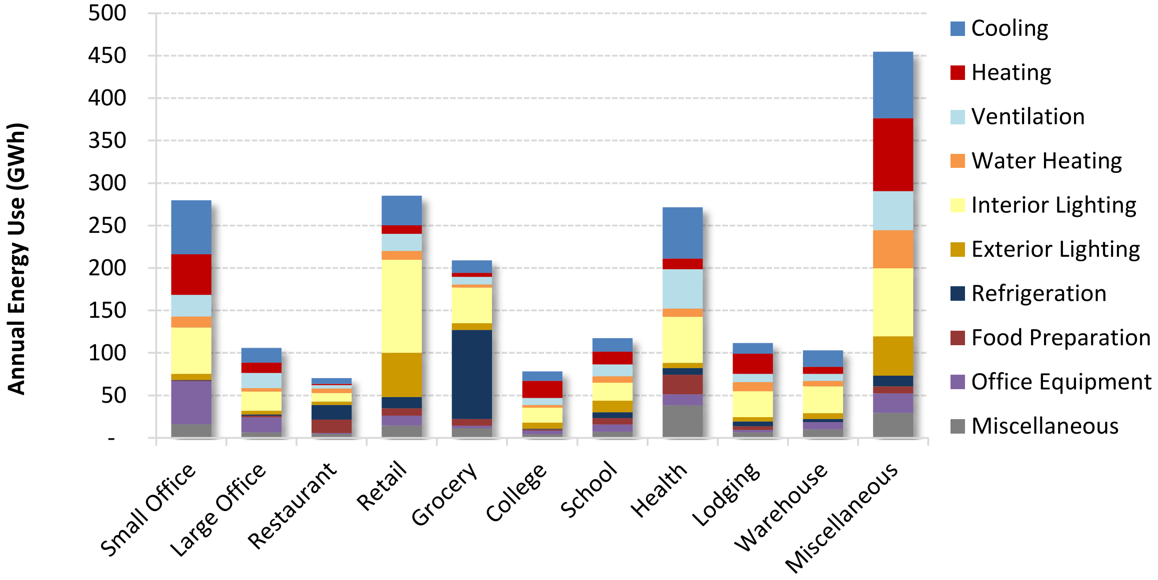


Figure 3-10 Commercial Electricity Usage by End Use Segment (GWh, 2013), Idaho

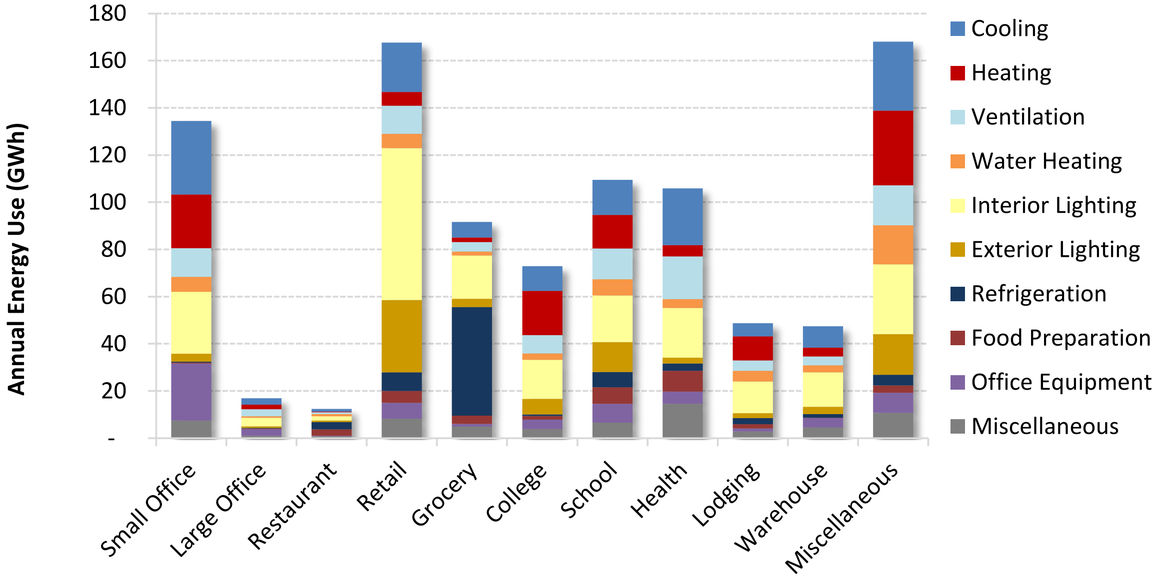


Table 3-9 (WA) and Table 3-10 (ID) show the average market profile for electricity of the commercial sector as a whole, representing a composite of all segments and buildings. Market profiles for each segment are presented in the appendix to this volume.

Table 3-9 Average Electric Market Profile for the Commercial Sector, 2013, Washington

Electric Market Profiles

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	10.3%	3.38	0.35	46.0
Cooling	Water-Cooled Chiller	12.3%	5.11	0.63	83.0
Cooling	RTU	37.5%	3.27	1.22	161.1
Cooling	Room AC	4.6%	2.93	0.13	17.5
Cooling	Air-Source Heat Pump	5.6%	3.01	0.17	22.1
Cooling	Geothermal Heat Pump	1.8%	1.85	0.03	4.4
Heating	Electric Furnace	12.7%	6.72	0.86	112.5
Heating	Electric Room Heat	7.6%	7.69	0.58	76.9
Heating	Air-Source Heat Pump	5.6%	5.87	0.33	43.1
Heating	Geothermal Heat Pump	1.8%	4.30	0.08	10.1
Ventilation	Ventilation	100.0%	1.59	1.59	209.2
Water Heating	Water Heater	53.1%	1.69	0.90	118.2
Interior Lighting	Screw-in/Hard-wire	100.0%	0.92	0.92	121.3
Interior Lighting	High-Bay Fixtures	100.0%	0.51	0.51	67.3
Interior Lighting	Linear Fluorescent	100.0%	2.17	2.17	285.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.23	0.23	30.0
Exterior Lighting	HID	100.0%	0.64	0.64	83.8
Exterior Lighting	Linear Fluorescent	100.0%	0.35	0.35	46.4
Refrigeration	Walk-in Refrigerator/Freezer	8.8%	1.81	0.16	21.1
Refrigeration	Reach-in Refrigerator/Freezer	12.1%	0.29	0.04	4.6
Refrigeration	Glass Door Display	15.6%	0.98	0.15	20.1
Refrigeration	Open Display Case	7.7%	9.75	0.76	99.3
Refrigeration	Icemaker	29.6%	0.54	0.16	21.2
Refrigeration	Vending Machine	20.2%	0.33	0.07	8.9
Food Preparation	Oven	15.5%	0.92	0.14	18.8
Food Preparation	Fryer	3.3%	2.63	0.09	11.4
Food Preparation	Dishwasher	16.8%	1.68	0.28	37.2
Food Preparation	Steamer	3.3%	2.23	0.07	9.6
Food Preparation	Hot Food Container	6.4%	0.32	0.02	2.7
Office Equipment	Desktop Computer	100.0%	0.62	0.62	82.2
Office Equipment	Laptop	98.8%	0.08	0.08	10.9
Office Equipment	Server	86.8%	0.20	0.17	22.9
Office Equipment	Monitor	100.0%	0.11	0.11	14.5
Office Equipment	Printer/Copier/Fax	100.0%	0.08	0.08	9.9
Office Equipment	POS Terminal	57.7%	0.05	0.03	4.0
Miscellaneous	Non-HVAC Motors	53.0%	0.19	0.10	13.2
Miscellaneous	Pool Pump	5.8%	0.02	0.00	0.2
Miscellaneous	Pool Heater	1.8%	0.03	0.00	0.1
Miscellaneous	Other Miscellaneous	100.0%	1.03	1.03	135.1
Total				**15.86**	**2,086.3**

Table 3-10 Average Electric Market Profile for the Commercial Sector, 2013, Idaho

Electric Market Profiles

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	12.4%	3.24	0.40	26.4
Cooling	Water-Cooled Chiller	10.2%	5.15	0.53	34.6
Cooling	RTU	35.6%	3.17	1.13	74.0
Cooling	Room AC	4.6%	2.77	0.13	8.4
Cooling	Air-Source Heat Pump	5.6%	2.81	0.16	10.2
Cooling	Geothermal Heat Pump	1.8%	1.68	0.03	2.0
Heating	Electric Furnace	11.5%	6.74	0.77	50.7
Heating	Electric Room Heat	7.6%	7.76	0.59	38.9
Heating	Air-Source Heat Pump	5.6%	5.91	0.33	21.5
Heating	Geothermal Heat Pump	1.8%	4.41	0.08	5.2
Ventilation	Ventilation	100.0%	1.46	1.46	95.5
Water Heating	Water Heater	51.4%	1.58	0.81	53.2
Interior Lighting	Screw-in/Hard-wire	100.0%	0.88	0.88	57.5
Interior Lighting	High-Bay Fixtures	100.0%	0.51	0.51	33.3
Interior Lighting	Linear Fluorescent	100.0%	2.11	2.11	138.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.20	0.20	13.1
Exterior Lighting	HID	100.0%	0.60	0.60	39.1
Exterior Lighting	Linear Fluorescent	100.0%	0.47	0.47	30.7
Refrigeration	Walk-in Refrigerator/Freezer	8.8%	1.30	0.11	7.5
Refrigeration	Reach-in Refrigerator/Freezer	13.4%	0.26	0.04	2.3
Refrigeration	Glass Door Display	15.4%	0.85	0.13	8.6
Refrigeration	Open Display Case	8.4%	7.98	0.67	44.1
Refrigeration	Icemaker	31.6%	0.48	0.15	10.0
Refrigeration	Vending Machine	20.0%	0.32	0.06	4.1
Food Preparation	Oven	16.2%	0.86	0.14	9.1
Food Preparation	Fryer	3.1%	2.15	0.07	4.3
Food Preparation	Dishwasher	16.1%	1.49	0.24	15.7
Food Preparation	Steamer	3.1%	1.99	0.06	4.0
Food Preparation	Hot Food Container	7.4%	0.25	0.02	1.2
Office Equipment	Desktop Computer	100.0%	0.58	0.58	37.7
Office Equipment	Laptop	98.9%	0.07	0.07	4.7
Office Equipment	Server	89.1%	0.18	0.16	10.7
Office Equipment	Monitor	100.0%	0.10	0.10	6.7
Office Equipment	Printer/Copier/Fax	100.0%	0.07	0.07	4.7
Office Equipment	POS Terminal	57.6%	0.05	0.03	1.8
Miscellaneous	Non-HVAC Motors	51.6%	0.17	0.09	5.8
Miscellaneous	Pool Pump	5.7%	0.02	0.00	0.1
Miscellaneous	Pool Heater	1.7%	0.03	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.91	0.91	59.5
Total				**14.87**	**975.5**

Industrial Sector

The total electricity used in 2013 by Avista's industrial customers was 1,265 GWh; 922 GWh (WA) and 343 GWh (ID). Summer peak demand was 336 MW; 245 MW (WA) and 91 MW (ID). Winter peak demand was 277 MW; 202 MW (WA) and 75 MW (ID). Avista billing data, load forecast and secondary sources were used to develop estimates of energy intensity (annual kWh/employee). Using the electricity use and intensity estimates, we infer the number of employees which is the unit of analysis in LoadMAP for the industrial sector. These are shown in Table 3-11.

Table 3-11 Industrial Sector Control Totals (2013)

State	Electricity Sales (GWh)	Intensity (Annual kWh/employee)	Summer Peak (MW)	Winter Peak (MW)
Washington	922	56,846	245	202
Idaho	343	38,668	91	75

Figure 3-11 shows the distribution of annual electricity consumption and summer and winter peak demand by end use for all industrial customers. Motors are the largest overall end use for the industrial sector, accounting for 54% of energy use. Note that this end use includes a wide range of industrial equipment, such as air compressors and refrigeration compressors, pumps, conveyor motors, and fans. The process end use accounts for 27% of annual energy use, which includes heating, cooling, refrigeration, and electro-chemical processes. Lighting is the next highest, followed by cooling, miscellaneous, heating and ventilation.

Figure 3-11 Industrial Electricity Use by End Use (2013), All Industries, WA and ID

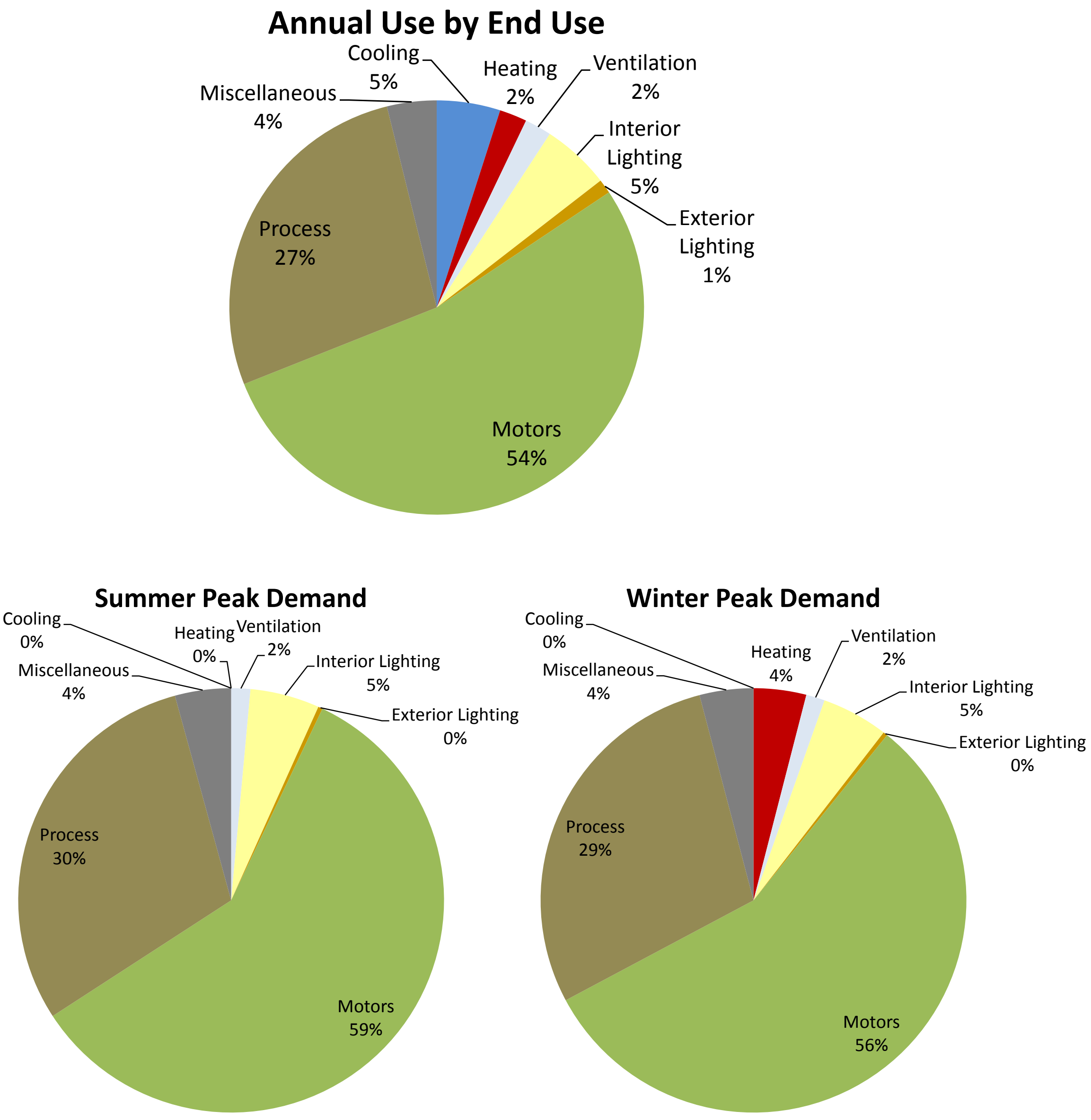


Table 3-12 (WA) and Table 3-13 (ID) show the composite market profile for the industrial sector.

Table 3-12 Average Electric Market Profile for the Industrial Sector, 2013, Washington

Average Market Profiles

End Use	Technology	Saturation	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	17.4
Cooling	Water-Cooled Chiller	1.4%	2.2
Cooling	RTU	17.0%	22.4
Cooling	Room AC	1.1%	1.5
Cooling	Air-Source Heat Pump	1.6%	2.1
Cooling	Geothermal Heat Pump	0.0%	0.0
Heating	Electric Furnace	4.9%	12.5
Heating	Electric Room Heat	1.7%	4.2
Heating	Air-Source Heat Pump	1.6%	3.1
Heating	Geothermal Heat Pump	0.0%	0.0
Ventilation	Ventilation	100.0%	19.3
Interior Lighting	Screw-in/Hard-wire	100.0%	4.9
Interior Lighting	High-Bay Fixtures	100.0%	20.4
Interior Lighting	Linear Fluorescent	100.0%	23.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	3.9
Exterior Lighting	HID	100.0%	3.2
Exterior Lighting	Linear Fluorescent	100.0%	3.2
Motors	Pumps	100.0%	86.8
Motors	Fans & Blowers	100.0%	68.0
Motors	Compressed Air	100.0%	54.3
Motors	Conveyors	100.0%	245.0
Motors	Other Motors	100.0%	38.0
Process	Process Heating	100.0%	99.2
Process	Process Cooling	100.0%	32.5
Process	Process Refrigeration	100.0%	32.5
Process	Process Electro-Chemical	100.0%	64.5
Process	Process Other	100.0%	21.8
Miscellaneous	Miscellaneous	100.0%	35.6
	Total		**922.3**

Table 3-13 Average Electric Market Profile for the Industrial Sector, 2013, Idaho

Average Market Profiles

End Use	Technology	Saturation	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	6.5
Cooling	Water-Cooled Chiller	1.4%	0.8
Cooling	RTU	17.0%	8.4
Cooling	Room AC	1.1%	0.6
Cooling	Air-Source Heat Pump	1.6%	0.8
Cooling	Geothermal Heat Pump	0.0%	0.0
Heating	Electric Furnace	4.9%	4.6
Heating	Electric Room Heat	1.7%	1.5
Heating	Air-Source Heat Pump	1.6%	1.1
Heating	Geothermal Heat Pump	0.0%	0.0
Ventilation	Ventilation	100.0%	7.2
Interior Lighting	Screw-in/Hard-wire	100.0%	1.8
Interior Lighting	High-Bay Fixtures	100.0%	7.6
Interior Lighting	Linear Fluorescent	100.0%	8.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	1.4
Exterior Lighting	HID	100.0%	1.2
Exterior Lighting	Linear Fluorescent	100.0%	1.2
Motors	Pumps	100.0%	32.3
Motors	Fans & Blowers	100.0%	25.3
Motors	Compressed Air	100.0%	20.2
Motors	Conveyors	100.0%	91.1
Motors	Other Motors	100.0%	14.1
Process	Process Heating	100.0%	36.9
Process	Process Cooling	100.0%	12.1
Process	Process Refrigeration	100.0%	12.1
Process	Process Electro-Chemical	100.0%	24.0
Process	Process Other	100.0%	8.1
Miscellaneous	Miscellaneous	100.0%	13.3
	Total		**343.0**

Baseline Projection

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

The baseline projection incorporates assumptions about:

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

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

Please note that the base-year for the study is 2013. Annual energy use and peak demand values reflect actual weather in that year. In future years, energy use and peak demand reflect normal weather, as defined by Avista. In the figures below, the shift from actual to normal weather is apparent in the decrease in energy use and peak demand in 2014 for the residential and commercial sectors. This results from the fact that 2013 was hotter during the summer months or cooler during the winter months than normal.

Residential Sector

Annual Use

Table 4-1 (WA) and Table 4-2 (ID) present the baseline projection for electricity at the end-use level for the residential sector as a whole. Overall in Washington, residential use increases from 2,546 GWh in 2013 to 2,761 GWh in 2035, an increase of 8%. Residential use in Idaho increases from 1,207 GWh in 2013 to 1,375 GWh, an increase of 14%. This reflects a modest customer growth forecast in both states. Figure 4-1 (WA) and Figure 4-3 (ID) display the graphical representation of the baseline projection.

Figure 4-2 (WA) and Figure 4-4 (ID) present the baseline projection of annual electricity use per household. Most noticeable is that lighting use decreases throughout the time period as the lighting standards from EISA come into effect. Usage in the cooling decreases over the forecast due to going from actual weather in 2014 to normal weather for the rest of the forecast.

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

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	141	92	93	93	93	96	-32%
Heating	681	702	706	713	722	743	9%
Water Heating	375	379	380	381	388	416	11%
Interior Lighting	289	244	230	196	151	140	-52%
Exterior Lighting	62	51	48	40	30	27	-56%
Appliances	569	572	571	568	567	585	3%
Electronics	211	226	229	239	262	331	57%
Miscellaneous	218	238	245	267	311	423	94%
Total	**2,546**	**2,503**	**2,500**	**2,498**	**2,523**	**2,761**	**8.4%**

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

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	58	38	38	39	40	42	-26%
Heating	351	366	370	379	392	417	19%
Water Heating	175	179	180	184	190	211	20%
Interior Lighting	152	132	126	111	89	87	-43%
Exterior Lighting	35	29	28	24	18	17	-50%
Appliances	278	282	283	286	291	312	12%
Electronics	91	99	102	108	122	160	75%
Miscellaneous	67	73	76	82	96	129	92%
Total	**1,207**	**1,199**	**1,203**	**1,213**	**1,238**	**1,375**	**13.9%**

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

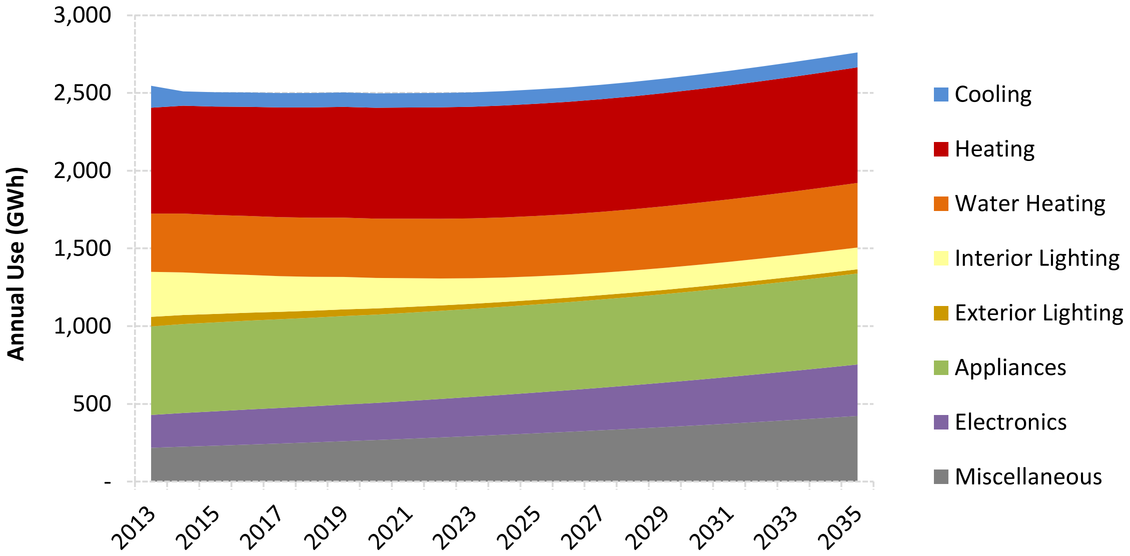


Figure 4-2 Residential Baseline Sales Projection by End Use – Annual Use per Household, Washington

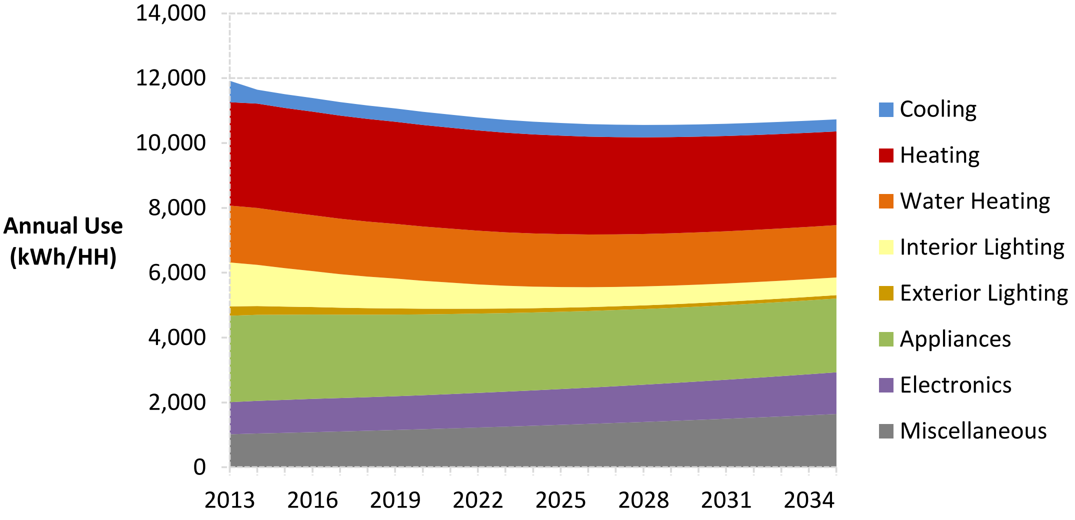


Figure 4-3 Residential Baseline Projection by End Use (GWh), Idaho

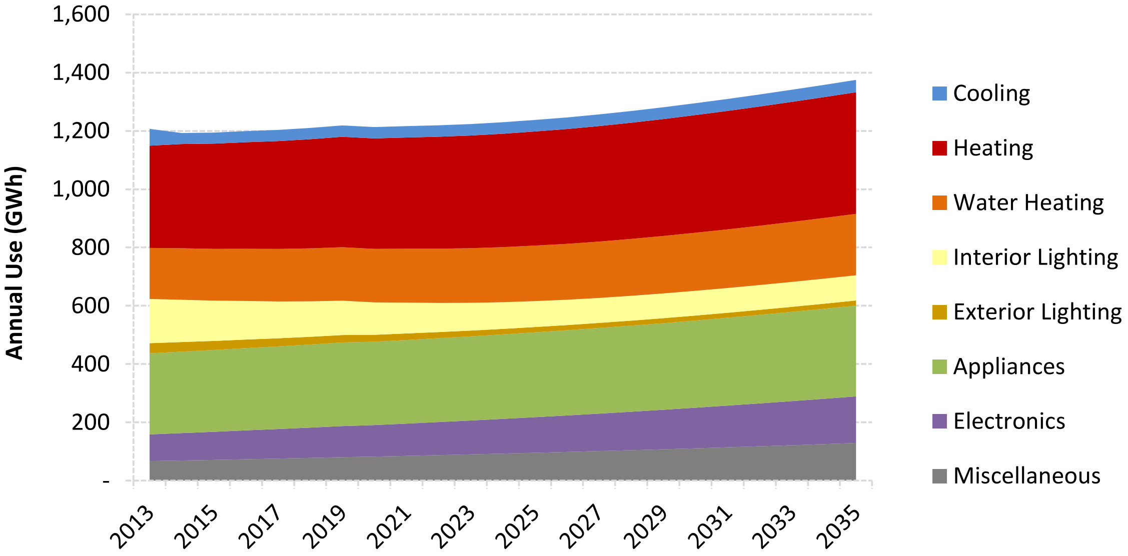
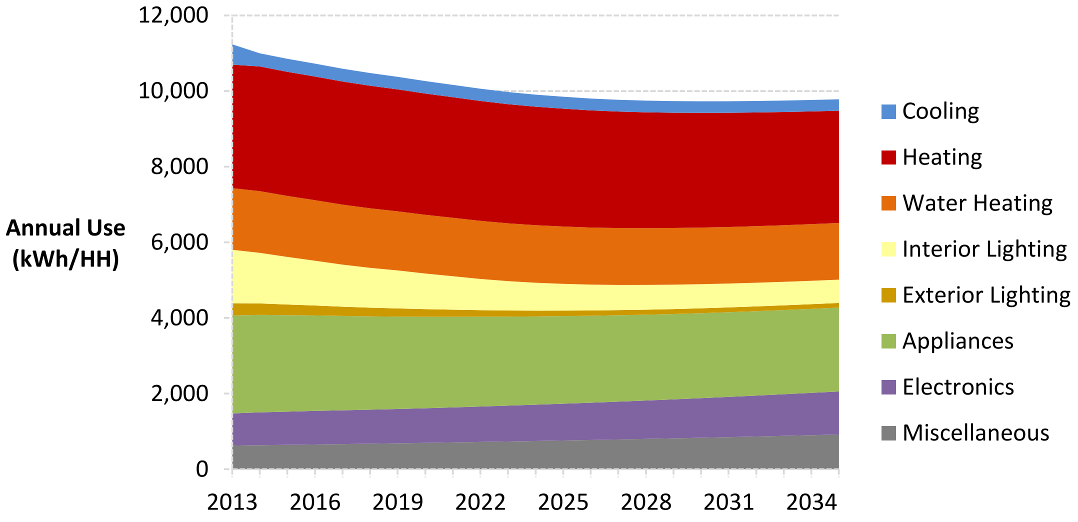


Figure 4-4 Residential Baseline Sales Projection by End Use – Annual Use per Household, Idaho



Residential Summer Peak Projection

Table 4-3 (WA) and Table 4-4 (ID) present the residential baseline projection for summer peak demand at the end-use level. Overall in Washington, residential summer peak increases from 404 MW in 2013 to 438 MW in 2035, an increase of 8%. In Idaho, the residential summer peak increases from 184 MW to 207 MW, an increase of 13%. All end uses except cooling and lighting show increases in the baseline peak projections. The summer peak associated with electronics and miscellaneous uses increases substantially, in correspondence with growth in annual energy use. Figure 4-5 (WA) and Figure 4-6 (ID) display the graphical representation of the baseline projection for summer peak. Usage in residential cooling decreases over the forecast due to going from actual weather in 2014 to weather-normal weather for the forecast.

Table 4-3 Residential Summer Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	46	30	30	30	31	32	-30%
Heating	-	-	-	-	-	-	0%
Water Heating	71	71	71	72	73	78	11%
Interior Lighting	49	41	39	33	25	24	-52%
Exterior Lighting	10	9	8	7	5	5	-56%
Appliances	141	141	141	140	140	144	2%
Electronics	44	47	48	50	54	69	57%
Miscellaneous	44	49	50	55	64	87	95%
Total	**404**	**388**	**387**	**386**	**392**	**438**	**8.3%**

Table 4-4 Residential Summer Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	19	13	13	13	13	14	-24%
Heating	-	-	-	-	-	-	0%
Water Heating	33	34	34	35	36	40	20%
Interior Lighting	25	22	21	19	15	15	-43%
Exterior Lighting	6	5	5	4	3	3	-50%
Appliances	68	69	69	69	71	75	11%
Electronics	19	21	21	23	26	34	75%
Miscellaneous	14	15	16	17	20	27	93%
Total	**184**	**178**	**179**	**180**	**183**	**207**	**12.6%**

Figure 4-5 Residential Summer Peak Baseline Projection by End Use (MW), Washington

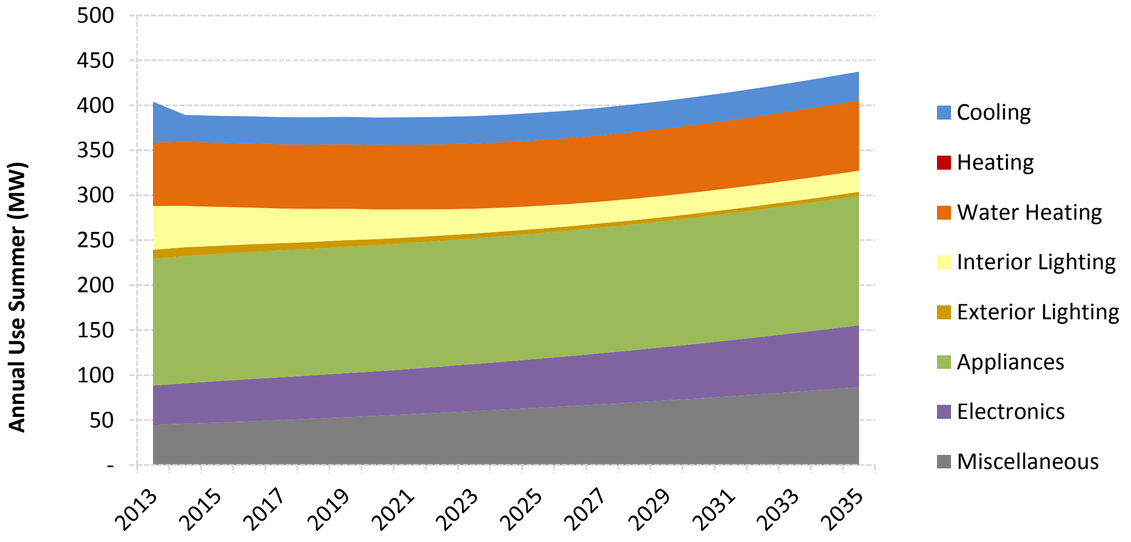
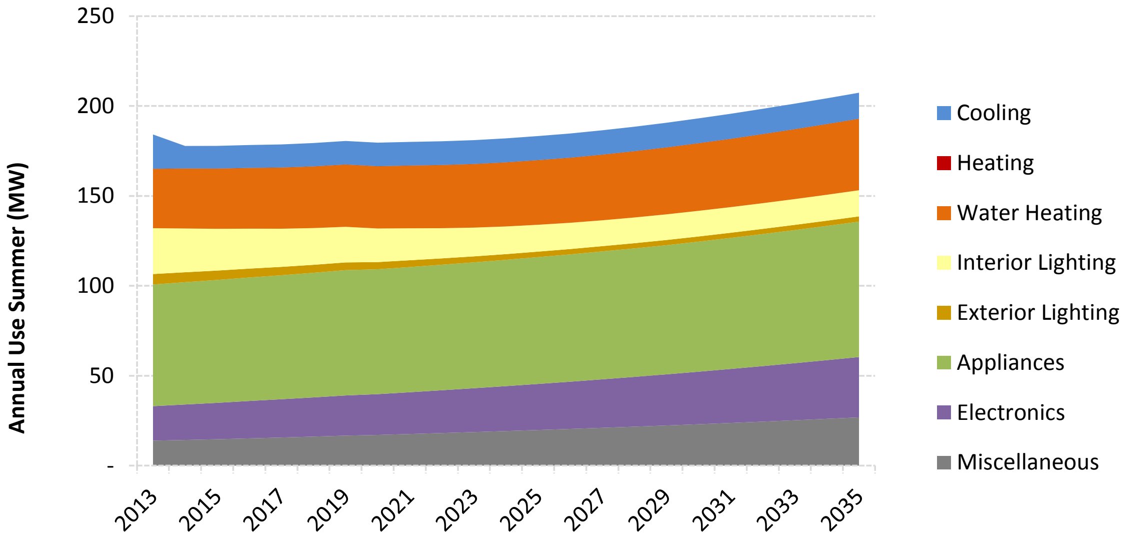


Figure 4-6 Residential Summer Peak Baseline Projection by End Use (MW), Idaho



Residential Winter Peak Projection

Table 4-5 (WA) and Table 4-6 (ID) present the residential baseline projection for winter peak demand at the end-use level. Overall in Washington, residential winter peak increases from 438 MW in 2013 to 440 MW in 2035, an increase of 0.4%. In Idaho, the residential winter peak increases from 217 MW to 233 MW, an increase of 8%. All end uses except lighting show increases in the baseline peak projections. The winter peak associated with electronics and miscellaneous uses increases substantially, in correspondence with growth in annual energy use. Figure 4-7Figure 4-5 (WA) and Figure 4-8Figure 4-6 (ID) display the graphical representation of the baseline projection for winter peak.

Table 4-5 Residential Winter Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	156	161	162	164	165	170	9%
Water Heating	66	67	67	68	69	74	11%
Interior Lighting	77	65	61	52	40	37	-52%
Exterior Lighting	16	14	13	11	8	7	-56%
Appliances	89	90	90	89	90	94	5%
Electronics	17	18	18	19	21	26	56%
Miscellaneous	16	18	18	20	23	32	96%
Total	**438**	**432**	**429**	**422**	**416**	**440**	**0.4%**

Table 4-6 Residential Winter Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	80	84	85	87	90	96	19%
Water Heating	31	32	32	33	34	37	20%
Interior Lighting	40	35	34	30	24	23	-43%
Exterior Lighting	9	8	7	6	5	5	-50%
Appliances	43	44	44	45	46	49	14%
Electronics	8	8	8	9	10	13	75%
Miscellaneous	5	6	6	6	8	10	97%
Total	**217**	**216**	**216**	**215**	**215**	**233**	**7.6%**

Figure 4-7 Residential Winter Peak Baseline Projection by End Use (MW), Washington

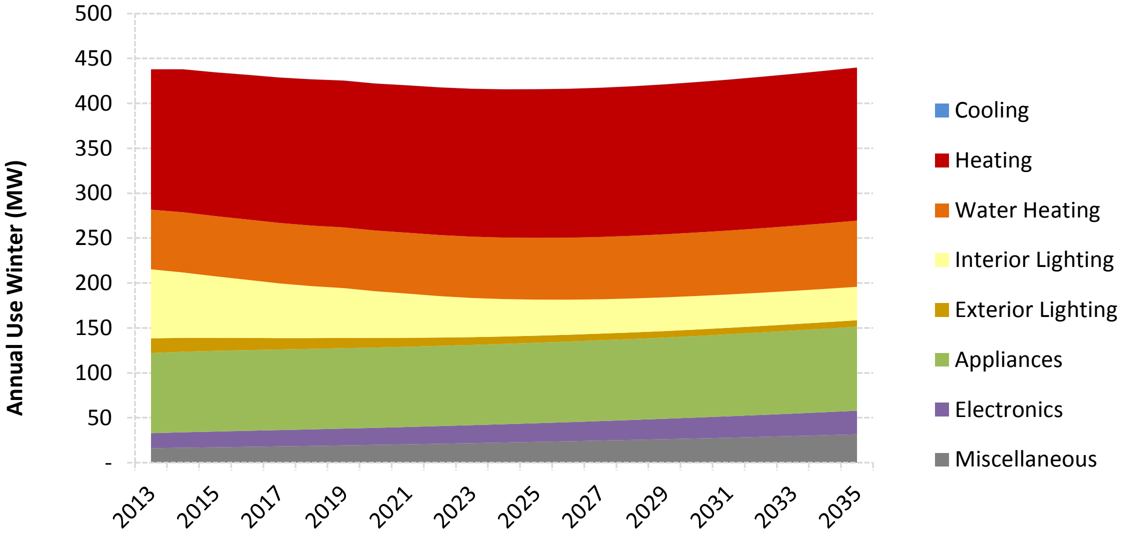
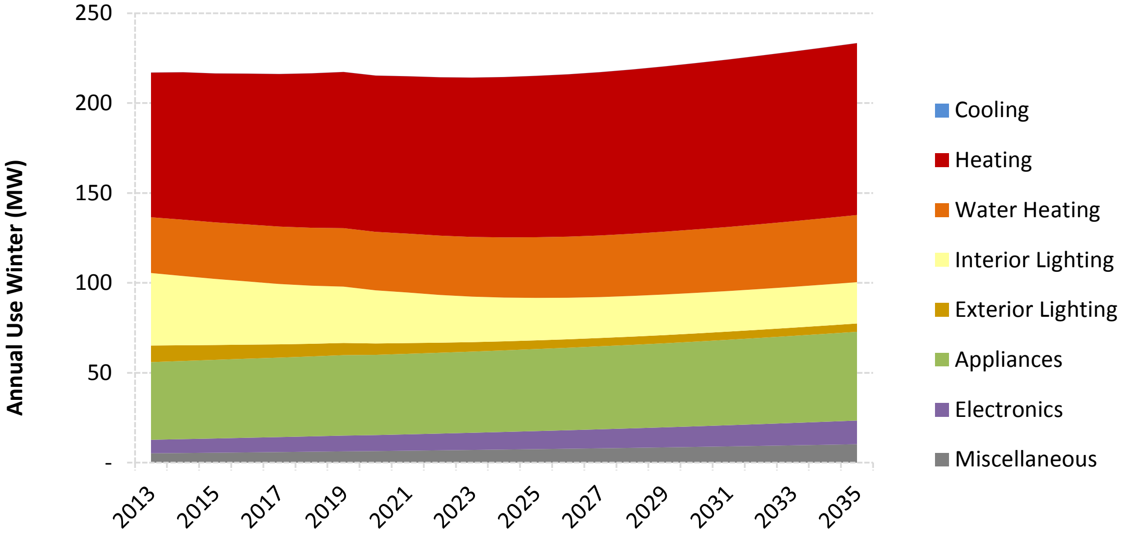


Figure 4-8 Residential Winter Peak Baseline Projection by End Use (MW), Idaho



Commercial Sector Baseline Projections

Annual Use

In Washington, annual electricity use in the commercial sector grows during the overall forecast horizon, starting at 2,086 GWh in 2013, and increasing to 2,282 in 2035, an increase of 9%. In Idaho, annual electricity use grows from 976 GWh in 2013 to 1,063 GWh in 2035, an increase of 9%. The tables and graphs below present the baseline projection at the end-use level for the commercial sector as a whole. Usage in lighting is declining throughout the forecast, due largely to the phasing in of codes and standards such as the EISA 2007 lighting standards. Usage in commercial cooling decreases over the forecast due to going from actual weather in 2014 to weather-normal weather for the forecast.

Table 4-7 Commercial Baseline Sales Projection by End Use (GWh), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change

							('13-'35)
Cooling	334	282	282	285	287	293	-12.3%
Heating	243	248	250	255	263	277	14.3%
Ventilation	209	211	212	215	217	224	6.9%
Water Heating	118	119	119	121	125	132	11.9%
Interior Lighting	474	462	460	455	452	475	0.1%
Exterior Lighting	160	146	143	133	122	121	-24.6%
Refrigeration	175	186	191	204	227	276	57.6%
Food Preparation	80	83	84	88	94	115	44.9%
Office Equipment	144	136	134	132	134	145	0.4%
Miscellaneous	149	153	155	166	184	224	51.0%
Total	**2,086**	**2,027**	**2,031**	**2,053**	**2,106**	**2,282**	**9.4%**

Table 4-8 Commercial Baseline Sales Projection by End Use (GWh), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	156	131	131	132	133	135	-13.3%
Heating	116	119	119	122	125	130	12.1%
Ventilation	96	96	97	98	98	101	5.5%
Water Heating	53	53	54	54	56	59	10.1%
Interior Lighting	229	223	222	219	217	226	-1.4%
Exterior Lighting	83	77	75	71	66	66	-20.7%
Refrigeration	77	82	84	90	100	123	61.1%
Food Preparation	34	36	37	39	42	52	50.8%
Office Equipment	66	63	62	61	62	68	2.1%
Miscellaneous	65	68	70	75	84	104	59.1%
Total	**976**	**949**	**950**	**960**	**983**	**1,063**	**9.0%**

Figure 4-9 Commercial Baseline Projection by End Use, Washington

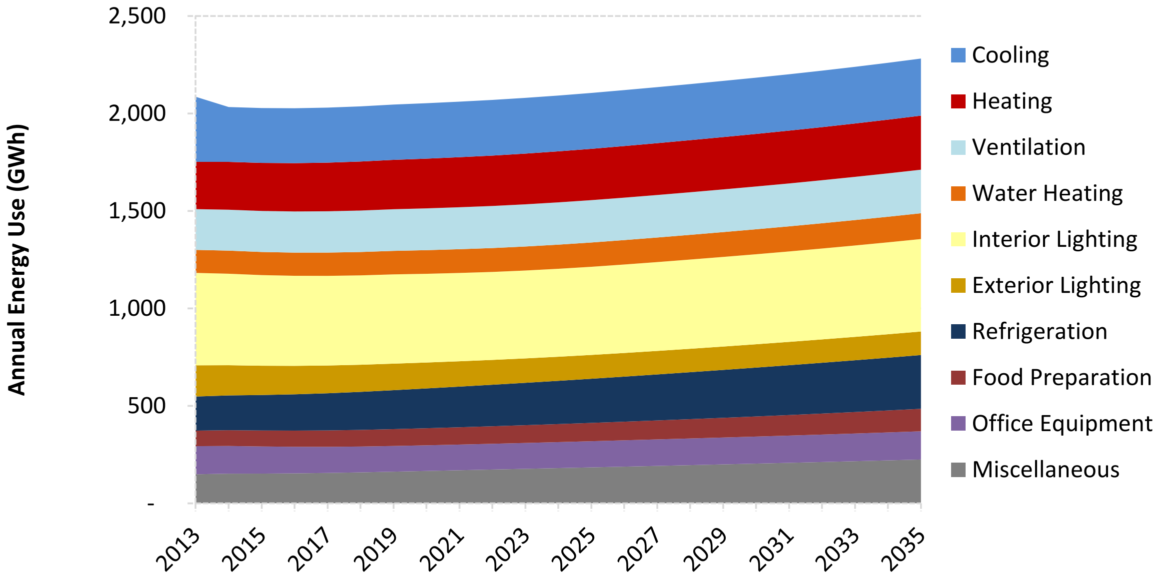
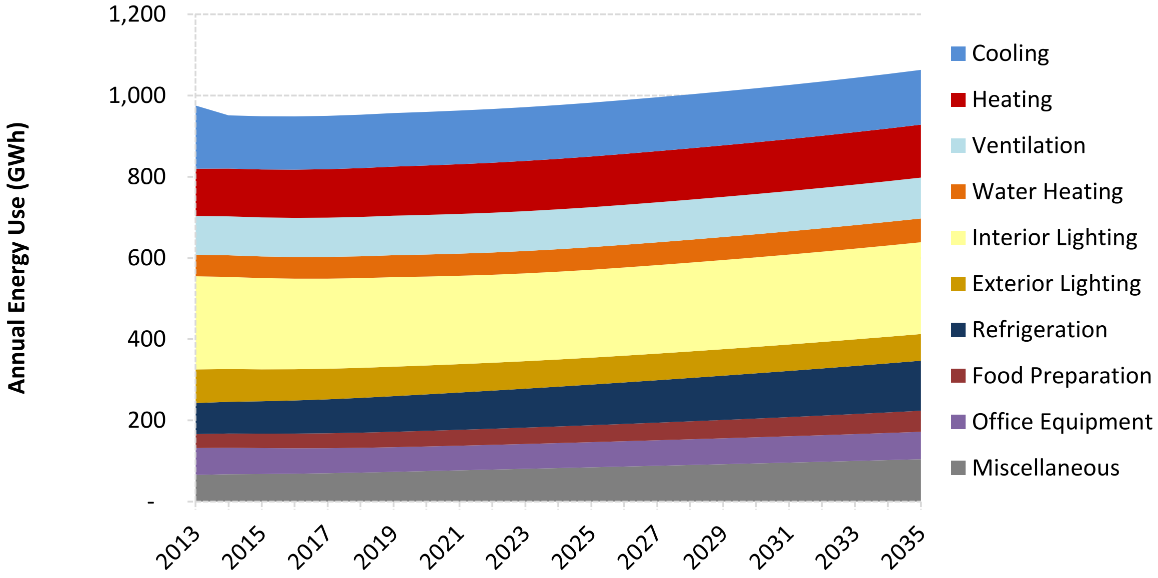


Figure 4-10 Commercial Baseline Projection by End Use, Idaho



Commercial Summer Peak Demand Projection

The tables and charts below present the summer peak baseline projection at the end-use level for the commercial sector as a whole. In Washington, summer peak demand increases during the overall forecast horizon, starting at 368 MW in 2013 and increasing by 4% to 383 MW in 2035. In Idaho, the summer peak demand is 167 MW in 2013 and 173 MW in 2035, an increase of 4%.

Table 4-9 Commercial Summer Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	162	137	137	138	139	143	-12.2%
Heating	0	0	0	0	0	0	17.5%
Ventilation	26	27	27	27	27	28	7.0%
Water Heating	18	18	18	18	19	20	13.4%
Interior Lighting	74	73	72	72	71	75	0.7%
Ext. Lighting	9	8	8	7	7	7	-24.6%
Refrigeration	27	28	29	31	35	42	57.7%
Food Prep	11	11	11	12	13	16	49.6%
Office Equip	19	18	17	17	17	19	1.4%
Miscellaneous	22	22	23	24	27	33	51.6%
Total	**368**	**342**	**343**	**347**	**356**	**383**	**4.1%**

Table 4-10 Commercial Summer Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	75	63	63	64	64	65	-12.9%
Heating	0	0	0	0	0	0	17.5%
Ventilation	12	12	12	12	12	13	5.5%
Water Heating	7	8	8	8	8	8	12.1%
Interior Lighting	35	34	34	34	33	35	-0.3%
Ext. Lighting	5	4	4	4	4	4	-20.7%
Refrigeration	11	12	13	14	15	19	62.1%
Food Prep	4	4	5	5	5	7	62.9%
Office Equip	8	8	8	7	8	8	2.6%
Miscellaneous	9	10	10	10	12	15	60.7%
Total	**167**	**155**	**156**	**157**	**161**	**173**	**3.8%**

Figure 4-11 Commercial Summer Peak Baseline Projection by End Use (MW), Washington

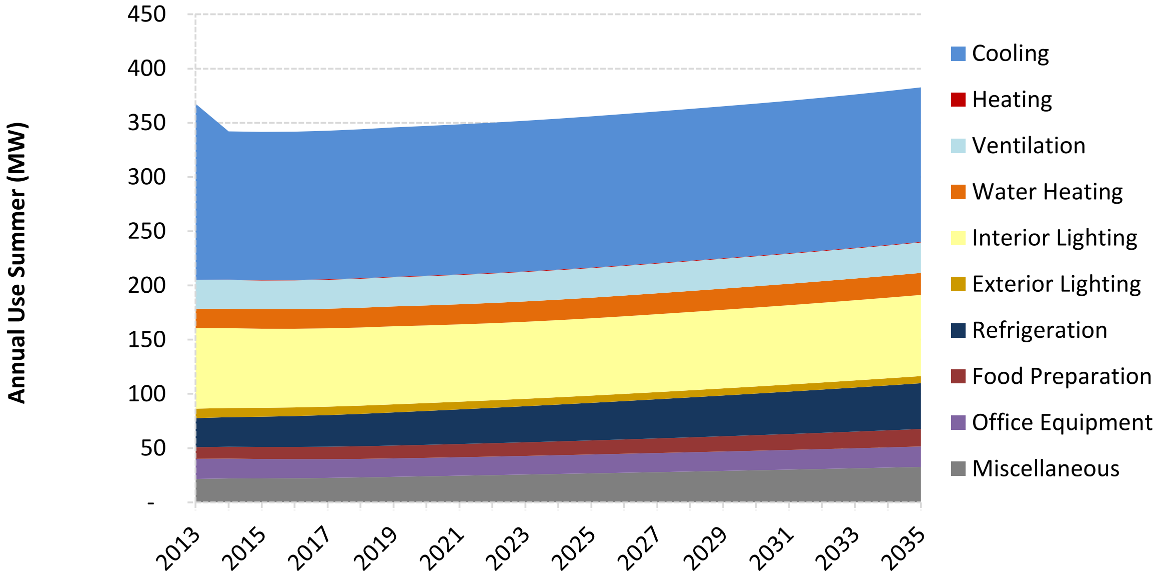
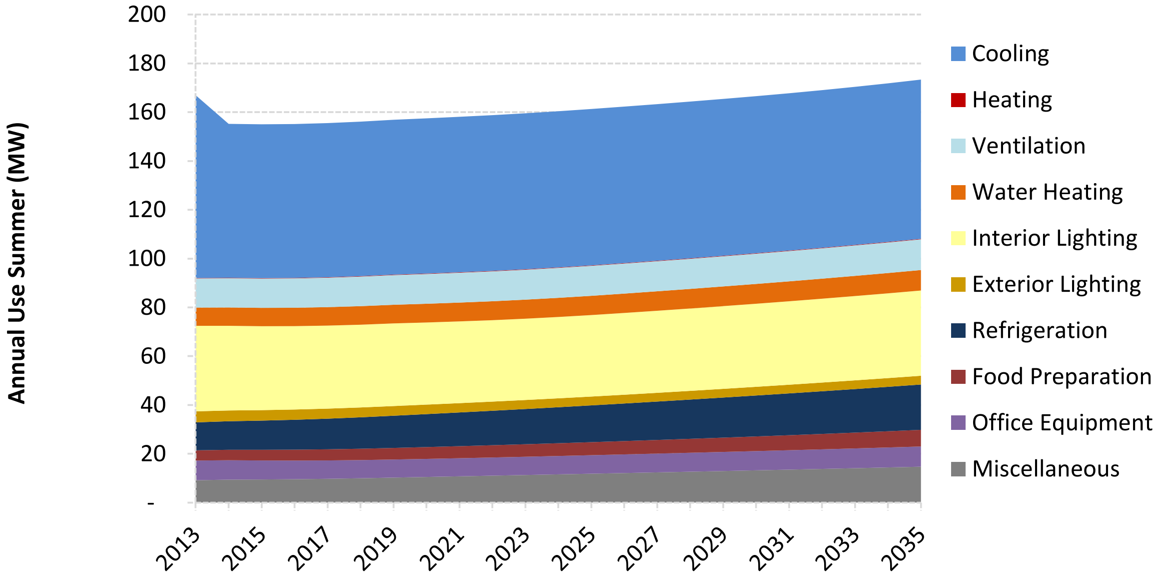


Figure 4-12 Commercial Summer Peak Baseline Projection by End Use (MW), Idaho



Commercial Winter Peak Demand Projection

The tables and charts below present the winter peak baseline projection at the end-use level for the commercial sector as a whole. In Washington, winter peak demand increases during the overall forecast horizon, starting at 333 MW in 2013 and increasing by 14% to 380 MW in 2035. In Idaho, the winter peak demand is 152 MW in 2013 and 173 MW in 2035, an increase of 14%.

Table 4-11 Commercial Winter Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	10	8	8	8	8	9	-11.4%
Heating	90	92	93	95	98	103	14.8%
Ventilation	30	31	31	31	31	32	6.9%
Water Heating	26	27	27	27	28	30	13.0%
Interior Lighting	86	84	84	83	82	86	0.4%
Ext. Lighting	10	9	9	8	8	7	-24.6%
Refrigeration	22	23	24	26	28	35	57.2%
Food Prep	12	13	13	14	15	18	49.2%
Office Equip	21	20	20	20	20	22	1.3%
Miscellaneous	25	26	26	28	31	38	51.5%
Total	**333**	**332**	**334**	**339**	**350**	**380**	**14.2%**

Table 4-12 Commercial Winter Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	4	3	3	3	3	3	-11.7%
Heating	42	43	43	44	45	48	13.0%
Ventilation	14	14	14	14	14	15	5.5%
Water Heating	11	11	11	12	12	13	11.4%
Interior Lighting	41	40	40	40	39	41	-0.9%
Ext. Lighting	5	5	5	4	4	4	-20.7%
Refrigeration	10	10	10	11	13	15	60.8%
Food Prep	5	5	5	6	6	8	61.7%
Office Equip	9	9	9	9	9	10	2.3%
Miscellaneous	11	11	12	12	14	17	60.0%
Total	**152**	**152**	**153**	**155**	**160**	**173**	**13.9%**

Figure 4-13 Commercial Winter Peak Baseline Projection by End Use (MW), Washington

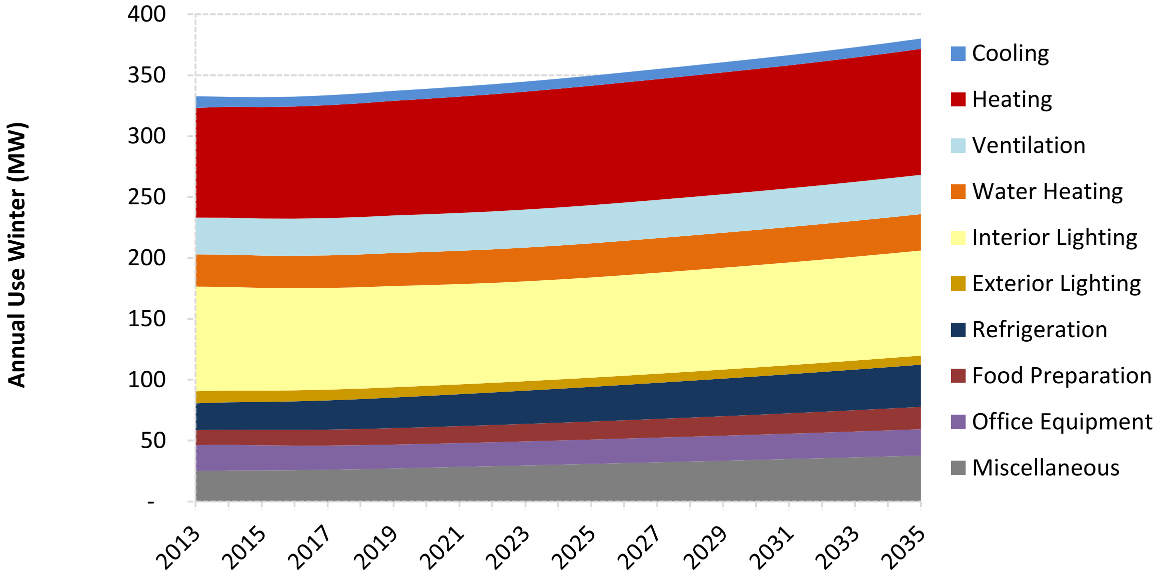
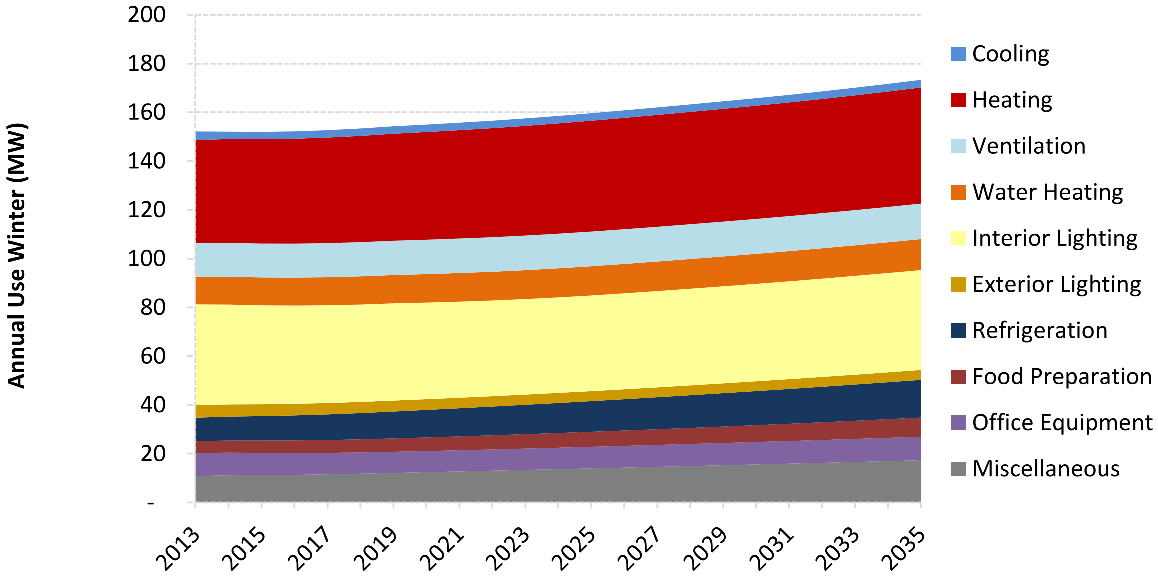


Figure 4-14 Commercial Winter Peak Baseline Projection by End Use (MW), Idaho



Industrial Sector Baseline Projections

Annual Use

Annual industrial use increases almost 25% through the forecast horizon, driven primarily by expected customer growth. The tables and graphs below present the projection at the end-use level. Overall in Washington, industrial annual electricity use increases from 922 GWh in 2013 to 1,149 GWh in 2035. In Idaho, annual electricity use increases from 343 GWh in 2013 to 426 GWh in 2035. This comprises an overall increase of 25% over the 23-year period in both states.

Table 4-13 Industrial Baseline Projection by End Use (GWh), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	46	41	41	41	42	44	-4%
Heating	20	21	22	22	23	24	23%
Ventilation	19	20	20	19	18	16	-18%
Interior Lighting	49	52	52	52	53	57	16%
Exterior Lighting	10	10	10	10	10	10	-1%
Process	492	534	540	555	578	626	27%
Motors	251	272	275	282	294	319	27%
Miscellaneous	36	40	40	42	46	53	48%
Total	**922**	**989**	**999**	**1,024**	**1,064**	**1,149**	**24.5%**

Table 4-14 Industrial Baseline Projection by End Use (GWh), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	17	15	15	15	16	16	-5%
Heating	7	8	8	8	8	9	23%
Ventilation	7	7	7	7	7	6	-18%
Interior Lighting	18	19	19	19	20	21	15%
Exterior Lighting	4	4	4	4	4	4	-1%
Process	183	198	200	206	215	232	27%
Motors	93	101	102	105	109	118	27%
Miscellaneous	13	15	15	16	17	20	48%
Total	**343**	**367**	**371**	**380**	**395**	**426**	**24.3%**

Figure 4-15 Industrial Baseline Projection by End Use (GWh), Washington

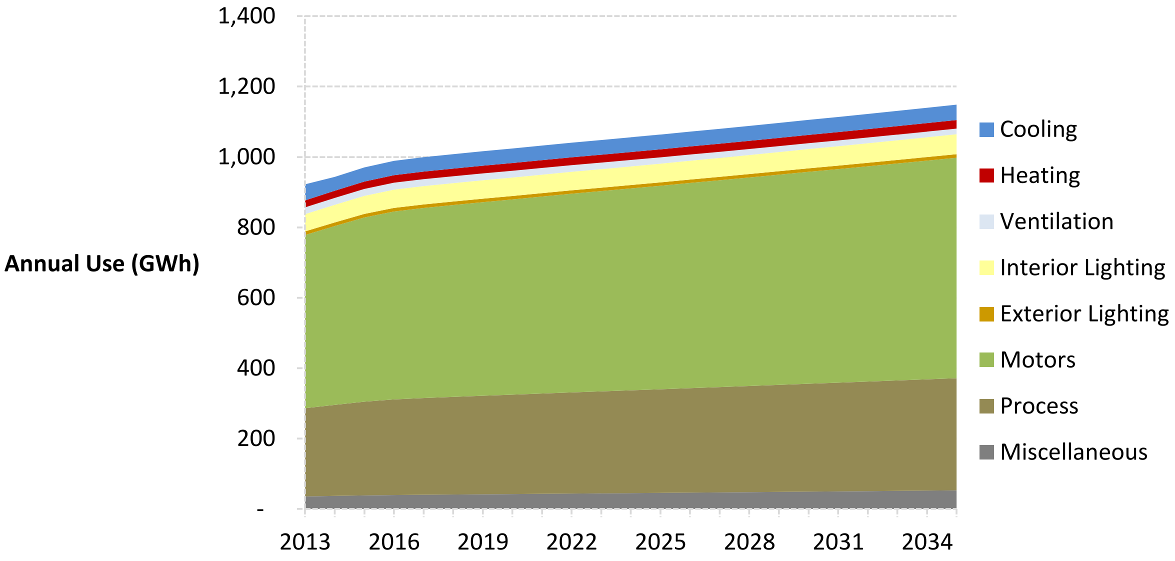
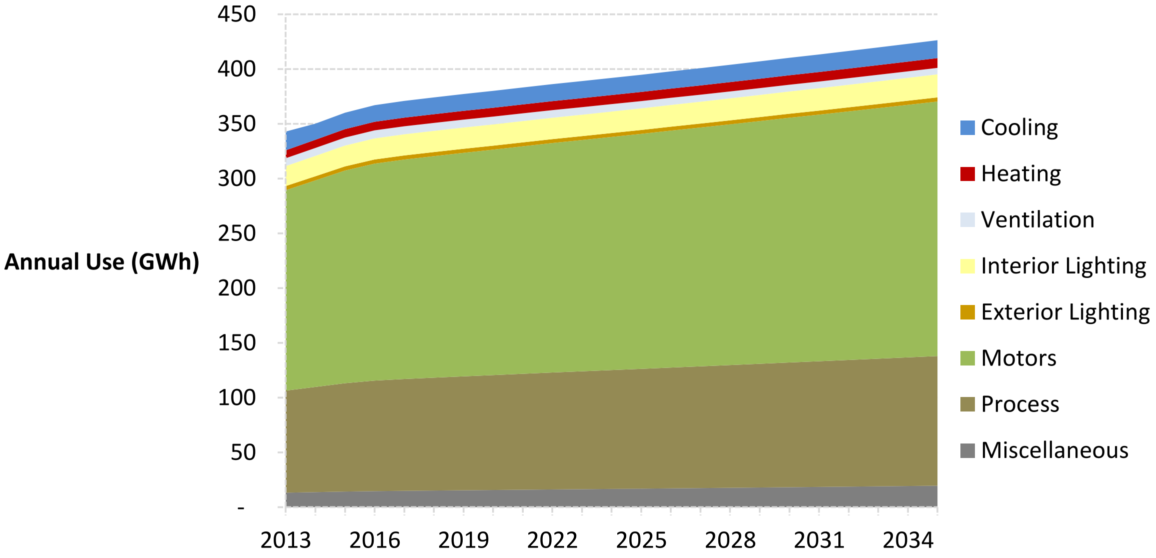


Figure 4-16 Industrial Baseline Projection by End Use (GWh), Idaho



Industrial Summer Peak Demand Projection

The tables and graphs below present the projection of summer peak demand for the industrial sector. This projection looks similar to the energy forecast largely because the industrial sector has a high load factor.

Table 4-15 Industrial Summer Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	-	-	-	-	-	-	0%
Ventilation	4	4	4	4	3	3	-18%
Interior Lighting	13	14	14	14	14	15	16%
Exterior Lighting	1	1	1	1	1	1	-1%
Process	144	156	158	162	169	183	27%
Motors	73	79	80	83	86	93	27%
Miscellaneous	10	12	12	12	13	15	48%
Total	**245**	**265**	**268**	**275**	**287**	**311**	**26.8%**

Table 4-16 Industrial Summer Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	-	-	-	-	-	-	0%
Ventilation	1	1	1	1	1	1	-18%
Interior Lighting	5	5	5	5	5	6	15%
Exterior Lighting	0	0	0	0	0	0	-1%
Process	54	58	59	60	63	68	27%
Motors	27	30	30	31	32	35	27%
Miscellaneous	4	4	4	5	5	6	48%
Total	**91**	**99**	**100**	**102**	**106**	**115**	**26.6%**

Figure 4-17 ***Industrial Summer Peak Baseline Projection by End Use (MW), Washington***

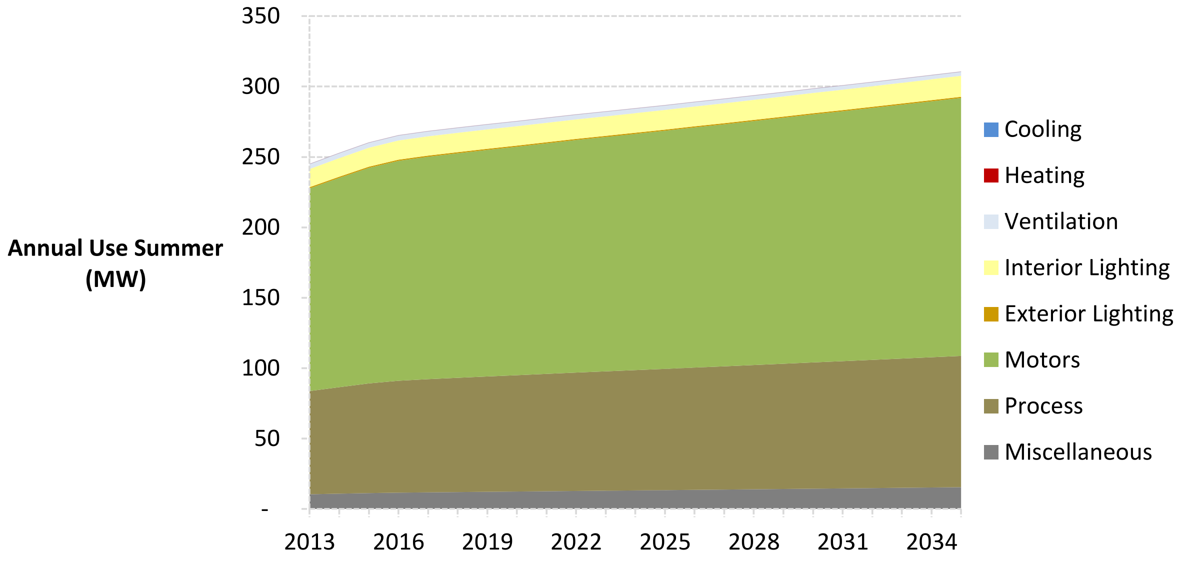
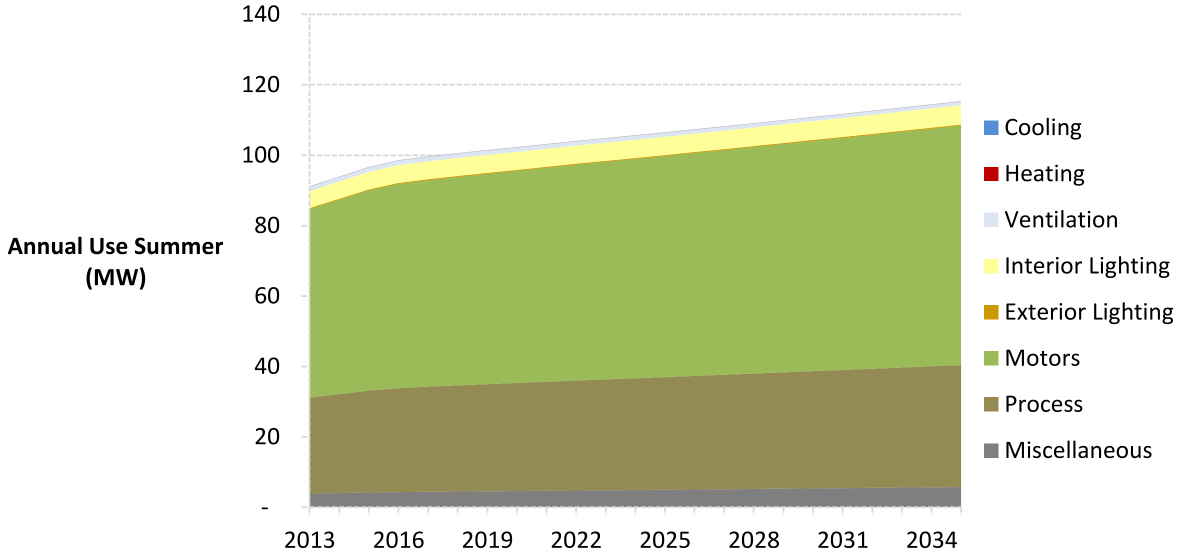


Figure 4-18 ***Industrial Summer Peak Baseline Projection by End Use (MW), Idaho***



Industrial Winter Peak Demand Projection

The tables and graphs below present the projection of winter peak demand for the industrial sector. This projection looks similar to the energy forecast largely because the industrial sector has a high load factor.

Table 4-17 Industrial Winter Peak Baseline Projection by End Use (MW), Washington

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	8	9	9	9	9	10	23%
Ventilation	3	3	3	3	3	2	-18%
Interior Lighting	10	11	11	11	11	12	16%
Exterior Lighting	1	1	1	1	1	1	-1%
Process	114	124	125	128	134	145	27%
Motors	58	63	64	65	68	74	27%
Miscellaneous	8	9	9	10	11	12	48%
Total	**202**	**219**	**221**	**227**	**236**	**256**	**26.63%**

Table 4-18 Industrial Winter Peak Baseline Projection by End Use (MW), Idaho

End Use	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Cooling	-	-	-	-	-	-	0%
Heating	3	3	3	3	3	4	23%
Ventilation	1	1	1	1	1	1	-18%
Interior Lighting	4	4	4	4	4	4	15%
Exterior Lighting	0	0	0	0	0	0	-1%
Process	42	46	46	48	50	54	27%
Motors	22	23	24	24	25	27	27%
Miscellaneous	3	3	3	4	4	5	48%
Total	**75**	**81**	**82**	**84**	**88**	**95**	**26.42%**

Figure 4-19 **Industrial Winter Peak Baseline Projection by End Use (MW), Washington**

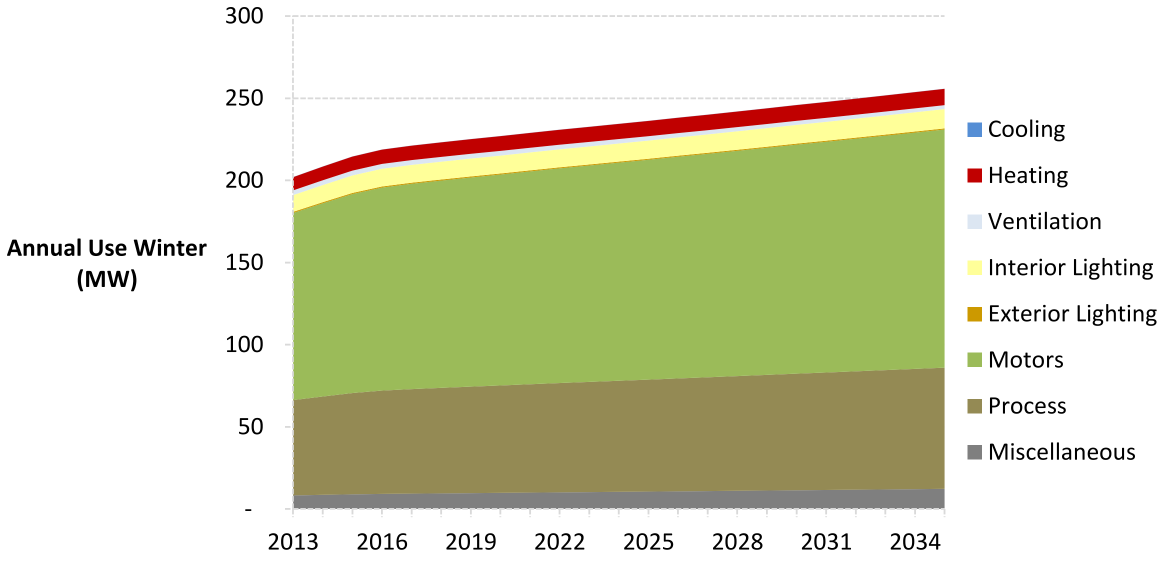
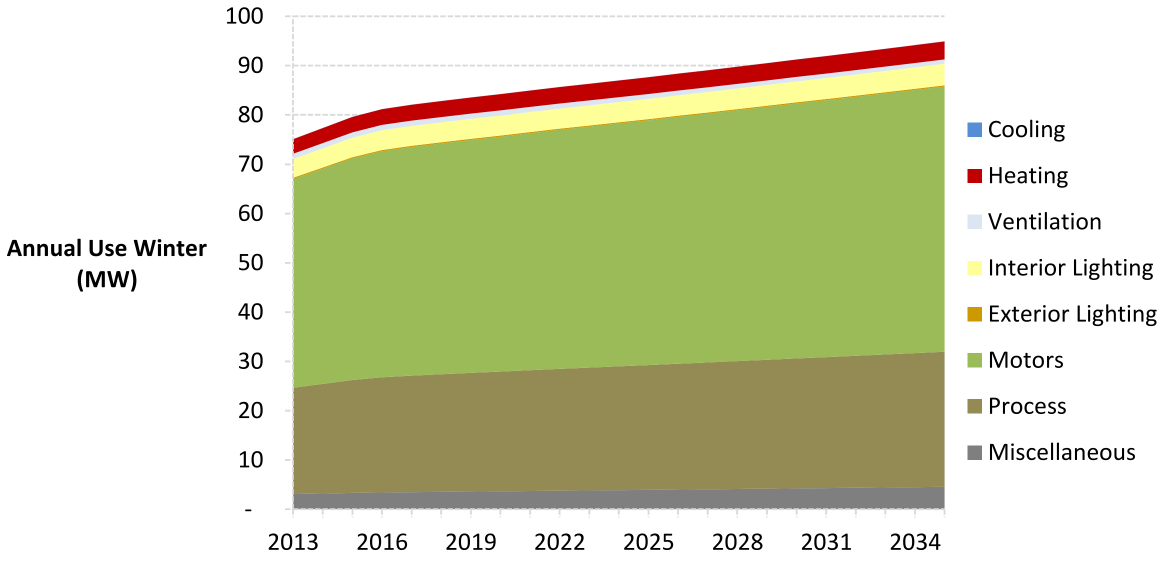


Figure 4-20 **Industrial Winter Peak Baseline Projection by End Use (MW), Idaho**



Summary of Baseline Projections across Sectors and States

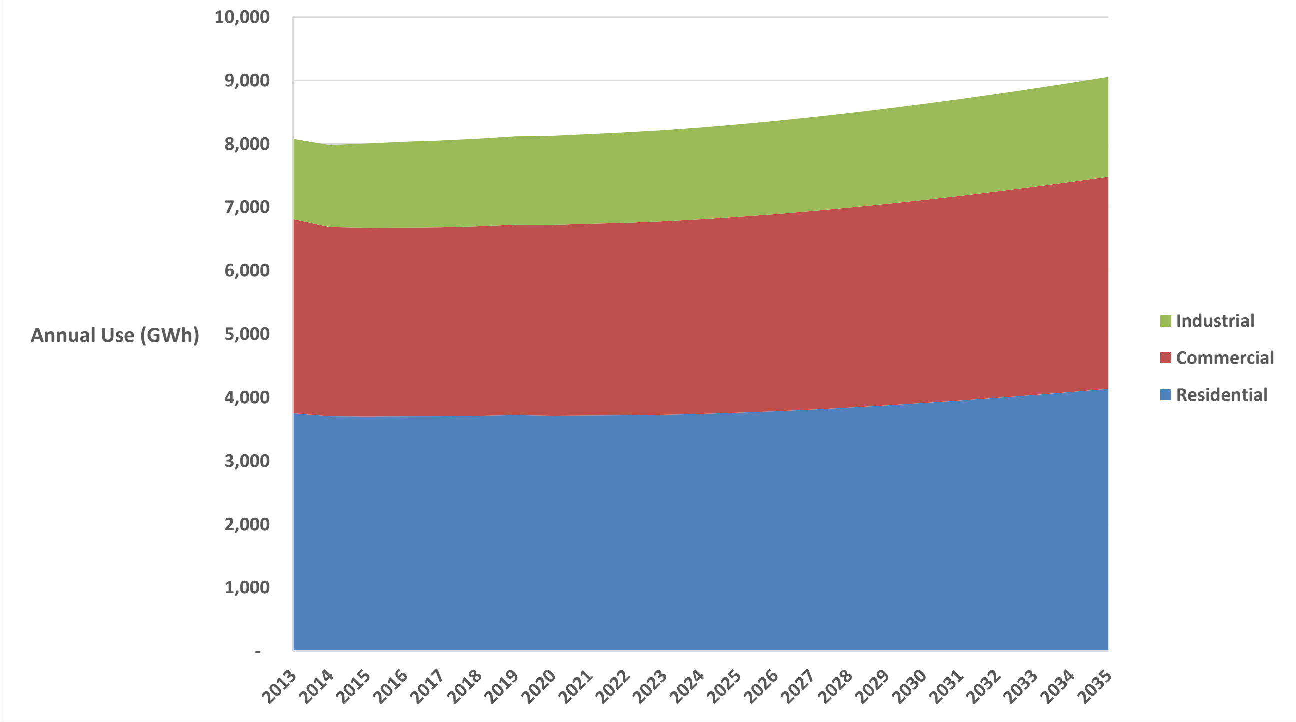
Annual Use

Table 4-19 and Figure 4-21 provide a summary of the baseline projection for annual use by sector for the entire Avista service territory. Overall, the projection shows strong growth in electricity use, driven primarily by customer growth forecasts.

Table 4-19 Baseline Projection Summary (GWh), WA and ID Combined

Sector	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Residential	3,753	3,703	3,703	3,711	3,761	4,136	10.2%
Commercial	3,062	2,976	2,981	3,013	3,089	3,346	9.3%
Industrial	1,265	1,356	1,370	1,404	1,458	1,575	24.5%
Total	**8,081**	**8,035**	**8,054**	**8,128**	**8,308**	**9,057**	**12.1%**

Figure 4-21 Baseline Projection Summary (GWh), WA and ID Combined



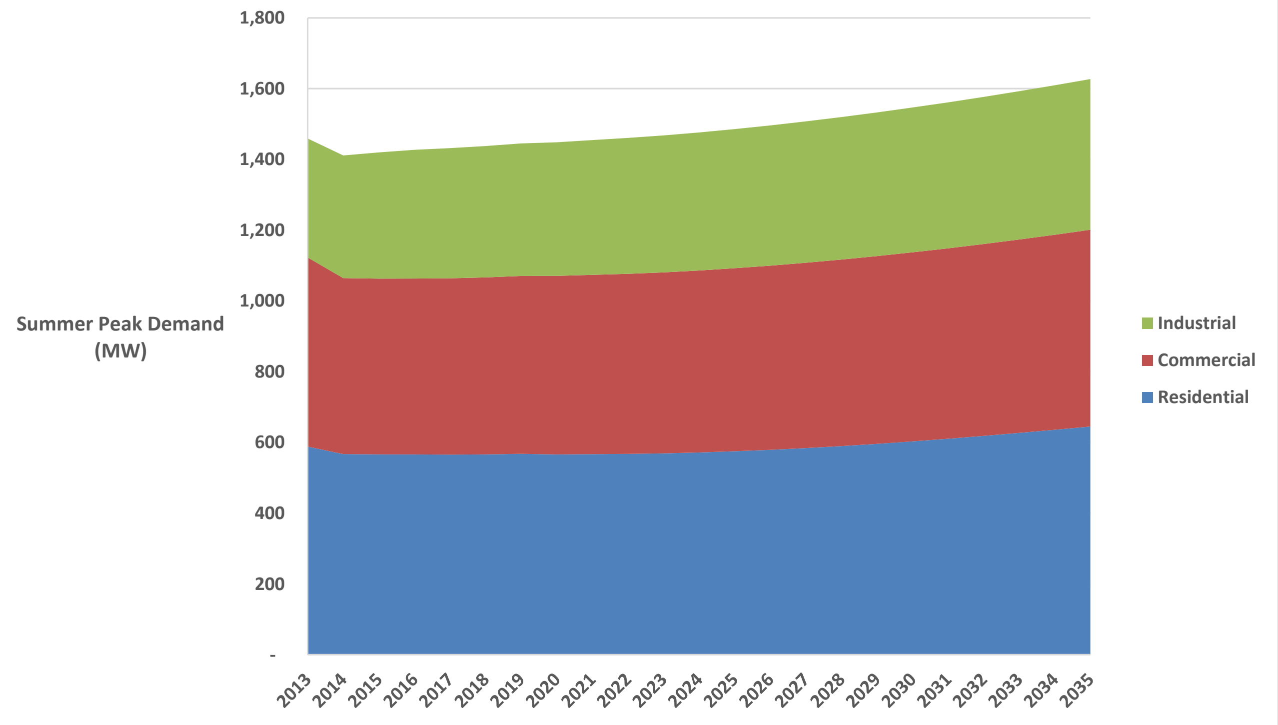
Summer Peak Demand Projection

Table 4-20 and Figure 4-22 provide a summary of the baseline projection for summer peak demand. Overall, the projection shows steady growth.

Table 4-20 Baseline Summer Peak Projection Summary (MW), WA and ID Combined

Sector	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Residential	588	566	566	566	575	645	9.6%
Commercial	535	497	498	505	517	556	4.0%
Industrial	336	364	368	378	393	426	26.7%
Total	**1,459**	**1,427**	**1,432**	**1,448**	**1,486**	**1,627**	**11.5%**

Figure 4-22 Baseline Summer Peak Projection Summary (MW), WA and ID Combined



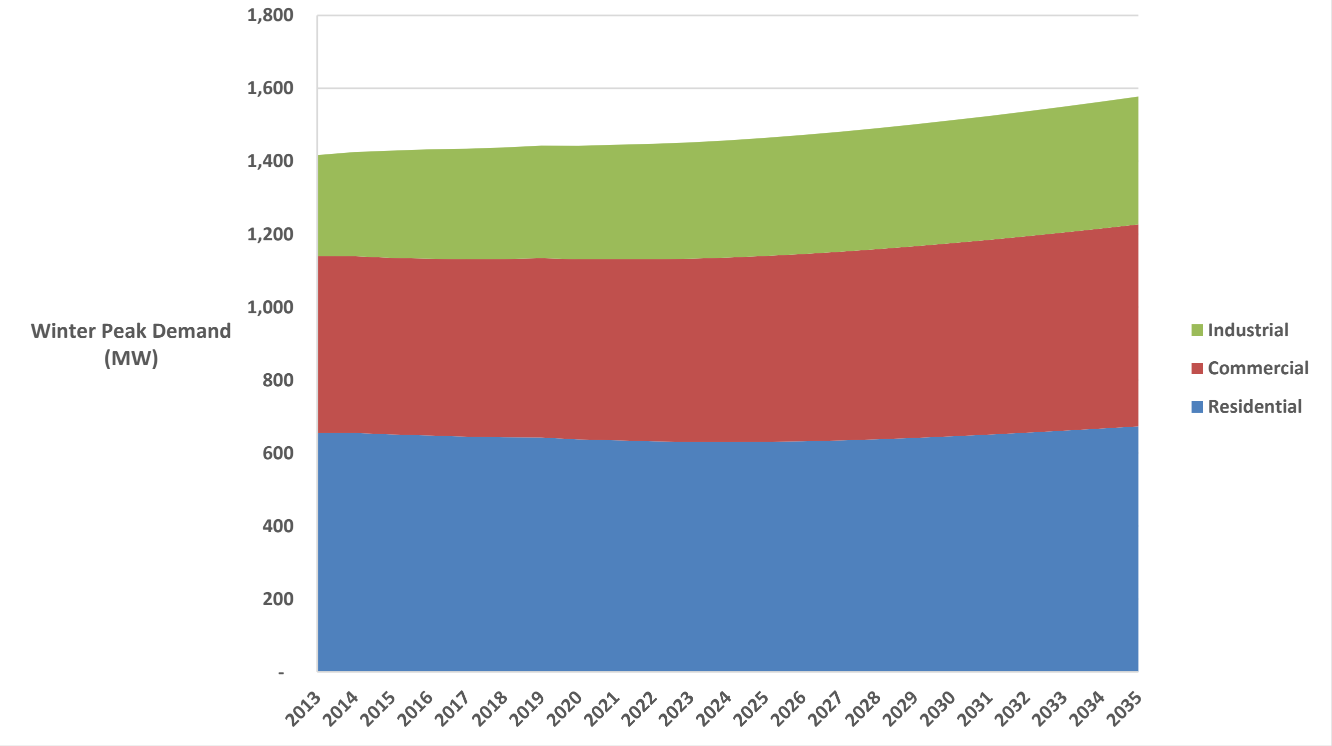
Winter Peak Demand Projection

Table 4-21Table 4-20 and Figure 4-23 provide a summary of the baseline projection for winter peak demand. Overall, the projection shows steady growth.

Table 4-21 Baseline Winter Peak Projection Summary (MW), WA and ID Combined

Sector	2013	2016	2017	2020	2025	2035	% Change ('13-'35)
Residential	655	648	645	637	631	673	2.8%
Commercial	485	485	486	494	509	554	14.1%
Industrial	277	300	303	311	324	351	26.6%
Total	**1,417**	**1,433**	**1,434**	**1,442**	**1,464**	**1,577**	**11.3%**

Figure 4-23 ***Baseline Winter Peak Projection Summary (MW), WA and ID Combined***



Conservation Potential

This section presents the measure-level conservation potential for Avista. This includes every possible measure that is considered in the measure list, regardless of program implementation concerns.

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

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

Overall Summary of Energy Efficiency Potential

Summary of Annual Energy Savings

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

- **Technical potential** reflects the adoption of all conservation measures regardless of cost-effectiveness. For Washington, first-year savings are 116 GWh, or 2.1% of the baseline projection. Cumulative savings in 2035 are 1,682 GWh, or 27.2% of the baseline. For Idaho, first-year savings are 57 GWh, or 2.2% of the baseline projection. Cumulative savings in 2035 are 824 GWh, or 28.8% of the baseline.
- **Economic potential** reflects the savings when the most efficient cost-effective measures are taken by all customers. For Washington, the first-year savings in 2016 are 45 GWh, or 0.8% of the baseline projection. By 2035, cumulative savings reach 884 GWh, or 14.3% of the baseline projection. For Idaho, the first-year savings in 2016 are 23 GWh, or 0.9% of the baseline projection. By 2035, cumulative savings reach 408 GWh, or 14.2% of the baseline projection.
- **Achievable potential** represents savings that are possible through utility programs. It shows for Washington, 23 GWh savings in the first year, or 0.4% of the baseline and by 2035 cumulative achievable savings reach 746 GWh, or 12% of the baseline projection. This results in average annual savings of 0.5% of the baseline each year. Achievable potential reflects 84% of economic potential throughout the forecast horizon. For Idaho, first year savings are 11 GWh or 0.4% of the baseline and by 2035 cumulative achievable savings reach 344 GWh, or 12% of the baseline.

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

	2016	2017	2020	2025	2035
Baseline projection (GWh)	5,520	5,530	5,575	5,693	6,192
Cumulative Savings (GWh)					
Achievable Potential	23	50	159	391	746
Economic Potential	45	92	242	499	884
Technical Potential	116	231	563	1,065	1,682
Cumulative Savings (aMW)					
Achievable Potential	2.6	5.7	18.1	44.6	85.2
Economic Potential	5.1	10.6	27.6	56.9	100.9
Technical Potential	13.3	26.4	64.2	121.6	192.0
Cumulative Savings as a % of Baseline					
Achievable Potential	0.4%	0.9%	2.8%	6.9%	12.0%
Economic Potential	0.8%	1.7%	4.3%	8.8%	14.3%
Technical Potential	2.1%	4.2%	10.1%	18.7%	27.2%

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

	2016	2017	2020	2025	2035
Baseline projection (GWh)	2,515	2,525	2,553	2,615	2,865
Cumulative Savings (GWh)					
Achievable Potential	11	24	77	184	344
Economic Potential	23	46	118	234	408
Technical Potential	57	113	274	516	824
Cumulative Savings (aMW)					
Achievable Potential	1.3	2.8	8.8	21.0	39.3
Economic Potential	2.6	5.3	13.5	26.8	46.6
Technical Potential	6.5	12.9	31.3	58.9	94.1
Cumulative Savings as a % of Baseline					
Achievable Potential	0.4%	1.0%	3.0%	7.0%	12.0%
Economic Potential	0.9%	1.8%	4.6%	9.0%	14.2%
Technical Potential	2.2%	4.5%	10.7%	19.7%	28.8%

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

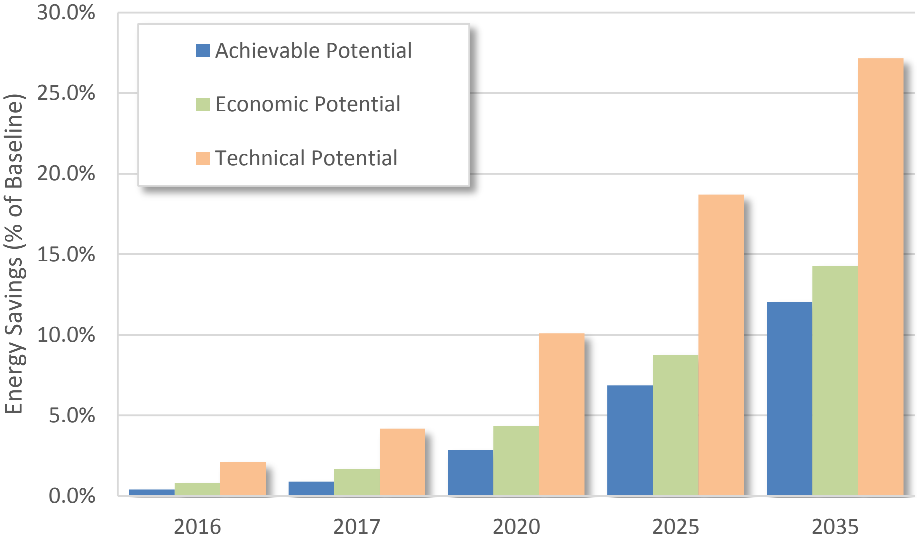


Figure 5-2 Summary of EE Potential as % of Baseline Projection (Annual Energy), Idaho

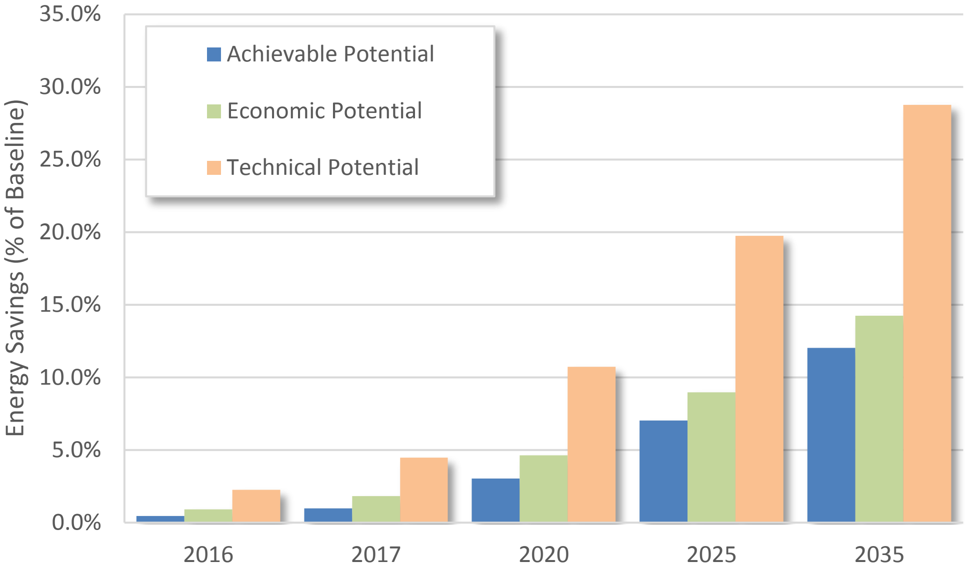


Figure 5-3 Baseline Projection and EE Forecast Summary (Annual Energy, GWh), Washington

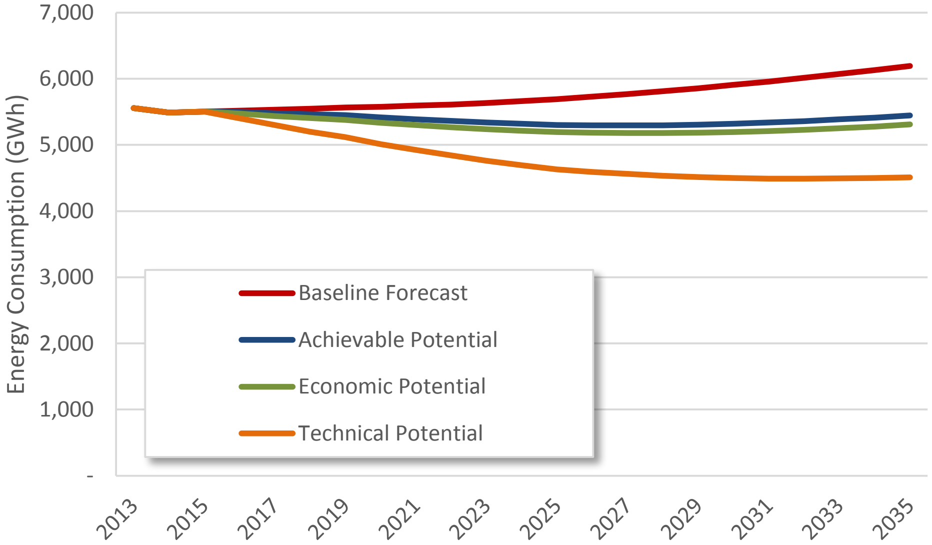
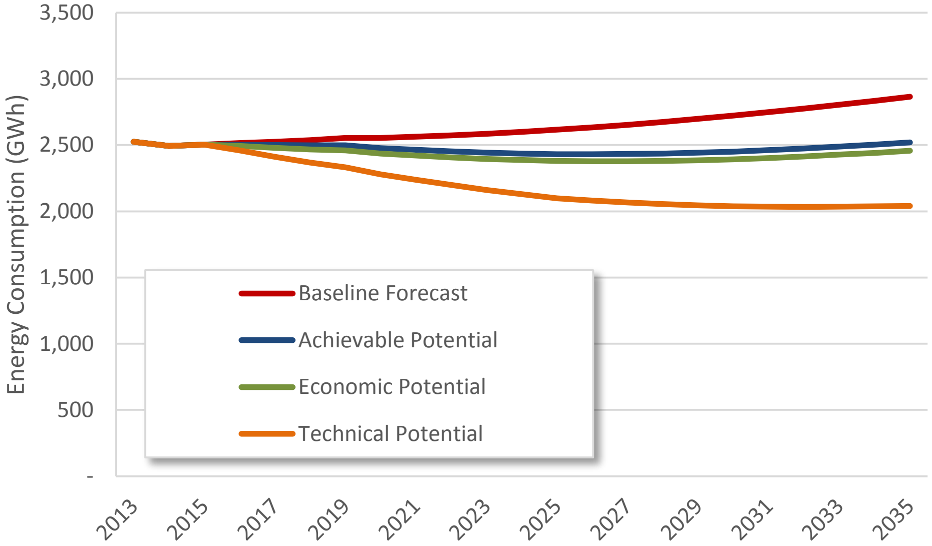


Figure 5-4 Baseline Projection and EE Forecast Summary (Annual Energy, GWh), Idaho



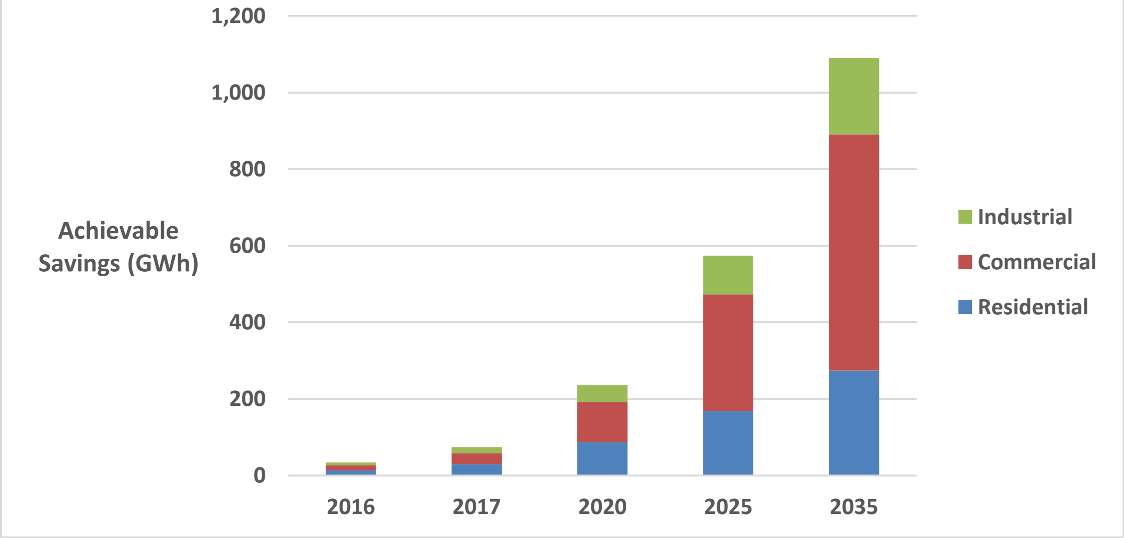
Summary of Conservation Potential by Sector

Table 5-3 and Figure 5-5 summarize the range of electric achievable potential by sector, both states combined. The residential and commercial sectors contribute the most savings in the early years, but by 2020 the commercial sector provides the most savings.

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

	2016	2017	2020	2025	2035
Cumulative Savings (GWh)					
Residential	13	30	87	169	274
Commercial	13	28	105	304	617
Industrial	8	16	44	101	199
Total	**34**	**74**	**236**	**574**	**1,090**
Cumulative Savings (aMW)					
Residential	1.5	3.4	9.9	19.3	31.3
Commercial	1.5	3.2	12.0	34.7	70.5
Industrial	0.9	1.8	5.1	11.6	22.7
Total	3.9	8.5	27.0	65.6	124.5

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



Residential Conservation Potential

Table 5-4 (Total), Table 5-5 (WA) and Table 5-6 (ID) present estimates for measure-level conservation potential for the residential sector in terms of annual energy savings. Figure 5-6 (WA) and Figure 5-7 (ID) display the three levels of potential by year. For Washington, achievable potential in the first year, 2016 is 9 GWh, or 0.3% of the baseline projection. By 2035, cumulative achievable savings are 181 GWh, or 6.6% of the baseline projection. At this level, it represents over 80% of economic potential. For Idaho, first year achievable savings are 5 GWh or 0.4% of the baseline and by 2035 cumulative achievable savings reach 93 GWh, or 6.8% of the baseline.

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

	2016	2017	2020	2025	2035
Baseline projection (GWh)	3,703	3,703	3,711	3,761	4,136
Cumulative Net Savings (GWh)					
Achievable Potential	13	30	87	169	274
Economic Potential	29	60	137	219	334
Technical Potential	84	169	400	719	1,117
Cumulative Net Savings (aMW)					
Achievable Potential	1.5	3.4	9.9	19.3	31.3
Economic Potential	3.3	6.9	15.6	25.0	38.1
Technical Potential	9.6	19.3	45.7	82.1	127.5
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.4%	0.8%	2.3%	4.5%	6.6%
Economic Potential	0.8%	1.6%	3.7%	5.8%	8.1%
Technical Potential	2.3%	4.6%	10.8%	19.1%	27.0%

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

	2016	2017	2020	2025	2035
Baseline projection (GWh)	2,503	2,500	2,498	2,523	2,761
Cumulative Net Savings (GWh)					
Achievable Potential	9	19	56	111	181
Economic Potential	19	39	88	145	221
Technical Potential	55	110	261	469	721
Cumulative Net Savings (aMW)					
Achievable Potential	1.0	2.2	6.4	12.6	20.7
Economic Potential	2.2	4.4	10.1	16.5	25.2
Technical Potential	6.3	12.6	29.8	53.6	82.3
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.3%	0.8%	2.2%	4.4%	6.6%
Economic Potential	0.8%	1.5%	3.5%	5.7%	8.0%
Technical Potential	2.2%	4.4%	10.5%	18.6%	26.1%

Table 5-6 Residential Conservation Potential (Annual Energy), Idaho

	2016	2017	2020	2025	2035
Baseline projection (GWh)	1,199	1,203	1,213	1,238	1,375
Cumulative Net Savings (GWh)					
Achievable Potential	5	11	31	58	93
Economic Potential	10	21	48	75	113
Technical Potential	29	59	139	250	395
Cumulative Net Savings (aMW)					
Achievable Potential	0.5	1.2	3.5	6.6	10.6
Economic Potential	1.2	2.4	5.5	8.5	12.9
Technical Potential	3.3	6.7	15.9	28.5	45.1
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.4%	0.9%	2.5%	4.7%	6.8%
Economic Potential	0.9%	1.8%	4.0%	6.0%	8.2%
Technical Potential	2.4%	4.9%	11.5%	20.2%	28.8%

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

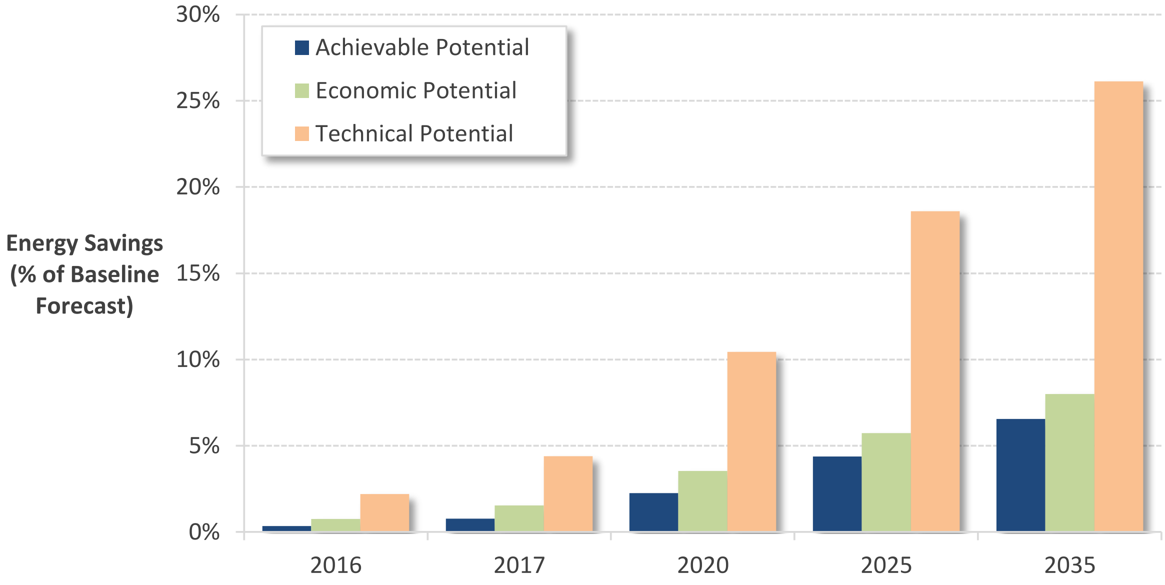
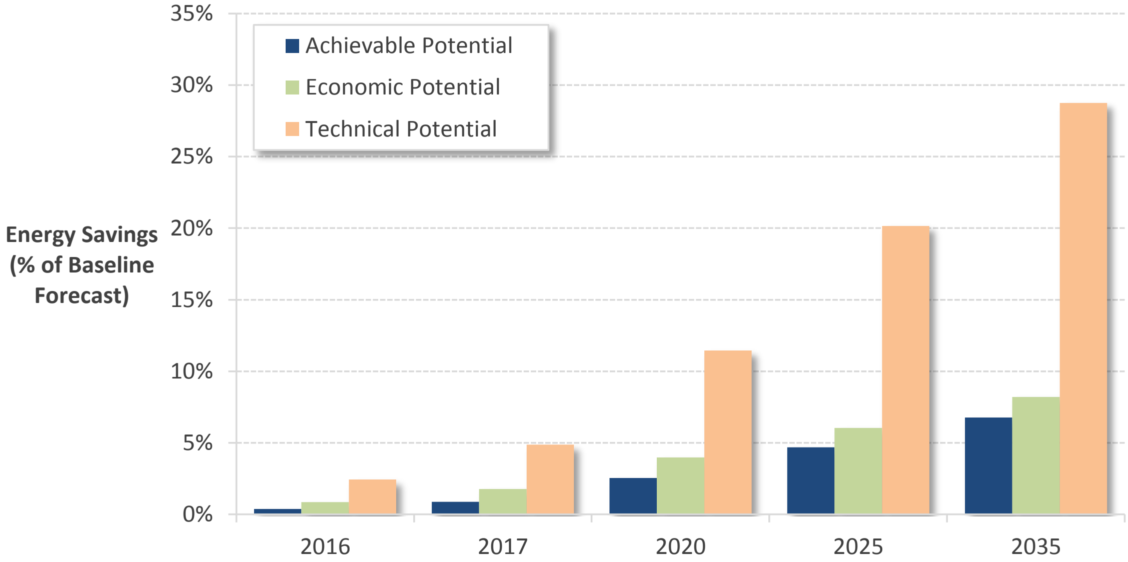


Figure 5-7 Residential Conservation Savings as a % of the Baseline Projection (Annual Energy), Idaho



Below, we present the top residential measures from the perspective of annual energy use. We first present information for both states, followed by Washington-only results and Idaho-only results.

Table 5-7 identifies the top 20 residential measures from the perspective of annual energy savings in 2017 for Washington and Idaho combined. The top three measures include interior and exterior lighting measures and repair and sealing of ducting. The lighting measures are a result of purchases of LED lamps which are cost effective throughout the forecast horizon.

Table 5-7 Residential Top Measures in 2017 (Annual Energy, MWh), Washington and Idaho

Rank	Residential Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Screw-in/Hard-wire	13,616	46%
2	Ducting - Repair and Sealing	5,057	17%
3	Exterior Lighting - Screw-in/Hard-wire	4,152	14%
4	Water Heater - Pipe Insulation	2,264	8%
5	Water Heater - Faucet Aerators	1,037	3%
6	Behavioral Programs	688	2%
7	Thermostat - Clock/Programmable	674	2%
8	Insulation - Ducting	621	2%
9	Water Heater - Low-Flow Showerheads	419	1%
10	Electronics - Personal Computers	285	1%
11	Appliances - Freezer	272	1%
12	Water Heater - Drainwater Heat Recovery	241	1%
13	Miscellaneous - Pool Pump	172	1%
14	Appliances - Second Refrigerator	169	1%
15	Electronics - Laptops	77	0%
16	Appliances - Refrigerator	56	0%
17	Water Heating - Water Heater (55 to 75 Gal)	36	0%
18	Water Heater - Desuperheater	17	0%
19	Electronics - Monitor	13	0%
20	Electronics - TVs	7	0%
Total	**Total**	**29,875**	**100.0%**

Table 5-8 identifies the top 20 residential measures from the perspective of annual energy savings in 2017 for Washington. The top three measures include interior and exterior lighting measures and repair and sealing of ducting. The lighting measures are a result of purchases of LED lamps which are cost effective throughout the forecast horizon.

Table 5-8 Residential Top Measures in 2017 (Annual Energy, MWh), Washington

Rank	Residential Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Screw-in/Hard-wire	8,479	44.0%
2	Ducting - Repair and Sealing	3,483	18.1%
3	Exterior Lighting - Screw-in/Hard-wire	2,564	13.3%
4	Water Heater - Pipe Insulation	1,535	8.0%
5	Water Heater - Faucet Aerators	699	3.6%
6	Behavioral Programs	464	2.4%
7	Thermostat - Clock/Programmable	443	2.3%
8	Insulation - Ducting	429	2.2%
9	Water Heater - Low-Flow Showerheads	284	1.5%
10	Electronics - Personal Computers	199	1.0%
11	Appliances - Freezer	177	0.9%
12	Water Heater - Drainwater Heat Recovery	157	0.8%
13	Miscellaneous - Pool Pump	121	0.6%
14	Appliances - Second Refrigerator	110	0.6%
15	Electronics - Laptops	51	0.3%
16	Appliances - Refrigerator	36	0.2%
17	Water Heating - Water Heater (55 to 75 Gal)	24	0.1%
18	Water Heater - Desuperheater	12	0.1%
19	Electronics - Monitor	9	0.0%
20	Electronics - TVs	5	0.0%
Total	**Total**	**19,280**	**100.0%**

Figure 5-8 presents forecasts of cumulative energy savings for Washington. Lighting savings account for a substantial portion of the savings throughout the forecast horizon. The same is true for exterior lighting. Savings from heating measures and appliances are steadily increasing throughout the forecast horizon.

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

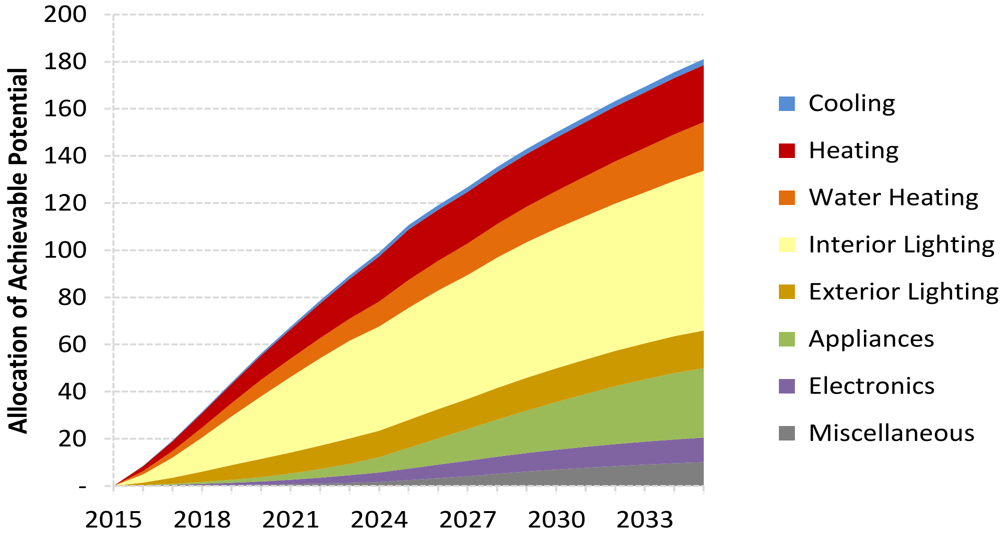


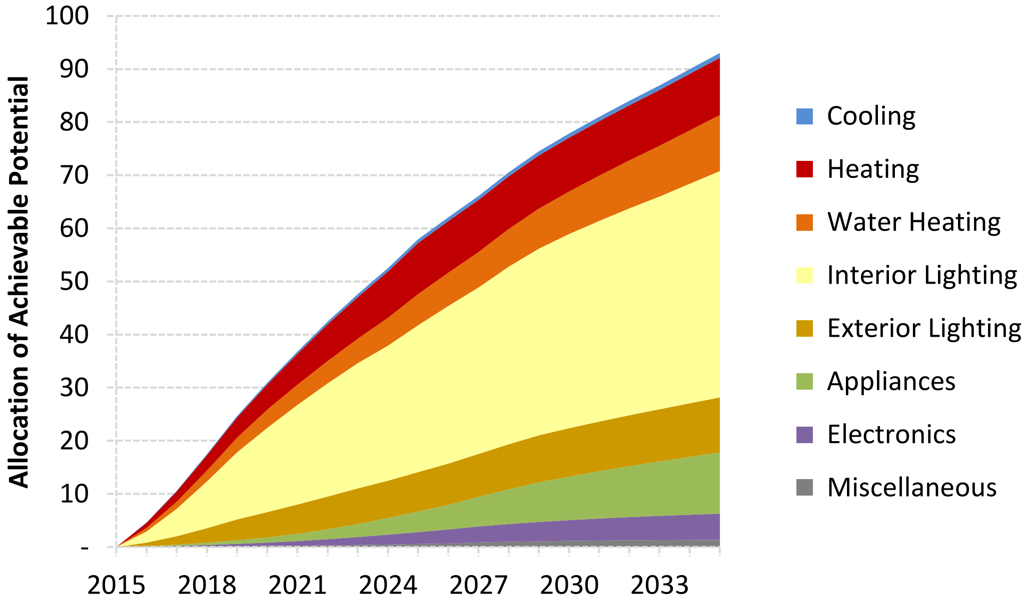
Table 5-9 identifies the top 20 residential measures from the perspective of annual energy savings in 2017 for Idaho. The top three measures include interior and exterior lighting measures and repair and sealing of ducting. The lighting measures are a result of purchases of LED lamps which are cost effective throughout the forecast horizon.

Table 5-9 Residential Top Measures in 2017 (Annual Energy, MWh), Idaho

Rank	Residential Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Screw-in/Hard-wire	5,137	48.5%
2	Exterior Lighting - Screw-in/Hard-wire	1,588	15.0%
3	Ducting - Repair and Sealing	1,574	14.9%
4	Water Heater - Pipe Insulation	729	6.9%
5	Water Heater - Faucet Aerators	337	3.2%
6	Thermostat - Clock/Programmable	231	2.2%
7	Behavioral Programs	225	2.1%
8	Insulation - Ducting	193	1.8%
9	Water Heater - Low-Flow Showerheads	135	1.3%
10	Appliances - Freezer	95	0.9%
11	Electronics - Personal Computers	86	0.8%
12	Water Heater - Drainwater Heat Recovery	85	0.8%
13	Appliances - Second Refrigerator	59	0.6%
14	Miscellaneous - Pool Pump	51	0.5%
15	Electronics - Laptops	26	0.2%
16	Appliances - Refrigerator	21	0.2%
17	Water Heating - Water Heater (55 to 75 Gal)	12	0.1%
18	Water Heater - Desuperheater	6	0.1%
19	Electronics - Monitor	4	0.0%
20	Electronics - TVs	2	0.0%
Total	**Total**	**10,595**	**100.0%**

Figure 5-9 presents forecasts of cumulative energy savings for Idaho. Results are similar to Washington.

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



Commercial Conservation Potential

Table 5-10 (Total), Table 5-11 (WA) and Table 5-12 (ID) present estimates for the three levels of conservation potential for the commercial sector from the perspective of annual energy savings. Figure 5-10 (WA) and Figure 5-11(ID) display the three levels of potential by year. For Washington, the first year of the projection, achievable potential is 9 GWh, or 0.4% of the baseline projection. By 2035, savings are 419 GWh, or 18.4% of the baseline projection. Throughout the forecast horizon, achievable potential represents about 85% of economic potential. . For Idaho, first year achievable savings are 4 GWh or 0.4% of the baseline and by 2035 cumulative achievable savings reach 198 GWh, or 18.7% of the baseline.

Table 5-10 Commercial Conservation Potential (Energy Savings), Washington and Idaho

	2016	2017	2020	2025	2035
Baseline projection (GWh)	2,976	2,981	3,013	3,089	3,346
Cumulative Net Savings (GWh)					
Achievable Potential	13	28	105	304	617
Economic Potential	29	60	171	395	728
Technical Potential	71	142	353	694	1,096
Cumulative Net Savings (aMW)					
Achievable Potential	1.5	3.2	12.0	34.7	70.5
Economic Potential	3.3	6.8	19.5	45.1	83.1
Technical Potential	8.1	16.2	40.3	79.2	125.1
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.4%	1.0%	3.5%	9.9%	18.4%
Economic Potential	1.0%	2.0%	5.7%	12.8%	21.7%
Technical Potential	2.4%	4.8%	11.7%	22.5%	32.8%

Table 5-11 Commercial Conservation Potential (Energy Savings), Washington

	2016	2017	2020	2025	2035
Baseline projection (GWh)	2,027	2,031	2,053	2,106	2,282
Cumulative Net Savings (GWh)					
Achievable Potential	9	19	71	207	419
Economic Potential	20	41	116	268	494
Technical Potential	49	97	241	473	746
Cumulative Net Savings (aMW)					
Achievable Potential	1.0	2.2	8.1	23.6	47.8
Economic Potential	2.3	4.6	13.3	30.6	56.4
Technical Potential	5.5	11.0	27.5	54.0	85.2
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.4%	1.0%	3.5%	9.8%	18.4%
Economic Potential	1.0%	2.0%	5.7%	12.7%	21.6%
Technical Potential	2.4%	4.8%	11.7%	22.5%	32.7%

Table 5-12 Commercial Conservation Potential (Energy Savings), Idaho

	2016	2017	2020	2025	2035
Baseline projection (GWh)	949	950	960	983	1,063
Cumulative Net Savings (GWh)					
Achievable Potential	4	9	33	98	198
Economic Potential	9	19	55	127	234
Technical Potential	23	45	112	221	349
Cumulative Net Savings (aMW)					
Achievable Potential	0.5	1.0	3.8	11.2	22.6
Economic Potential	1.1	2.2	6.2	14.5	26.7
Technical Potential	2.6	5.2	12.8	25.3	39.9
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.4%	1.0%	3.5%	9.9%	18.7%
Economic Potential	1.0%	2.0%	5.7%	12.9%	22.0%
Technical Potential	2.4%	4.7%	11.7%	22.5%	32.9%

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

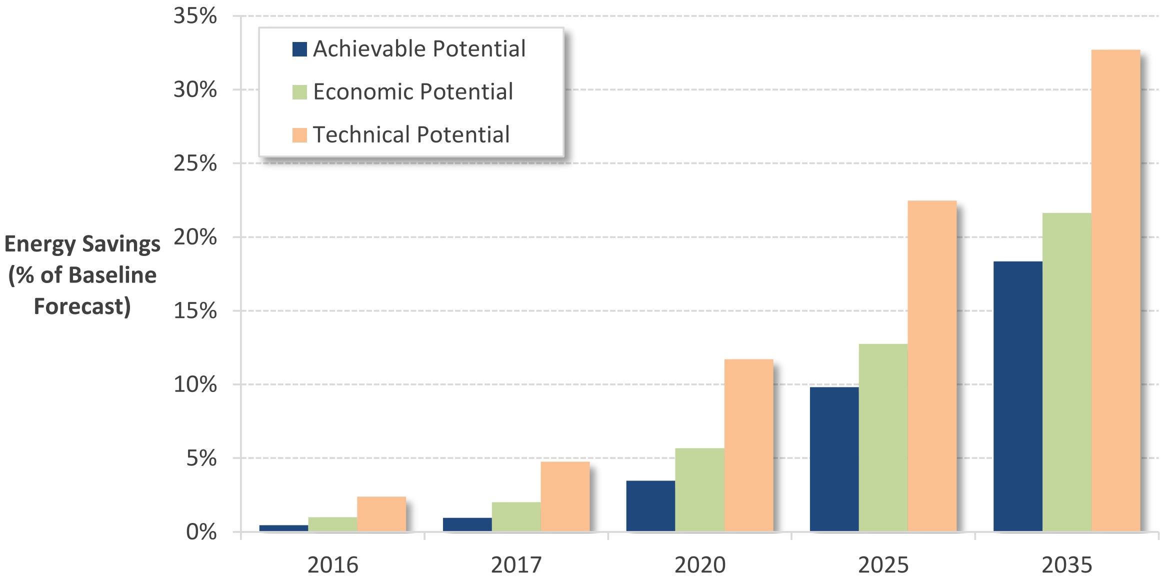
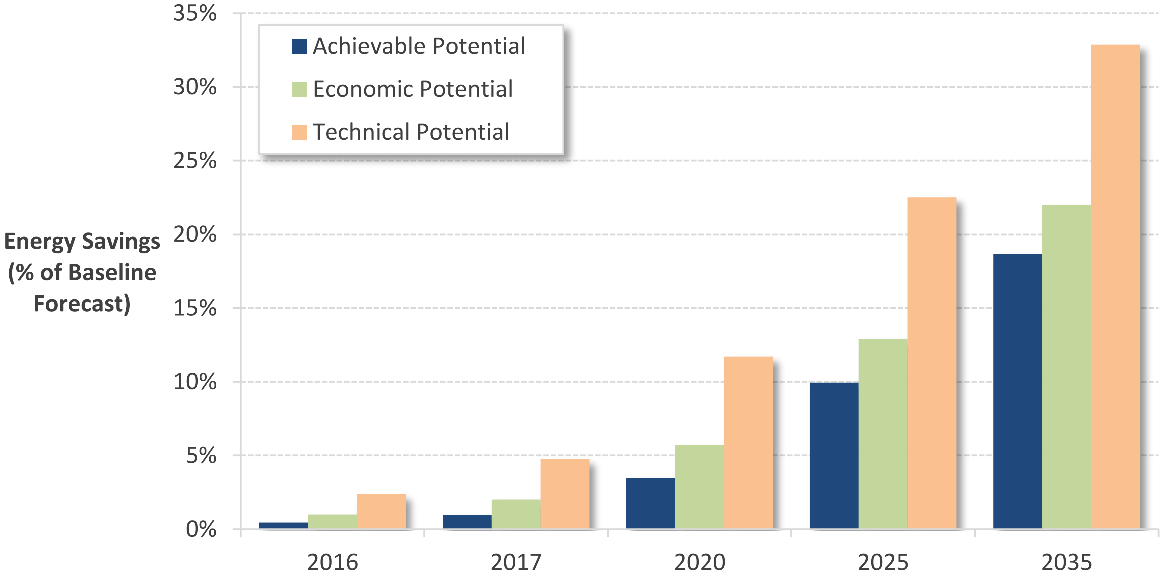


Figure 5-11 Commercial Conservation Savings (Energy), Idaho



Below, we present the top commercial measures from the perspective of annual energy use for Washington and Idaho combined, followed by each state on its own.

Table 5-13 identifies the top 20 commercial-sector measures from the perspective of annual energy savings in 2017 for Washington and Idaho combined. The top measure is interior LED replacements for linear-fluorescent style lighting applications. Lighting dominates the top 10 measures. Other measures among the top 10 include chilled water reset, duct repair and sealing, and night covers for open display cases in grocery stores.

Table 5-13 Commercial Top Measures in 2017 (Annual Energy, MWh), Washington and Idaho

Rank	Commercial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Linear LED	6,604	23.3%
2	Interior Lighting - Screw-in/Hard-wire	3,889	13.7%
3	Chiller - Chilled Water Reset	1,362	4.8%
4	Exterior Lighting - Linear LED	1,135	4.0%
5	Interior Lighting - High-Bay Fixtures	1,130	4.0%
6	HVAC - Duct Repair and Sealing	1,068	3.8%
7	Interior Lighting - Occupancy Sensors	975	3.4%
8	Interior Lighting - Skylights	831	2.9%
9	Exterior Lighting - Screw-in/Hard-wire	702	2.5%
10	Exterior Lighting - HID	671	2.4%
11	Grocery - Open Display Case - Night Covers	661	2.3%
12	Insulation - Ducting	599	2.1%
13	Refrigerator - High Efficiency Compressor	575	2.0%
14	Cooling - Water-Cooled Chiller	540	1.9%
15	HVAC - Economizer	519	1.8%
16	Food Preparation - Dishwasher	506	1.8%
17	Insulation - Ceiling	475	1.7%
18	Space Heating - Heat Recovery Ventilator	468	1.7%
19	Exterior Lighting - Bi-Level Fixture	458	1.6%
20	Exterior Lighting - Photovoltaic Installation	453	1.6%
Total	**Total Top 20**	**23,620**	**83.0%**

Table 5-14 identifies the top 20 commercial-sector measures from the perspective of annual energy savings in 2017 in Washington and Table 5-15 shows the top measures for Idaho. For both states, the top measure is interior LED replacements for linear-fluorescent style lighting applications. Lighting dominates the top 10 measures. Other measures among the top 10 include chilled water reset, duct repair and sealing, and night covers for open display cases in grocery stores.

Figure 5-12 (WA) and Figure 5-13 (ID) present forecasts of cumulative energy savings by end use. Lighting savings from interior and exterior applications account for a substantial portion of the savings throughout the forecast horizon. Cooling savings are also substantial throughout the forecast.

Table 5-14 Commercial Top Measures in 2017 (Annual Energy, MWh), Washington

Rank	Commercial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Linear LED	4,470	23.1%
2	Interior Lighting - Screw-in/Hard-wire	2,652	13.7%
3	Chiller - Chilled Water Reset	924	4.8%
4	HVAC - Duct Repair and Sealing	793	4.1%
5	Interior Lighting - High-Bay Fixtures	764	4.0%
6	Exterior Lighting - Linear LED	688	3.6%
7	Interior Lighting - Occupancy Sensors	678	3.5%
8	Interior Lighting - Skylights	561	2.9%
9	Exterior Lighting - Screw-in/Hard-wire	478	2.5%
10	Grocery - Open Display Case - Night Covers	459	2.4%
11	Exterior Lighting - HID	454	2.3%
12	Insulation - Ducting	408	2.1%
13	Refrigerator - High Efficiency Compressor	401	2.1%
14	Cooling - Water-Cooled Chiller	391	2.0%
15	Food Preparation - Dishwasher	347	1.8%
16	HVAC - Economizer	345	1.8%
17	Insulation - Ceiling	337	1.7%
18	Space Heating - Heat Recovery Ventilator	315	1.6%
19	Exterior Lighting - Bi-Level Fixture	299	1.5%
20	Exterior Lighting - Photovoltaic Installation	289	1.5%
Total	**Total Top 20**	**16,053**	**83.0%**

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

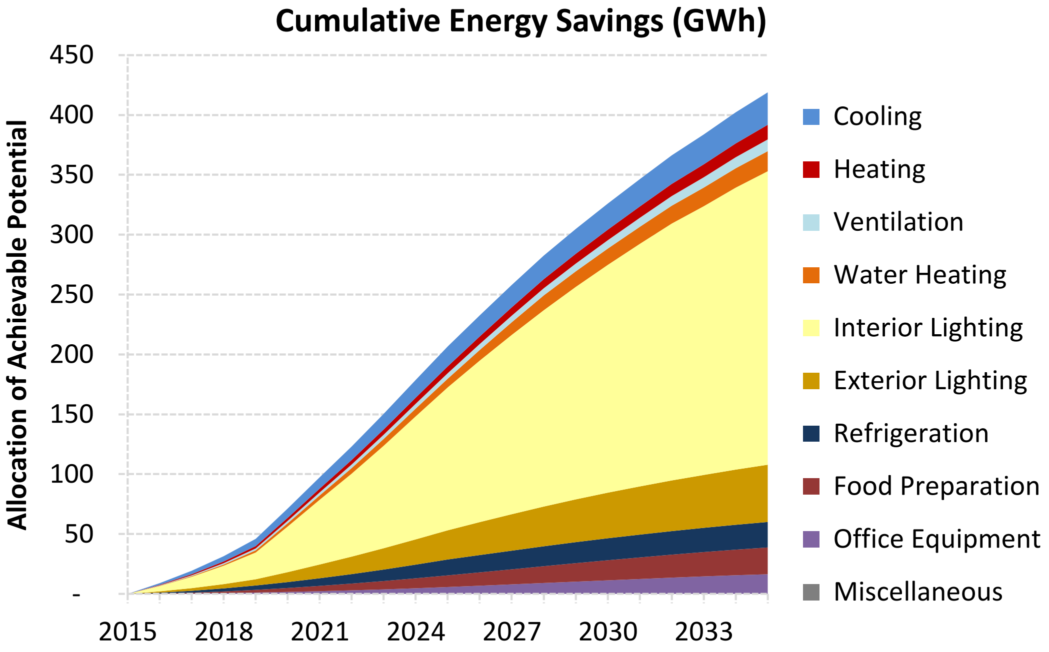
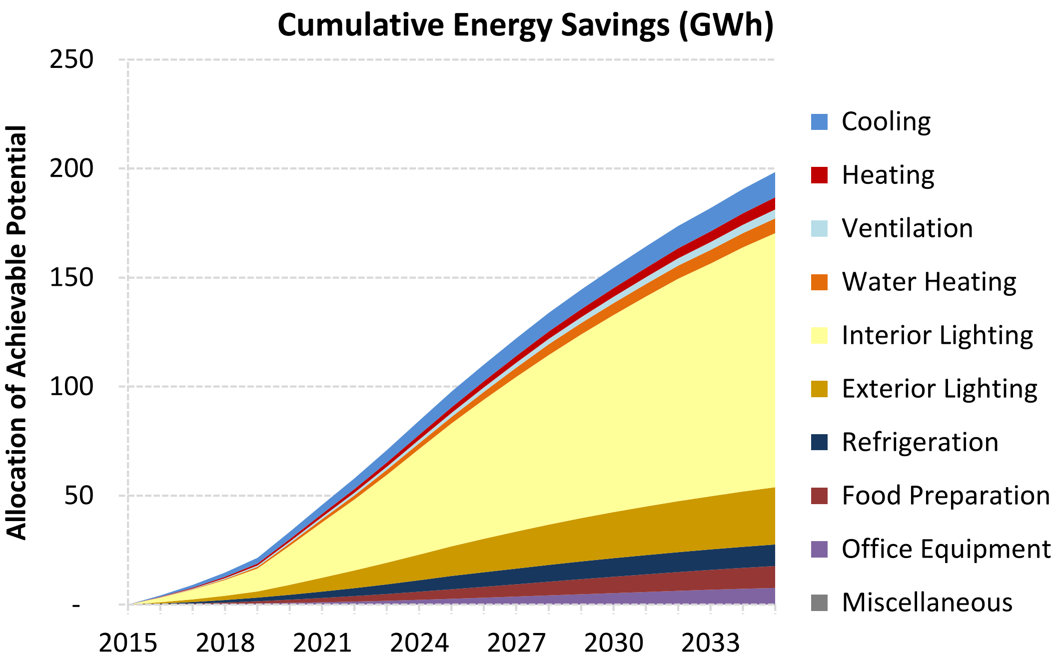


Table 5-15 Commercial Top Measures in 2017 (Annual Energy, MWh), Idaho

Rank	Commercial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Interior Lighting - Linear LED	2,134	23.6%
2	Interior Lighting - Screw-in/Hard-wire	1,237	13.7%
3	Exterior Lighting - Linear LED	448	5.0%
4	Chiller - Chilled Water Reset	437	4.8%
5	Interior Lighting - High-Bay Fixtures	366	4.1%
6	Interior Lighting - Occupancy Sensors	297	3.3%
7	HVAC - Duct Repair and Sealing	275	3.0%
8	Interior Lighting - Skylights	270	3.0%
9	Exterior Lighting - Screw-in/Hard-wire	224	2.5%
10	Exterior Lighting - HID	217	2.4%
11	Grocery - Open Display Case - Night Covers	202	2.2%
12	Insulation - Ducting	191	2.1%
13	Refrigerator - High Efficiency Compressor	174	1.9%
14	HVAC - Economizer	174	1.9%
15	Exterior Lighting - Photovoltaic Installation	164	1.8%
16	Food Preparation - Dishwasher	159	1.8%
17	Exterior Lighting - Bi-Level Fixture	158	1.8%
18	Space Heating - Heat Recovery Ventilator	153	1.7%
19	Cooling - Water-Cooled Chiller	149	1.6%
20	Refrigerator - Variable Speed Compressor	140	1.6%
Total	**Total Top 20**	**7,569**	**83.8%**

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



Industrial Conservation Potential

Table 5-16 (Total), Table 5-17 (WA) and Table 5-18 (ID) present potential estimates at the measure level for the industrial sector, from the perspective of annual energy savings.

Figure 5-14 (WA) and Figure 5-15 (ID) display the three levels of potential by year.

For Washington, achievable savings in the first year, 2016, are 5 GWh, or 0.5% of the baseline projection. In 2035, savings reach 146 GWh, or 12.7% of the baseline projection. For Idaho, achievable savings in the first year, 2016, are 2 GWh, or 0.7% of the baseline projection. In 2035, savings reach 53 GWh, or 12.4% of the baseline projection.

Table 5-16 Industrial Conservation Potential (Annual Energy, GWh), Washington and Idaho

	2016	2017	2020	2025	2035
Baseline projection (GWh)	1,356	1,370	1,404	1,458	1,575
Cumulative Net Savings (GWh)					
Achievable Potential	8	16	44	101	199
Economic Potential	9	19	52	118	231
Technical Potential	17	34	84	168	293
Cumulative Net Savings (aMW)					
Achievable Potential	0.9	1.8	5.1	11.6	22.7
Economic Potential	1.0	2.1	5.9	13.5	26.3
Technical Potential	1.9	3.9	9.6	19.2	33.5
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.6%	1.2%	3.2%	7.0%	12.6%
Economic Potential	0.7%	1.4%	3.7%	8.1%	14.7%
Technical Potential	1.3%	2.5%	6.0%	11.5%	18.6%

Table 5-17 Industrial Conservation Potential (Annual Energy, GWh), Washington

	2016	2017	2020	2025	2035
Baseline projection (GWh)	989	999	1,024	1,064	1,149
Cumulative Net Savings (GWh)					
Achievable Potential	5	11	31	73	146
Economic Potential	6	13	37	86	169
Technical Potential	12	25	61	123	214
Cumulative Net Savings (aMW)					
Achievable Potential	0.6	1.3	3.6	8.4	16.7
Economic Potential	0.7	1.5	4.2	9.8	19.3
Technical Potential	1.4	2.8	7.0	14.0	24.4
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.5%	1.1%	3.1%	6.9%	12.7%
Economic Potential	0.6%	1.3%	3.6%	8.0%	14.7%
Technical Potential	1.3%	2.5%	6.0%	11.5%	18.6%

Table 5-18 Industrial Conservation Potential (Annual Energy, GWh), Idaho

	2016	2017	2020	2025	2035
Baseline projection (GWh)	367	371	380	395	426
Cumulative Net Savings (GWh)					
Achievable Potential	2	5	13	28	53
Economic Potential	3	6	15	33	61
Technical Potential	5	9	23	46	79
Cumulative Net Savings (aMW)					
Achievable Potential	0.3	0.6	1.5	3.2	6.0
Economic Potential	0.3	0.6	1.7	3.8	7.0
Technical Potential	0.5	1.0	2.6	5.2	9.1
Cumulative Net Savings as a % of Baseline					
Achievable Potential	0.7%	1.3%	3.4%	7.1%	12.4%
Economic Potential	0.8%	1.5%	4.0%	8.3%	14.4%
Technical Potential	1.3%	2.5%	6.0%	11.5%	18.6%

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

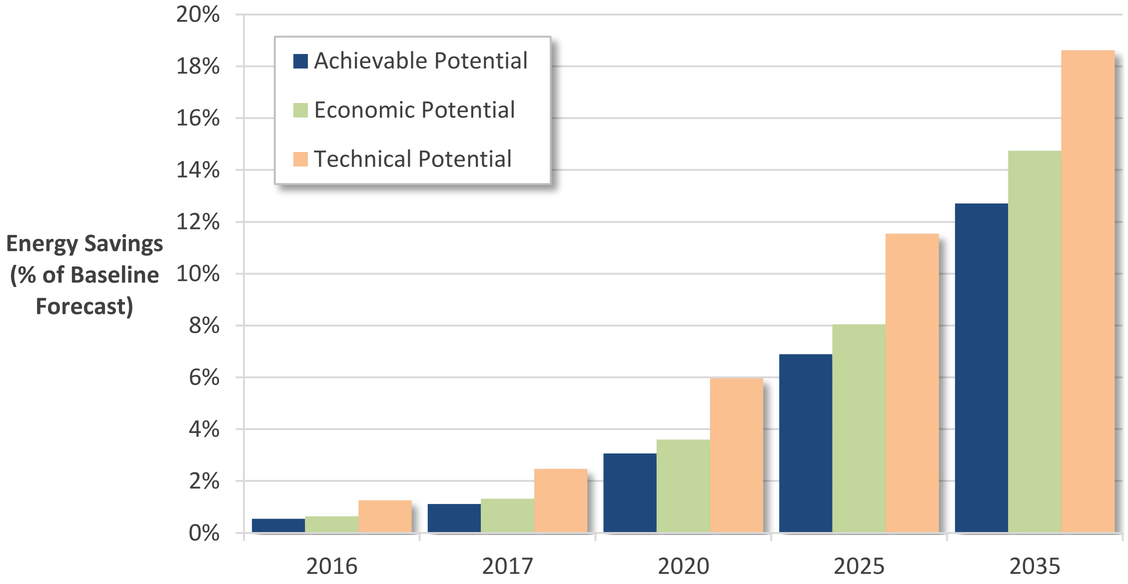
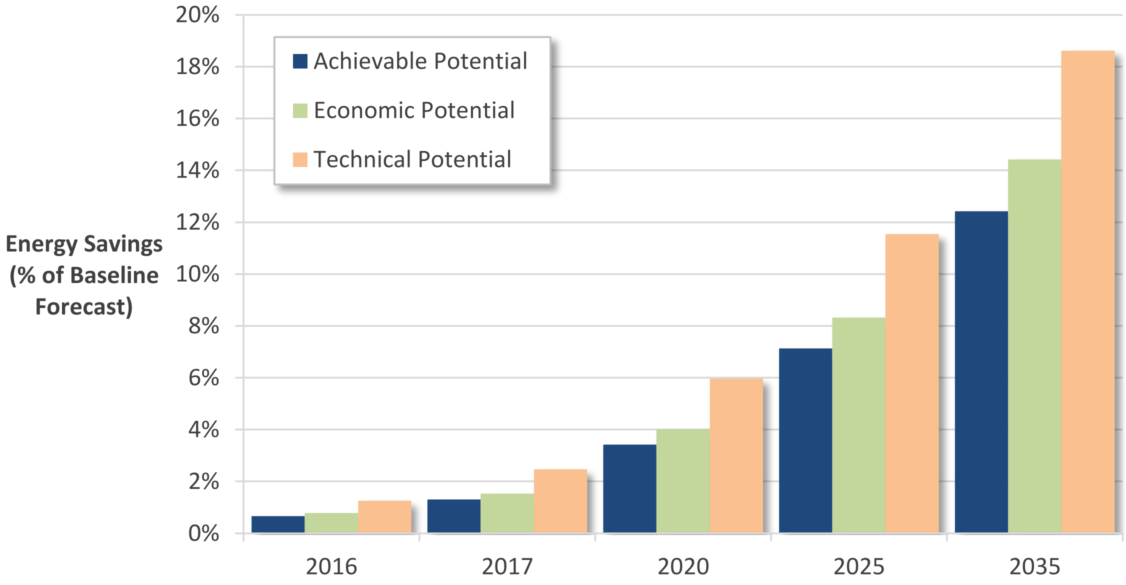


Figure 5-15 Industrial Conservation Potential as a % of the Baseline Projection (Annual Energy), Idaho



Below, we present the top industrial measures from the perspective of annual energy use for Washington and Idaho combined, followed by each state.

Table 5-19 identifies the top 20 industrial measures from the perspective of annual energy savings in 2017 for Washington and Idaho. Table 5-20 and Table 5-21 show the top measures for each state individually. For both states, the top measure is optimization and improvements on fan systems. The measure with the second highest savings is variable frequency drive for pumps.

Figure 5-16 (WA) and Figure 5-17 (ID) present forecasts of energy savings by end use as a percent of total annual savings and cumulative savings. Motor-related measures account for a substantial portion of the savings throughout the forecast horizon. The share of savings by end use remains fairly similar throughout the forecast period.

Table 5-19 Industrial Top Measures in 2017 (Annual Energy, GWh), Washington and Idaho

Rank	Industrial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Fan System - Optimization and Improvements	4,524	28.3%
2	Motors - Variable Frequency Drive (Pumps)	3,020	18.9%
3	Motors - Variable Frequency Drive (Fans & Blowers)	1,505	9.4%
4	Compressed Air - Air Usage Reduction	1,247	7.8%
5	Pumping System - Optimization and Improvements	893	5.6%
6	Interior Lighting - Occupancy Sensors	703	4.4%
7	Interior Lighting - High-Bay Fixtures	420	2.6%
8	Fan System - Maintenance	414	2.6%
9	Interior Lighting - Screw-in/Hard-wire	403	2.5%
10	Motors - Variable Frequency Drive (Compressed Air)	399	2.5%
11	HVAC - Duct Repair and Sealing	362	2.3%
12	Transformer - High Efficiency	298	1.9%
13	Motors - Variable Frequency Drive (Other)	272	1.7%
14	Compressed Air - System Optimization and Improvements	271	1.7%
15	Exterior Lighting - Screw-in/Hard-wire	240	1.5%
16	Chiller - Chilled Water Reset	216	1.3%
17	Insulation - Wall Cavity	143	0.9%
18	Compressed Air - Compressor Replacement	142	0.9%
19	Interior Lighting - Skylights	118	0.7%
20	Destratification Fans (HVLS)	101	0.6%
Total	**Total**	**15,692**	**98.1%**

Table 5-20 Industrial Top Measures in 2017 (Annual Energy, GWh), Washington

Rank	Industrial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Fan System - Optimization and Improvements	3,298	29.5%
2	Motors - Variable Frequency Drive (Pumps)	2,206	19.8%
3	Motors - Variable Frequency Drive (Fans & Blowers)	1,098	9.8%
4	Compressed Air - Air Usage Reduction	911	8.2%
5	Pumping System - Optimization and Improvements	663	5.9%
6	Interior Lighting - Occupancy Sensors	520	4.7%
7	Motors - Variable Frequency Drive (Compressed Air)	377	3.4%
8	Interior Lighting - High-Bay Fixtures	306	2.7%
9	Interior Lighting - Screw-in/Hard-wire	294	2.6%
10	HVAC - Duct Repair and Sealing	264	2.4%
11	Transformer - High Efficiency	217	1.9%
12	Exterior Lighting - Screw-in/Hard-wire	175	1.6%
13	Motors - Variable Frequency Drive (Other)	162	1.4%
14	Chiller - Chilled Water Reset	157	1.4%
15	Insulation - Wall Cavity	106	1.0%
16	Compressed Air - Compressor Replacement	104	0.9%
17	Interior Lighting - Skylights	86	0.8%
18	Chiller - Chilled Water Variable-Flow System	47	0.4%
19	Exterior Lighting - HID	44	0.4%
20	Chiller - VSD on Fans	43	0.4%
Total	**Total**	**11,080**	**99.2%**

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

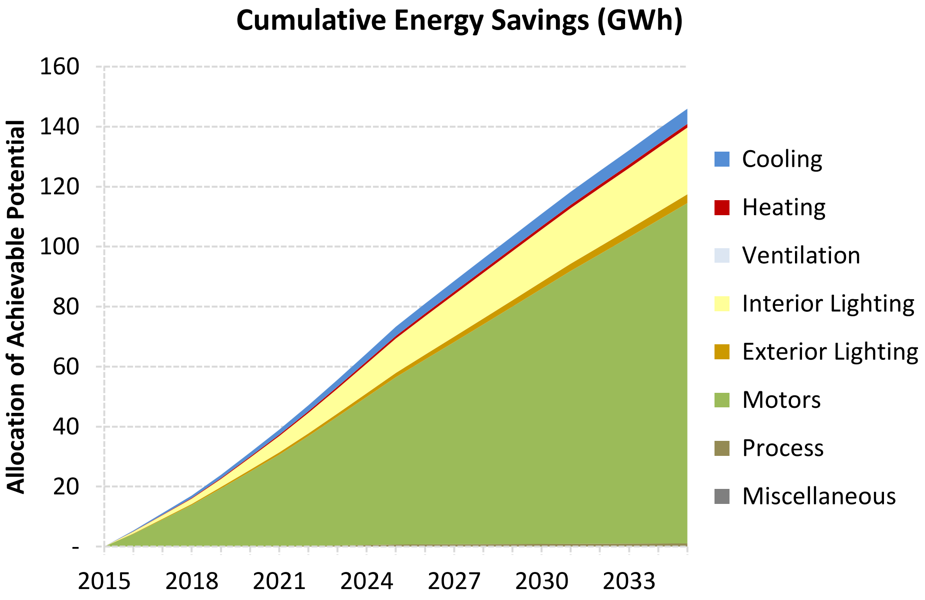
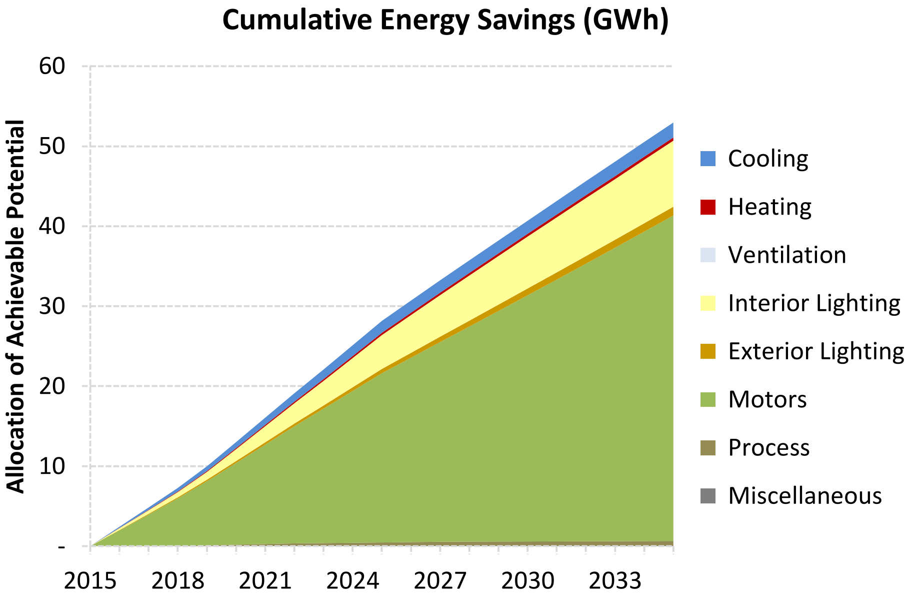


Table 5-21 Industrial Top Measures in 2017 (Annual Energy, GWh), Idaho

Rank	Industrial Measure	2017 Cumulative Energy Savings (MWh)	% of Total
1	Fan System - Optimization and Improvements	1,226	25.4%
2	Motors - Variable Frequency Drive (Pumps)	814	16.8%
3	Fan System - Maintenance	414	8.6%
4	Motors - Variable Frequency Drive (Fans & Blowers)	407	8.4%
5	Compressed Air - Air Usage Reduction	336	7.0%
6	Compressed Air - System Optimization and Improvements	271	5.6%
7	Pumping System - Optimization and Improvements	230	4.8%
8	Interior Lighting - Occupancy Sensors	183	3.8%
9	Interior Lighting - High-Bay Fixtures	114	2.4%
10	Motors - Variable Frequency Drive (Other)	110	2.3%
11	Interior Lighting - Screw-in/Hard-wire	109	2.3%
12	Destratification Fans (HVLS)	101	2.1%
13	HVAC - Duct Repair and Sealing	98	2.0%
14	Transformer - High Efficiency	81	1.7%
15	Exterior Lighting - Screw-in/Hard-wire	65	1.3%
16	Chiller - Chilled Water Reset	59	1.2%
17	Compressed Air - Compressor Replacement	39	0.8%
18	Insulation - Wall Cavity	37	0.8%
19	Interior Lighting - Skylights	32	0.7%
20	Motors - Variable Frequency Drive (Compressed Air)	22	0.5%
Total	**Total**	**4,747**	**98.2%**

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



Market Profiles

This appendix presents the market profiles for each sector and segment for Washington, followed by Idaho.

Table A-1 Residential Single Family Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	47.8%	1,462	699	91
Cooling	Room AC	15.3%	532	81	11
Cooling	Air-Source Heat Pump	8.0%	1,531	123	16
Cooling	Geothermal Heat Pump	0.3%	1,352	4	0
Cooling	Evaporative AC	1.3%	1,054	14	2
Space Heating	Electric Room Heat	6.3%	15,052	951	124
Space Heating	Electric Furnace	7.4%	17,137	1,271	165
Space Heating	Air-Source Heat Pump	8.0%	12,902	1,034	134
Space Heating	Geothermal Heat Pump	0.3%	5,686	16	2
Water Heating	Water Heater (<= 55 Gal)	42.1%	3,866	1,629	212
Water Heating	Water Heater (55 to 75 Gal)	5.1%	4,065	209	27
Water Heating	Water Heater (> 75 Gal)	0.4%	4,261	19	2
Interior Lighting	Screw-in/Hard-wire	100.0%	1,135	1,135	147
Interior Lighting	Linear Fluorescent	100.0%	154	154	20
Interior Lighting	Specialty Lighting	100.0%	425	425	55
Exterior Lighting	Screw-in/Hard-wire	100.0%	445	445	58
Appliances	Clothes Washer	96.4%	111	107	14
Appliances	Clothes Dryer	38.6%	862	333	43
Appliances	Dishwasher	80.9%	476	385	50
Appliances	Refrigerator	100.0%	888	888	115
Appliances	Freezer	59.1%	710	419	54
Appliances	Second Refrigerator	29.4%	1,034	304	40
Appliances	Stove	66.9%	509	341	44
Appliances	Microwave	95.6%	148	142	18
Electronics	Personal Computers	80.5%	223	180	23
Electronics	Monitor	98.4%	95	93	12
Electronics	Laptops	94.4%	59	56	7
Electronics	TVs	205.8%	253	521	68
Electronics	Printer/Fax/Copier	85.5%	68	58	8
Electronics	Set top Boxes/DVRs	175.4%	134	234	30
Electronics	Devices and Gadgets	100.0%	58	58	7
Miscellaneous	Pool Pump	3.1%	2,526	78	10
Miscellaneous	Pool Heater	0.8%	4,045	31	4
Miscellaneous	Furnace Fan	75.8%	279	212	28
Miscellaneous	Well pump	14.9%	645	96	12
Miscellaneous	Miscellaneous	100.0%	982	982	128
	Total			**13,726**	**1,783**

Table A-2 Residential Multifamily Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	16.2%	355	57	1
Cooling	Room AC	48.5%	282	137	2
Cooling	Air-Source Heat Pump	3.6%	355	13	0
Cooling	Geothermal Heat Pump	0.0%	314	0	0
Cooling	Evaporative AC	0.9%	293	3	0
Space Heating	Electric Room Heat	74.4%	2,814	2,095	25
Space Heating	Electric Furnace	7.8%	3,204	249	3
Space Heating	Air-Source Heat Pump	3.6%	1,754	63	1
Space Heating	Geothermal Heat Pump	0.0%	773	0	0
Water Heating	Water Heater (<= 55 Gal)	65.9%	2,205	1,453	17
Water Heating	Water Heater (55 to 75 Gal)	8.7%	2,319	202	2
Water Heating	Water Heater (> 75 Gal)	0.0%	2,430	0	0
Interior Lighting	Screw-in/Hard-wire	100.0%	639	639	8
Interior Lighting	Linear Fluorescent	100.0%	40	40	0
Interior Lighting	Specialty Lighting	100.0%	37	37	0
Exterior Lighting	Screw-in/Hard-wire	100.0%	0	0	0
Appliances	Clothes Washer	82.7%	96	79	1
Appliances	Clothes Dryer	69.1%	593	410	5
Appliances	Dishwasher	70.9%	413	293	4
Appliances	Refrigerator	100.0%	771	771	9
Appliances	Freezer	46.4%	620	288	3
Appliances	Second Refrigerator	3.0%	898	27	0
Appliances	Stove	74.5%	357	266	3
Appliances	Microwave	93.6%	129	121	1
Electronics	Personal Computers	35.5%	194	69	1
Electronics	Monitor	43.4%	82	36	0
Electronics	Laptops	41.9%	52	22	0
Electronics	TVs	124.7%	269	335	4
Electronics	Printer/Fax/Copier	49.5%	59	29	0
Electronics	Set top Boxes/DVRs	91.4%	116	106	1
Electronics	Devices and Gadgets	100.0%	50	50	1
Miscellaneous	Pool Pump	0.0%	2,197	0	0
Miscellaneous	Pool Heater	0.0%	3,517	0	0
Miscellaneous	Furnace Fan	18.9%	98	19	0
Miscellaneous	Well pump	0.0%	556	0	0
Miscellaneous	Miscellaneous	100.0%	328	328	4
	Total			**8,236**	**99**

Table A-3 Residential Manufactured Home Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	30.8%	556	171	1
Cooling	Room AC	29.1%	439	128	1
Cooling	Air-Source Heat Pump	5.1%	556	29	0
Cooling	Geothermal Heat Pump	0.0%	490	0	0
Cooling	Evaporative AC	1.7%	354	6	0
Space Heating	Electric Room Heat	4.1%	7,208	294	2
Space Heating	Electric Furnace	52.3%	8,207	4,295	33
Space Heating	Air-Source Heat Pump	5.1%	6,752	346	3
Space Heating	Geothermal Heat Pump	0.0%	3,094	0	0
Water Heating	Water Heater (<= 55 Gal)	63.3%	2,370	1,501	12
Water Heating	Water Heater (55 to 75 Gal)	8.4%	2,492	209	2
Water Heating	Water Heater (> 75 Gal)	0.0%	2,612	0	0
Interior Lighting	Screw-in/Hard-wire	100.0%	724	724	6
Interior Lighting	Linear Fluorescent	100.0%	87	87	1
Interior Lighting	Specialty Lighting	100.0%	134	134	1
Exterior Lighting	Screw-in/Hard-wire	100.0%	170	170	1
Appliances	Clothes Washer	91.2%	91	83	1
Appliances	Clothes Dryer	66.7%	888	592	5
Appliances	Dishwasher	70.2%	394	277	2
Appliances	Refrigerator	100.0%	732	732	6
Appliances	Freezer	61.4%	586	360	3
Appliances	Second Refrigerator	21.0%	852	179	1
Appliances	Stove	82.5%	510	421	3
Appliances	Microwave	93.0%	123	114	1
Electronics	Personal Computers	45.8%	184	85	1
Electronics	Monitor	56.0%	78	44	0
Electronics	Laptops	66.7%	49	33	0
Electronics	TVs	156.3%	273	426	3
Electronics	Printer/Fax/Copier	58.3%	56	33	0
Electronics	Set top Boxes/DVRs	91.7%	110	101	1
Electronics	Devices and Gadgets	100.0%	48	48	0
Miscellaneous	Pool Pump	0.0%	2,087	0	0
Miscellaneous	Pool Heater	0.0%	3,341	0	0
Miscellaneous	Furnace Fan	84.6%	205	173	1
Miscellaneous	Well pump	0.0%	428	0	0
Miscellaneous	Miscellaneous	100.0%	560	560	4
	Total			**12,354**	**95**

Table A-4 Residential Low Income Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	19.4%	456	88	6
Cooling	Room AC	44.7%	333	149	10
Cooling	Air-Source Heat Pump	4.0%	460	18	1
Cooling	Geothermal Heat Pump	0.0%	406	0	0
Cooling	Evaporative AC	1.0%	350	3	0
Space Heating	Electric Room Heat	53.8%	3,606	1,939	124
Space Heating	Electric Furnace	22.1%	4,106	906	58
Space Heating	Air-Source Heat Pump	4.0%	2,697	108	7
Space Heating	Geothermal Heat Pump	0.0%	1,202	0	0
Water Heating	Water Heater (<= 55 Gal)	64.3%	2,142	1,378	88
Water Heating	Water Heater (55 to 75 Gal)	8.5%	2,253	191	12
Water Heating	Water Heater (> 75 Gal)	0.0%	2,361	1	0
Interior Lighting	Screw-in/Hard-wire	100.0%	676	676	43
Interior Lighting	Linear Fluorescent	100.0%	51	51	3
Interior Lighting	Specialty Lighting	100.0%	68	68	4
Exterior Lighting	Screw-in/Hard-wire	100.0%	42	42	3
Appliances	Clothes Washer	84.3%	91	77	5
Appliances	Clothes Dryer	67.1%	603	405	26
Appliances	Dishwasher	71.4%	393	280	18
Appliances	Refrigerator	100.0%	732	732	47
Appliances	Freezer	48.5%	589	286	18
Appliances	Second Refrigerator	6.2%	853	53	3
Appliances	Stove	74.9%	360	270	17
Appliances	Microwave	93.7%	123	115	7
Electronics	Personal Computers	39.0%	184	72	5
Electronics	Monitor	47.7%	78	37	2
Electronics	Laptops	47.3%	49	23	1
Electronics	TVs	132.4%	255	337	22
Electronics	Printer/Fax/Copier	52.4%	56	29	2
Electronics	Set top Boxes/DVRs	96.2%	110	106	7
Electronics	Devices and Gadgets	100.0%	48	48	3
Miscellaneous	Pool Pump	0.2%	2,087	4	0
Miscellaneous	Pool Heater	0.0%	3,341	1	0
Miscellaneous	Furnace Fan	28.5%	119	34	2
Miscellaneous	Well pump	0.8%	519	4	0
Miscellaneous	Miscellaneous	100.0%	361	361	23
	Total			**8,892**	**570**

Table A-5 Small Office Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	0.5%	4.59	0.02	0.4
Cooling	Water-Cooled Chiller	0.0%	5.20	0.00	0.0
Cooling	RTU	77.9%	3.79	2.96	53.5
Cooling	Room AC	3.6%	3.90	0.14	2.6
Cooling	Air-Source Heat Pump	8.2%	3.79	0.31	5.6
Cooling	Geothermal Heat Pump	3.2%	2.31	0.07	1.3
Heating	Electric Furnace	16.0%	6.82	1.09	19.7
Heating	Electric Room Heat	14.5%	6.50	0.94	17.1
Heating	Air-Source Heat Pump	8.2%	5.76	0.47	8.5
Heating	Geothermal Heat Pump	3.2%	4.38	0.14	2.5
Ventilation	Ventilation	100.0%	1.40	1.40	25.3
Water Heating	Water Heater	69.8%	1.05	0.73	13.2
Interior Lighting	Screw-in/Hard-wire	100.0%	0.62	0.62	11.3
Interior Lighting	High-Bay Fixtures	100.0%	0.34	0.34	6.2
Interior Lighting	Linear Fluorescent	100.0%	2.05	2.05	37.1
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.14	0.14	2.5
Exterior Lighting	HID	100.0%	0.19	0.19	3.4
Exterior Lighting	Linear Fluorescent	100.0%	0.07	0.07	1.2
Refrigeration	Walk-in Refrigerator/Freezer	0.2%	2.34	0.01	0.1
Refrigeration	Reach-in Refrigerator/Freezer	1.6%	0.52	0.01	0.2
Refrigeration	Glass Door Display	0.5%	0.54	0.00	0.0
Refrigeration	Open Display Case	0.5%	3.19	0.01	0.3
Refrigeration	Icemaker	0.5%	0.88	0.00	0.1
Refrigeration	Vending Machine	0.2%	0.41	0.00	0.0
Food Preparation	Oven	0.8%	1.50	0.01	0.2
Food Preparation	Fryer	0.1%	2.17	0.00	0.0
Food Preparation	Dishwasher	1.0%	2.99	0.03	0.5
Food Preparation	Steamer	0.1%	2.19	0.00	0.0
Food Preparation	Hot Food Container	0.1%	0.41	0.00	0.0
Office Equipment	Desktop Computer	100.0%	1.55	1.55	28.1
Office Equipment	Laptop	100.0%	0.24	0.24	4.3
Office Equipment	Server	100.0%	0.46	0.46	8.3
Office Equipment	Monitor	100.0%	0.27	0.27	5.0
Office Equipment	Printer/Copier/Fax	100.0%	0.21	0.21	3.8
Office Equipment	POS Terminal	40.0%	0.12	0.05	0.9
Miscellaneous	Non-HVAC Motors	22.0%	0.20	0.04	0.8
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.86	0.86	15.5
Total				**15.44**	**279.6**

Table A-6 Large Office Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	23.5%	2.69	0.63	3.8
Cooling	Water-Cooled Chiller	23.5%	2.97	0.70	4.2
Cooling	RTU	33.4%	3.28	1.10	6.6
Cooling	Room AC	0.6%	3.37	0.02	0.1
Cooling	Air-Source Heat Pump	7.5%	3.28	0.25	1.5
Cooling	Geothermal Heat Pump	6.5%	2.00	0.13	0.8
Heating	Electric Furnace	15.7%	5.04	0.79	4.8
Heating	Electric Room Heat	14.3%	4.80	0.68	4.1
Heating	Air-Source Heat Pump	7.5%	4.62	0.35	2.1
Heating	Geothermal Heat Pump	6.5%	3.66	0.24	1.4
Ventilation	Ventilation	100.0%	2.96	2.96	17.9
Water Heating	Water Heater	68.0%	0.99	0.67	4.1
Interior Lighting	Screw-in/Hard-wire	100.0%	0.62	0.62	3.8
Interior Lighting	High-Bay Fixtures	100.0%	0.37	0.37	2.3
Interior Lighting	Linear Fluorescent	100.0%	2.74	2.74	16.6
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.14	0.14	0.8
Exterior Lighting	HID	100.0%	0.37	0.37	2.2
Exterior Lighting	Linear Fluorescent	100.0%	0.23	0.23	1.4
Refrigeration	Walk-in Refrigerator/Freezer	2.0%	1.62	0.03	0.2
Refrigeration	Reach-in Refrigerator/Freezer	14.0%	0.36	0.05	0.3
Refrigeration	Glass Door Display	4.0%	0.37	0.01	0.1
Refrigeration	Open Display Case	4.0%	2.22	0.09	0.5
Refrigeration	Icemaker	4.0%	0.61	0.02	0.1
Refrigeration	Vending Machine	2.1%	0.29	0.01	0.0
Food Preparation	Oven	10.0%	0.76	0.08	0.5
Food Preparation	Fryer	1.0%	1.10	0.01	0.1
Food Preparation	Dishwasher	12.0%	1.52	0.18	1.1
Food Preparation	Steamer	1.0%	1.11	0.01	0.1
Food Preparation	Hot Food Container	1.0%	0.21	0.00	0.0
Office Equipment	Desktop Computer	100.0%	1.96	1.96	11.8
Office Equipment	Laptop	100.0%	0.30	0.30	1.8
Office Equipment	Server	100.0%	0.19	0.19	1.2
Office Equipment	Monitor	100.0%	0.35	0.35	2.1
Office Equipment	Printer/Copier/Fax	100.0%	0.18	0.18	1.1
Office Equipment	POS Terminal	40.0%	0.03	0.01	0.1
Miscellaneous	Non-HVAC Motors	89.6%	0.22	0.20	1.2
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.86	0.86	5.2
Total				**17.54**	**105.9**

Table A-7 Restaurant Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	0.3%	3.59	0.01	0.0
Cooling	Water-Cooled Chiller	0.0%	3.97	0.00	0.0
Cooling	RTU	76.3%	4.51	3.44	5.7
Cooling	Room AC	6.6%	4.63	0.31	0.5
Cooling	Air-Source Heat Pump	6.6%	4.51	0.30	0.5
Cooling	Geothermal Heat Pump	3.3%	2.75	0.09	0.1
Heating	Electric Furnace	5.1%	7.05	0.36	0.6
Heating	Electric Room Heat	0.1%	6.72	0.01	0.0
Heating	Air-Source Heat Pump	6.6%	4.98	0.33	0.5
Heating	Geothermal Heat Pump	3.3%	3.51	0.12	0.2
Ventilation	Ventilation	100.0%	2.48	2.48	4.1
Water Heating	Water Heater	35.2%	8.81	3.10	5.1
Interior Lighting	Screw-in/Hard-wire	100.0%	2.09	2.09	3.5
Interior Lighting	High-Bay Fixtures	100.0%	0.40	0.40	0.7
Interior Lighting	Linear Fluorescent	100.0%	3.62	3.62	6.0
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.23	0.23	0.4
Exterior Lighting	HID	100.0%	1.61	1.61	2.7
Exterior Lighting	Linear Fluorescent	100.0%	0.47	0.47	0.8
Refrigeration	Walk-in Refrigerator/Freezer	74.0%	6.56	4.85	8.0
Refrigeration	Reach-in Refrigerator/Freezer	7.0%	2.94	0.21	0.3
Refrigeration	Glass Door Display	77.6%	1.51	1.17	1.9
Refrigeration	Open Display Case	26.0%	8.95	2.33	3.9
Refrigeration	Icemaker	75.9%	2.47	1.88	3.1
Refrigeration	Vending Machine	0.0%	1.16	0.00	0.0
Food Preparation	Oven	16.0%	9.79	1.57	2.6
Food Preparation	Fryer	14.0%	14.16	1.98	3.3
Food Preparation	Dishwasher	48.0%	9.75	4.68	7.8
Food Preparation	Steamer	14.0%	7.15	1.00	1.7
Food Preparation	Hot Food Container	31.0%	1.33	0.41	0.7
Office Equipment	Desktop Computer	100.0%	0.29	0.29	0.5
Office Equipment	Laptop	100.0%	0.04	0.04	0.1
Office Equipment	Server	50.0%	0.34	0.17	0.3
Office Equipment	Monitor	100.0%	0.05	0.05	0.1
Office Equipment	Printer/Copier/Fax	100.0%	0.06	0.06	0.1
Office Equipment	POS Terminal	100.0%	0.09	0.09	0.1
Miscellaneous	Non-HVAC Motors	20.0%	0.58	0.12	0.2
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	2.57	2.57	4.3
Total				**42.40**	**70.3**

Table A-8 Retail Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	9.5%	2.74	0.26	5.4
Cooling	Water-Cooled Chiller	2.4%	3.10	0.07	1.5
Cooling	RTU	54.2%	2.26	1.23	25.4
Cooling	Room AC	2.8%	2.48	0.07	1.4
Cooling	Air-Source Heat Pump	1.7%	2.26	0.04	0.8
Cooling	Geothermal Heat Pump	1.4%	1.38	0.02	0.4
Heating	Electric Furnace	5.8%	4.86	0.28	5.8
Heating	Electric Room Heat	2.1%	4.63	0.10	2.0
Heating	Air-Source Heat Pump	1.7%	3.89	0.07	1.4
Heating	Geothermal Heat Pump	1.4%	2.65	0.04	0.7
Ventilation	Ventilation	100.0%	0.98	0.98	20.2
Water Heating	Water Heater	63.0%	0.79	0.50	10.3
Interior Lighting	Screw-in/Hard-wire	100.0%	0.85	0.85	17.5
Interior Lighting	High-Bay Fixtures	100.0%	1.02	1.02	21.1
Interior Lighting	Linear Fluorescent	100.0%	3.43	3.43	70.9
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.36	0.36	7.4
Exterior Lighting	HID	100.0%	1.30	1.30	26.9
Exterior Lighting	Linear Fluorescent	100.0%	0.87	0.87	18.0
Refrigeration	Walk-in Refrigerator/Freezer	2.0%	2.04	0.04	0.8
Refrigeration	Reach-in Refrigerator/Freezer	0.0%	0.46	0.00	0.0
Refrigeration	Glass Door Display	16.3%	0.47	0.08	1.6
Refrigeration	Open Display Case	14.0%	2.79	0.39	8.1
Refrigeration	Icemaker	7.1%	0.77	0.05	1.1
Refrigeration	Vending Machine	22.8%	0.36	0.08	1.7
Food Preparation	Oven	8.0%	2.43	0.19	4.0
Food Preparation	Fryer	1.6%	3.51	0.06	1.2
Food Preparation	Dishwasher	2.0%	4.84	0.10	2.0
Food Preparation	Steamer	1.6%	3.55	0.06	1.2
Food Preparation	Hot Food Container	1.0%	0.66	0.01	0.1
Office Equipment	Desktop Computer	100.0%	0.34	0.34	7.0
Office Equipment	Laptop	100.0%	0.05	0.05	1.1
Office Equipment	Server	82.0%	0.06	0.05	1.0
Office Equipment	Monitor	100.0%	0.06	0.06	1.2
Office Equipment	Printer/Copier/Fax	100.0%	0.05	0.05	1.0
Office Equipment	POS Terminal	100.0%	0.01	0.01	0.3
Miscellaneous	Non-HVAC Motors	40.2%	0.17	0.07	1.4
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.64	0.64	13.2
Total				**13.80**	**285.2**

Table A-9 Grocery Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	5.3%	5.10	0.27	1.2
Cooling	Water-Cooled Chiller	0.0%	5.77	0.00	0.0
Cooling	RTU	69.6%	4.21	2.93	13.0
Cooling	Room AC	0.0%	4.33	0.00	0.0
Cooling	Air-Source Heat Pump	3.1%	3.72	0.12	0.5
Cooling	Geothermal Heat Pump	0.0%	1.57	0.00	0.0
Heating	Electric Furnace	15.4%	5.68	0.87	3.9
Heating	Electric Room Heat	1.5%	5.41	0.08	0.4
Heating	Air-Source Heat Pump	3.1%	3.05	0.10	0.4
Heating	Geothermal Heat Pump	0.0%	1.95	0.00	0.0
Ventilation	Ventilation	100.0%	2.07	2.07	9.2
Water Heating	Water Heater	38.2%	2.18	0.83	3.7
Interior Lighting	Screw-in/Hard-wire	100.0%	1.93	1.93	8.5
Interior Lighting	High-Bay Fixtures	100.0%	1.70	1.70	7.5
Interior Lighting	Linear Fluorescent	100.0%	5.83	5.83	25.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.19	0.19	0.8
Exterior Lighting	HID	100.0%	1.16	1.16	5.1
Exterior Lighting	Linear Fluorescent	100.0%	0.48	0.48	2.1
Refrigeration	Walk-in Refrigerator/Freezer	16.0%	5.13	0.82	3.6
Refrigeration	Reach-in Refrigerator/Freezer	83.1%	0.33	0.27	1.2
Refrigeration	Glass Door Display	95.6%	3.37	3.23	14.3
Refrigeration	Open Display Case	95.6%	19.99	19.12	84.6
Refrigeration	Icemaker	66.6%	0.28	0.18	0.8
Refrigeration	Vending Machine	36.5%	0.26	0.09	0.4
Food Preparation	Oven	17.0%	2.44	0.42	1.8
Food Preparation	Fryer	13.0%	3.53	0.46	2.0
Food Preparation	Dishwasher	7.0%	4.86	0.34	1.5
Food Preparation	Steamer	13.0%	3.57	0.46	2.1
Food Preparation	Hot Food Container	16.0%	0.67	0.11	0.5
Office Equipment	Desktop Computer	100.0%	0.25	0.25	1.1
Office Equipment	Laptop	64.0%	0.04	0.03	0.1
Office Equipment	Server	100.0%	0.15	0.15	0.7
Office Equipment	Monitor	100.0%	0.04	0.04	0.2
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	0.1
Office Equipment	POS Terminal	100.0%	0.10	0.10	0.4
Miscellaneous	Non-HVAC Motors	34.6%	0.57	0.20	0.9
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	2.40	2.40	10.6
Total				**47.25**	**209.1**

Table A-10 College Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	34.8%	3.08	1.07	6.0
Cooling	Water-Cooled Chiller	8.7%	4.56	0.40	2.2
Cooling	RTU	15.6%	2.00	0.31	1.7
Cooling	Room AC	5.0%	2.05	0.10	0.6
Cooling	Air-Source Heat Pump	3.6%	1.99	0.07	0.4
Cooling	Geothermal Heat Pump	0.0%	1.21	0.00	0.0
Heating	Electric Furnace	10.5%	8.76	0.92	5.1
Heating	Electric Room Heat	29.7%	8.34	2.48	13.9
Heating	Air-Source Heat Pump	3.6%	6.22	0.23	1.3
Heating	Geothermal Heat Pump	0.0%	4.81	0.00	0.0
Ventilation	Ventilation	100.0%	1.48	1.48	8.3
Water Heating	Water Heater	26.3%	2.02	0.53	3.0
Interior Lighting	Screw-in/Hard-wire	100.0%	0.83	0.83	4.6
Interior Lighting	High-Bay Fixtures	100.0%	0.30	0.30	1.7
Interior Lighting	Linear Fluorescent	100.0%	2.04	2.04	11.5
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.01	0.01	0.0
Exterior Lighting	HID	100.0%	0.27	0.27	1.5
Exterior Lighting	Linear Fluorescent	100.0%	0.97	0.97	5.4
Refrigeration	Walk-in Refrigerator/Freezer	7.7%	0.29	0.02	0.1
Refrigeration	Reach-in Refrigerator/Freezer	13.4%	0.13	0.02	0.1
Refrigeration	Glass Door Display	8.0%	0.07	0.01	0.0
Refrigeration	Open Display Case	4.8%	0.40	0.02	0.1
Refrigeration	Icemaker	28.2%	0.22	0.06	0.3
Refrigeration	Vending Machine	8.8%	0.10	0.01	0.1
Food Preparation	Oven	13.7%	0.68	0.09	0.5
Food Preparation	Fryer	1.6%	0.98	0.02	0.1
Food Preparation	Dishwasher	11.7%	1.35	0.16	0.9
Food Preparation	Steamer	1.6%	0.99	0.02	0.1
Food Preparation	Hot Food Container	8.4%	0.19	0.02	0.1
Office Equipment	Desktop Computer	100.0%	0.51	0.51	2.9
Office Equipment	Laptop	100.0%	0.02	0.02	0.1
Office Equipment	Server	100.0%	0.06	0.06	0.3
Office Equipment	Monitor	100.0%	0.09	0.09	0.5
Office Equipment	Printer/Copier/Fax	100.0%	0.07	0.07	0.4
Office Equipment	POS Terminal	36.0%	0.02	0.01	0.0
Miscellaneous	Non-HVAC Motors	88.8%	0.14	0.12	0.7
Miscellaneous	Pool Pump	6.0%	0.01	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.01	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.61	0.61	3.4
Total				**13.93**	**78.1**

Table A-11 School Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	24.5%	2.56	0.63	7.5
Cooling	Water-Cooled Chiller	6.1%	3.79	0.23	2.8
Cooling	RTU	11.9%	1.66	0.20	2.4
Cooling	Room AC	5.0%	1.70	0.09	1.0
Cooling	Air-Source Heat Pump	8.6%	1.65	0.14	1.7
Cooling	Geothermal Heat Pump	3.9%	1.01	0.04	0.5
Heating	Electric Furnace	3.7%	9.39	0.35	4.2
Heating	Electric Room Heat	1.8%	8.94	0.16	1.9
Heating	Air-Source Heat Pump	8.6%	6.66	0.57	6.8
Heating	Geothermal Heat Pump	3.9%	5.16	0.20	2.4
Ventilation	Ventilation	100.0%	1.17	1.17	14.0
Water Heating	Water Heater	38.1%	1.63	0.62	7.4
Interior Lighting	Screw-in/Hard-wire	100.0%	0.55	0.55	6.6
Interior Lighting	High-Bay Fixtures	100.0%	0.13	0.13	1.5
Interior Lighting	Linear Fluorescent	100.0%	1.10	1.10	13.1
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.00	0.00	0.1
Exterior Lighting	HID	100.0%	0.17	0.17	2.0
Exterior Lighting	Linear Fluorescent	100.0%	0.96	0.96	11.5
Refrigeration	Walk-in Refrigerator/Freezer	19.0%	0.51	0.10	1.2
Refrigeration	Reach-in Refrigerator/Freezer	33.0%	0.23	0.08	0.9
Refrigeration	Glass Door Display	19.7%	0.12	0.02	0.3
Refrigeration	Open Display Case	11.9%	0.69	0.08	1.0
Refrigeration	Icemaker	69.7%	0.38	0.27	3.2
Refrigeration	Vending Machine	21.8%	0.18	0.04	0.5
Food Preparation	Oven	34.0%	0.58	0.20	2.3
Food Preparation	Fryer	4.0%	0.84	0.03	0.4
Food Preparation	Dishwasher	29.0%	1.15	0.33	4.0
Food Preparation	Steamer	4.0%	0.84	0.03	0.4
Food Preparation	Hot Food Container	21.0%	0.16	0.03	0.4
Office Equipment	Desktop Computer	100.0%	0.45	0.45	5.4
Office Equipment	Laptop	100.0%	0.03	0.03	0.3
Office Equipment	Server	100.0%	0.11	0.11	1.3
Office Equipment	Monitor	100.0%	0.08	0.08	1.0
Office Equipment	Printer/Copier/Fax	100.0%	0.05	0.05	0.6
Office Equipment	POS Terminal	36.0%	0.01	0.01	0.1
Miscellaneous	Non-HVAC Motors	43.7%	0.11	0.05	0.6
Miscellaneous	Pool Pump	6.0%	0.01	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.01	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.55	0.55	6.6
Total				**9.85**	**117.5**

Table A-12 Health Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	16.5%	5.62	0.93	8.7
Cooling	Water-Cooled Chiller	65.9%	7.38	4.86	45.4
Cooling	RTU	10.8%	5.40	0.58	5.5
Cooling	Room AC	0.4%	5.55	0.02	0.2
Cooling	Air-Source Heat Pump	1.1%	5.39	0.06	0.5
Cooling	Geothermal Heat Pump	0.4%	3.28	0.01	0.1
Heating	Electric Furnace	0.3%	13.34	0.04	0.3
Heating	Electric Room Heat	9.3%	12.71	1.18	11.1
Heating	Air-Source Heat Pump	1.1%	9.12	0.10	0.9
Heating	Geothermal Heat Pump	0.4%	6.69	0.02	0.2
Ventilation	Ventilation	100.0%	4.96	4.96	46.3
Water Heating	Water Heater	22.3%	4.64	1.03	9.7
Interior Lighting	Screw-in/Hard-wire	100.0%	1.54	1.54	14.3
Interior Lighting	High-Bay Fixtures	100.0%	0.35	0.35	3.3
Interior Lighting	Linear Fluorescent	100.0%	3.92	3.92	36.6
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.04	0.04	0.4
Exterior Lighting	HID	100.0%	0.46	0.46	4.3
Exterior Lighting	Linear Fluorescent	100.0%	0.16	0.16	1.5
Refrigeration	Walk-in Refrigerator/Freezer	33.0%	1.05	0.35	3.2
Refrigeration	Reach-in Refrigerator/Freezer	50.0%	0.23	0.12	1.1
Refrigeration	Glass Door Display	8.6%	0.24	0.02	0.2
Refrigeration	Open Display Case	6.7%	1.43	0.10	0.9
Refrigeration	Icemaker	21.1%	0.79	0.17	1.6
Refrigeration	Vending Machine	27.9%	0.37	0.10	1.0
Food Preparation	Oven	13.0%	2.58	0.34	3.1
Food Preparation	Fryer	10.0%	3.73	0.37	3.5
Food Preparation	Dishwasher	25.0%	5.14	1.28	12.0
Food Preparation	Steamer	10.0%	3.77	0.38	3.5
Food Preparation	Hot Food Container	10.0%	0.70	0.07	0.7
Office Equipment	Desktop Computer	100.0%	0.91	0.91	8.5
Office Equipment	Laptop	100.0%	0.06	0.06	0.5
Office Equipment	Server	100.0%	0.11	0.11	1.0
Office Equipment	Monitor	100.0%	0.16	0.16	1.5
Office Equipment	Printer/Copier/Fax	100.0%	0.10	0.10	0.9
Office Equipment	POS Terminal	100.0%	0.07	0.07	0.7
Miscellaneous	Non-HVAC Motors	74.1%	0.37	0.27	2.6
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	3.84	3.84	35.8
Total				**29.06**	**271.4**

Table A-13 Lodging Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	4.4%	1.18	0.05	0.4
Cooling	Water-Cooled Chiller	17.8%	1.54	0.27	1.9
Cooling	RTU	8.1%	2.62	0.21	1.5
Cooling	Room AC	27.5%	2.69	0.74	5.1
Cooling	Air-Source Heat Pump	17.6%	2.62	0.46	3.2
Cooling	Geothermal Heat Pump	2.5%	2.26	0.06	0.4
Heating	Electric Furnace	60.2%	4.21	2.54	17.6
Heating	Electric Room Heat	3.6%	4.01	0.15	1.0
Heating	Air-Source Heat Pump	17.6%	3.85	0.68	4.7
Heating	Geothermal Heat Pump	2.5%	2.50	0.06	0.4
Ventilation	Ventilation	100.0%	1.42	1.42	9.9
Water Heating	Water Heater	31.5%	4.81	1.51	10.5
Interior Lighting	Screw-in/Hard-wire	100.0%	3.31	3.31	23.0
Interior Lighting	High-Bay Fixtures	100.0%	0.27	0.27	1.8
Interior Lighting	Linear Fluorescent	100.0%	0.87	0.87	6.0
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.13	0.13	0.9
Exterior Lighting	HID	100.0%	0.51	0.51	3.6
Exterior Lighting	Linear Fluorescent	100.0%	0.03	0.03	0.2
Refrigeration	Walk-in Refrigerator/Freezer	3.0%	0.82	0.02	0.2
Refrigeration	Reach-in Refrigerator/Freezer	19.0%	0.18	0.03	0.2
Refrigeration	Glass Door Display	40.0%	0.19	0.08	0.5
Refrigeration	Open Display Case	0.0%	1.12	0.00	0.0
Refrigeration	Icemaker	88.9%	0.62	0.55	3.8
Refrigeration	Vending Machine	57.8%	0.29	0.17	1.2
Food Preparation	Oven	24.0%	0.83	0.20	1.4
Food Preparation	Fryer	4.0%	1.20	0.05	0.3
Food Preparation	Dishwasher	39.0%	0.82	0.32	2.2
Food Preparation	Steamer	4.0%	0.60	0.02	0.2
Food Preparation	Hot Food Container	10.0%	0.11	0.01	0.1
Office Equipment	Desktop Computer	100.0%	0.20	0.20	1.4
Office Equipment	Laptop	100.0%	0.03	0.03	0.2
Office Equipment	Server	100.0%	0.12	0.12	0.8
Office Equipment	Monitor	100.0%	0.04	0.04	0.2
Office Equipment	Printer/Copier/Fax	100.0%	0.02	0.02	0.2
Office Equipment	POS Terminal	58.0%	0.03	0.02	0.1
Miscellaneous	Non-HVAC Motors	91.3%	0.15	0.14	1.0
Miscellaneous	Pool Pump	76.0%	0.02	0.02	0.1
Miscellaneous	Pool Heater	27.0%	0.03	0.01	0.1
Miscellaneous	Other Miscellaneous	100.0%	0.76	0.76	5.3
Total				**16.08**	**111.7**

Table A-14 Warehouse Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	4.14	0.54	7.4
Cooling	Water-Cooled Chiller	1.4%	4.74	0.07	0.9
Cooling	RTU	17.0%	4.07	0.69	9.5
Cooling	Room AC	1.1%	4.18	0.05	0.6
Cooling	Air-Source Heat Pump	1.6%	4.07	0.07	0.9
Cooling	Geothermal Heat Pump	0.0%	2.48	0.00	0.0
Heating	Electric Furnace	4.9%	7.90	0.39	5.3
Heating	Electric Room Heat	1.7%	7.53	0.13	1.8
Heating	Air-Source Heat Pump	1.6%	5.91	0.09	1.3
Heating	Geothermal Heat Pump	0.0%	4.50	0.00	0.0
Ventilation	Ventilation	100.0%	0.60	0.60	8.2
Water Heating	Water Heater	76.9%	0.61	0.47	6.4
Interior Lighting	Screw-in/Hard-wire	100.0%	0.23	0.23	3.2
Interior Lighting	High-Bay Fixtures	100.0%	0.96	0.96	13.2
Interior Lighting	Linear Fluorescent	100.0%	1.12	1.12	15.4
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.18	0.18	2.5
Exterior Lighting	HID	100.0%	0.15	0.15	2.1
Exterior Lighting	Linear Fluorescent	100.0%	0.15	0.15	2.1
Refrigeration	Walk-in Refrigerator/Freezer	1.1%	4.49	0.05	0.7
Refrigeration	Reach-in Refrigerator/Freezer	2.0%	1.01	0.02	0.3
Refrigeration	Glass Door Display	0.0%	1.03	0.00	0.0
Refrigeration	Open Display Case	0.0%	6.13	0.00	0.0
Refrigeration	Icemaker	8.3%	1.69	0.14	1.9
Refrigeration	Vending Machine	6.9%	0.80	0.05	0.7
Food Preparation	Oven	0.0%	0.28	0.00	0.0
Food Preparation	Fryer	0.0%	0.41	0.00	0.0
Food Preparation	Dishwasher	2.0%	0.56	0.01	0.2
Food Preparation	Steamer	0.0%	0.41	0.00	0.0
Food Preparation	Hot Food Container	0.0%	0.08	0.00	0.0
Office Equipment	Desktop Computer	100.0%	0.23	0.23	3.2
Office Equipment	Laptop	100.0%	0.03	0.03	0.4
Office Equipment	Server	89.0%	0.27	0.24	3.4
Office Equipment	Monitor	100.0%	0.04	0.04	0.6
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	0.4
Office Equipment	POS Terminal	77.0%	0.07	0.06	0.8
Miscellaneous	Non-HVAC Motors	49.9%	0.14	0.07	1.0
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.65	0.65	8.9
Total				**7.50**	**102.9**

Table A-15 Miscellaneous Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	4.2%	3.85	0.16	5.3
Cooling	Water-Cooled Chiller	16.7%	4.36	0.73	24.0
Cooling	RTU	34.5%	3.18	1.10	36.3
Cooling	Room AC	4.9%	3.27	0.16	5.3
Cooling	Air-Source Heat Pump	6.2%	3.18	0.20	6.5
Cooling	Geothermal Heat Pump	1.1%	1.94	0.02	0.7
Heating	Electric Furnace	15.2%	8.97	1.36	45.0
Heating	Electric Room Heat	8.4%	8.54	0.72	23.7
Heating	Air-Source Heat Pump	6.2%	7.44	0.46	15.1
Heating	Geothermal Heat Pump	1.1%	5.77	0.07	2.2
Ventilation	Ventilation	100.0%	1.39	1.39	45.9
Water Heating	Water Heater	51.3%	2.64	1.35	44.8
Interior Lighting	Screw-in/Hard-wire	100.0%	0.75	0.75	24.9
Interior Lighting	High-Bay Fixtures	100.0%	0.25	0.25	8.1
Interior Lighting	Linear Fluorescent	100.0%	1.42	1.42	46.9
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.43	0.43	14.2
Exterior Lighting	HID	100.0%	0.91	0.91	30.0
Exterior Lighting	Linear Fluorescent	100.0%	0.07	0.07	2.3
Refrigeration	Walk-in Refrigerator/Freezer	9.0%	0.98	0.09	2.9
Refrigeration	Reach-in Refrigerator/Freezer	0.0%	0.22	0.00	0.0
Refrigeration	Glass Door Display	15.0%	0.23	0.03	1.1
Refrigeration	Open Display Case	0.0%	1.34	0.00	0.0
Refrigeration	Icemaker	41.6%	0.37	0.15	5.1
Refrigeration	Vending Machine	28.6%	0.35	0.10	3.3
Food Preparation	Oven	28.0%	0.24	0.07	2.3
Food Preparation	Fryer	4.0%	0.35	0.01	0.5
Food Preparation	Dishwasher	31.0%	0.49	0.15	5.0
Food Preparation	Steamer	4.0%	0.36	0.01	0.5
Food Preparation	Hot Food Container	7.0%	0.07	0.00	0.2
Office Equipment	Desktop Computer	100.0%	0.37	0.37	12.4
Office Equipment	Laptop	100.0%	0.06	0.06	1.9
Office Equipment	Server	66.0%	0.22	0.15	4.8
Office Equipment	Monitor	100.0%	0.07	0.07	2.2
Office Equipment	Printer/Copier/Fax	100.0%	0.04	0.04	1.4
Office Equipment	POS Terminal	28.0%	0.06	0.02	0.5
Miscellaneous	Non-HVAC Motors	59.9%	0.15	0.09	3.0
Miscellaneous	Pool Pump	4.0%	0.02	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.03	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.79	0.79	26.2
Total				**13.75**	**454.6**

Table A-16 Industrial Electric Market Profile, Washington

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	8,256	1,072	17.40
Cooling	Water-Cooled Chiller	1.4%	9,464	137	2.22
Cooling	RTU	17.0%	8,121	1,383	22.44
Cooling	Room AC	1.1%	8,347	94	1.53
Cooling	Air-Source Heat Pump	1.6%	8,118	130	2.12
Cooling	Geothermal Heat Pump	0.0%	5,414	0	0.00
Heating	Electric Furnace	4.9%	15,767	769	12.47
Heating	Electric Room Heat	1.7%	15,016	258	4.18
Heating	Air-Source Heat Pump	1.6%	11,786	189	3.07
Heating	Geothermal Heat Pump	0.0%	7,861	0	0.00
Ventilation	Ventilation	100.0%	1,190	1,190	19.30
Interior Lighting	Screw-in/Hard-wire	100.0%	302	302	4.90
Interior Lighting	High-Bay Fixtures	100.0%	1,256	1,256	20.38
Interior Lighting	Linear Fluorescent	100.0%	1,466	1,466	23.78
Exterior Lighting	Screw-in/Hard-wire	100.0%	238	238	3.86
Exterior Lighting	HID	100.0%	196	196	3.19
Exterior Lighting	Linear Fluorescent	100.0%	198	198	3.21
Motors	Pumps	100.0%	5,352	5,352	86.83
Motors	Fans & Blowers	100.0%	4,189	4,189	67.97
Motors	Compressed Air	100.0%	3,345	3,345	54.27
Motors	Conveyors	100.0%	15,101	15,101	245.01
Motors	Other Motors	100.0%	2,341	2,341	37.99
Process	Process Heating	100.0%	6,115	6,115	99.21
Process	Process Cooling	100.0%	2,005	2,005	32.53
Process	Process Refrigeration	100.0%	2,005	2,005	32.53
Process	Process Electro-Chemical	100.0%	3,972	3,972	64.45
Process	Process Other	100.0%	1,345	1,345	21.83
Miscellaneous	Miscellaneous	100.0%	2,197	2,197	35.64
	Total			**56,846**	**922.32**

Table A-17 Residential Single Family Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	38.2%	1,424	544	36
Cooling	Room AC	12.3%	518	64	4
Cooling	Air-Source Heat Pump	7.0%	1,491	104	7
Cooling	Geothermal Heat Pump	0.0%	1,317	0	0
Cooling	Evaporative AC	1.6%	1,027	16	1
Space Heating	Electric Room Heat	9.8%	14,299	1,397	91
Space Heating	Electric Furnace	7.4%	16,280	1,212	79
Space Heating	Air-Source Heat Pump	7.0%	12,257	852	56
Space Heating	Geothermal Heat Pump	0.0%	5,402	0	0
Water Heating	Water Heater (<= 55 Gal)	43.1%	3,530	1,523	100
Water Heating	Water Heater (55 to 75 Gal)	5.3%	3,712	195	13
Water Heating	Water Heater (> 75 Gal)	0.5%	3,890	18	1
Interior Lighting	Screw-in/Hard-wire	100.0%	1,267	1,267	83
Interior Lighting	Linear Fluorescent	100.0%	179	179	12
Interior Lighting	Specialty Lighting	100.0%	350	350	23
Exterior Lighting	Screw-in/Hard-wire	100.0%	491	491	32
Appliances	Clothes Washer	95.5%	103	98	6
Appliances	Clothes Dryer	65.6%	802	527	34
Appliances	Dishwasher	80.1%	443	355	23
Appliances	Refrigerator	100.0%	826	826	54
Appliances	Freezer	66.3%	660	438	29
Appliances	Second Refrigerator	29.4%	962	283	18
Appliances	Stove	58.4%	474	277	18
Appliances	Microwave	93.1%	138	129	8
Electronics	Personal Computers	63.3%	208	131	9
Electronics	Monitor	77.3%	88	68	4
Electronics	Laptops	85.7%	55	47	3
Electronics	TVs	199.0%	245	487	32
Electronics	Printer/Fax/Copier	76.9%	63	49	3
Electronics	Set top Boxes/DVRs	105.8%	124	131	9
Electronics	Devices and Gadgets	100.0%	54	54	3
Miscellaneous	Pool Pump	2.6%	2,350	61	4
Miscellaneous	Pool Heater	0.6%	3,763	24	2
Miscellaneous	Furnace Fan	70.2%	279	196	13
Miscellaneous	Well pump	20.0%	600	120	8
Miscellaneous	Miscellaneous	100.0%	389	389	25
	Total			**12,902**	**843**

Table A-18 Residential Multifamily Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	22.3%	373	83	0
Cooling	Room AC	31.6%	296	94	0
Cooling	Air-Source Heat Pump	1.9%	373	7	0
Cooling	Geothermal Heat Pump	0.0%	329	0	0
Cooling	Evaporative AC	1.9%	307	6	0
Space Heating	Electric Room Heat	59.5%	2,937	1,748	9
Space Heating	Electric Furnace	16.7%	3,343	557	3
Space Heating	Air-Source Heat Pump	1.9%	1,831	34	0
Space Heating	Geothermal Heat Pump	0.0%	807	0	0
Water Heating	Water Heater (<= 55 Gal)	57.4%	2,205	1,266	7
Water Heating	Water Heater (55 to 75 Gal)	7.6%	2,319	176	1
Water Heating	Water Heater (> 75 Gal)	0.0%	2,430	0	0
Interior Lighting	Screw-in/Hard-wire	100.0%	639	639	3
Interior Lighting	Linear Fluorescent	100.0%	40	40	0
Interior Lighting	Specialty Lighting	100.0%	37	37	0
Exterior Lighting	Screw-in/Hard-wire	100.0%	0	0	0
Appliances	Clothes Washer	59.6%	96	57	0
Appliances	Clothes Dryer	42.3%	593	251	1
Appliances	Dishwasher	73.1%	413	302	2
Appliances	Refrigerator	100.0%	771	771	4
Appliances	Freezer	23.1%	620	143	1
Appliances	Second Refrigerator	3.0%	898	27	0
Appliances	Stove	69.2%	357	247	1
Appliances	Microwave	86.5%	129	112	1
Electronics	Personal Computers	46.3%	194	90	0
Electronics	Monitor	56.6%	82	47	0
Electronics	Laptops	74.1%	52	38	0
Electronics	TVs	140.7%	269	379	2
Electronics	Printer/Fax/Copier	51.9%	59	31	0
Electronics	Set top Boxes/DVRs	64.8%	116	75	0
Electronics	Devices and Gadgets	100.0%	50	50	0
Miscellaneous	Pool Pump	0.0%	2,197	0	0
Miscellaneous	Pool Heater	0.0%	3,517	0	0
Miscellaneous	Furnace Fan	33.3%	98	33	0
Miscellaneous	Well pump	0.0%	556	0	0
Miscellaneous	Miscellaneous	100.0%	395	395	2
	Total			**7,733**	**41**

Table A-19 Residential Manufactured Home Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	35.9%	500	180	1
Cooling	Room AC	20.5%	395	81	0
Cooling	Air-Source Heat Pump	5.1%	500	26	0
Cooling	Geothermal Heat Pump	0.0%	441	0	0
Cooling	Evaporative AC	0.0%	319	0	0
Space Heating	Electric Room Heat	10.7%	6,758	724	4
Space Heating	Electric Furnace	42.9%	7,694	3,297	16
Space Heating	Air-Source Heat Pump	5.1%	6,330	325	2
Space Heating	Geothermal Heat Pump	0.0%	2,900	0	0
Water Heating	Water Heater (<= 55 Gal)	66.2%	2,370	1,570	8
Water Heating	Water Heater (55 to 75 Gal)	8.8%	2,492	219	1
Water Heating	Water Heater (> 75 Gal)	0.0%	2,612	0	0
Interior Lighting	Screw-in/Hard-wire	100.0%	750	750	4
Interior Lighting	Linear Fluorescent	100.0%	61	61	0
Interior Lighting	Specialty Lighting	100.0%	158	158	1
Exterior Lighting	Screw-in/Hard-wire	100.0%	184	184	1
Appliances	Clothes Washer	94.9%	91	87	0
Appliances	Clothes Dryer	82.1%	888	729	4
Appliances	Dishwasher	74.4%	394	293	1
Appliances	Refrigerator	100.0%	732	732	4
Appliances	Freezer	48.7%	586	286	1
Appliances	Second Refrigerator	21.0%	852	179	1
Appliances	Stove	82.1%	510	419	2
Appliances	Microwave	92.3%	123	113	1
Electronics	Personal Computers	46.4%	184	86	0
Electronics	Monitor	56.8%	78	44	0
Electronics	Laptops	50.0%	49	25	0
Electronics	TVs	110.7%	273	302	1
Electronics	Printer/Fax/Copier	42.9%	56	24	0
Electronics	Set top Boxes/DVRs	89.3%	110	99	0
Electronics	Devices and Gadgets	100.0%	48	48	0
Miscellaneous	Pool Pump	0.0%	2,087	0	0
Miscellaneous	Pool Heater	0.0%	3,341	0	0
Miscellaneous	Furnace Fan	71.4%	205	146	1
Miscellaneous	Well pump	0.0%	428	0	0
Miscellaneous	Miscellaneous	100.0%	415	415	2
	Total			**11,599**	**56**

Table A-20 Residential Low Income Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	UEC (kWh)	Intensity (kWh/HH)	Usage (GWh)
Cooling	Central AC	25.1%	481	121	4
Cooling	Room AC	29.0%	351	102	3
Cooling	Air-Source Heat Pump	2.6%	485	13	0
Cooling	Geothermal Heat Pump	0.0%	428	0	0
Cooling	Evaporative AC	1.6%	363	6	0
Space Heating	Electric Room Heat	50.0%	3,842	1,920	61
Space Heating	Electric Furnace	19.6%	4,374	859	28
Space Heating	Air-Source Heat Pump	2.6%	2,951	77	2
Space Heating	Geothermal Heat Pump	0.0%	1,319	0	0
Water Heating	Water Heater (<= 55 Gal)	57.7%	2,155	1,244	40
Water Heating	Water Heater (55 to 75 Gal)	7.6%	2,266	173	6
Water Heating	Water Heater (> 75 Gal)	0.0%	2,374	1	0
Interior Lighting	Screw-in/Hard-wire	100.0%	692	692	22
Interior Lighting	Linear Fluorescent	100.0%	51	51	2
Interior Lighting	Specialty Lighting	100.0%	72	72	2
Exterior Lighting	Screw-in/Hard-wire	100.0%	54	54	2
Appliances	Clothes Washer	66.5%	90	60	2
Appliances	Clothes Dryer	49.1%	610	299	10
Appliances	Dishwasher	73.7%	389	286	9
Appliances	Refrigerator	100.0%	725	725	23
Appliances	Freezer	29.1%	583	170	5
Appliances	Second Refrigerator	7.0%	844	59	2
Appliances	Stove	70.3%	363	255	8
Appliances	Microwave	87.7%	121	106	3
Electronics	Personal Computers	47.3%	182	86	3
Electronics	Monitor	57.9%	77	45	1
Electronics	Laptops	71.5%	49	35	1
Electronics	TVs	140.2%	253	354	11
Electronics	Printer/Fax/Copier	52.1%	55	29	1
Electronics	Set top Boxes/DVRs	70.6%	109	77	2
Electronics	Devices and Gadgets	100.0%	47	47	2
Miscellaneous	Pool Pump	0.2%	2,065	3	0
Miscellaneous	Pool Heater	0.0%	3,306	1	0
Miscellaneous	Furnace Fan	40.7%	123	50	2
Miscellaneous	Well pump	1.2%	510	6	0
Miscellaneous	Miscellaneous	100.0%	272	272	9
	Total			**8,349**	**267**

Table A-21 Small Office Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	0.5%	4.68	0.02	0.2
Cooling	Water-Cooled Chiller	0.0%	5.30	0.00	0.0
Cooling	RTU	77.9%	3.86	3.01	26.2
Cooling	Room AC	3.6%	3.97	0.14	1.3
Cooling	Air-Source Heat Pump	8.2%	3.86	0.32	2.7
Cooling	Geothermal Heat Pump	3.2%	2.36	0.08	0.7
Heating	Electric Furnace	16.0%	6.76	1.08	9.4
Heating	Electric Room Heat	14.5%	6.44	0.93	8.1
Heating	Air-Source Heat Pump	8.2%	5.71	0.47	4.1
Heating	Geothermal Heat Pump	3.2%	4.34	0.14	1.2
Ventilation	Ventilation	100.0%	1.40	1.40	12.1
Water Heating	Water Heater	69.8%	1.05	0.73	6.4
Interior Lighting	Screw-in/Hard-wire	100.0%	0.62	0.62	5.4
Interior Lighting	High-Bay Fixtures	100.0%	0.34	0.34	3.0
Interior Lighting	Linear Fluorescent	100.0%	2.05	2.05	17.8
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.14	0.14	1.2
Exterior Lighting	HID	100.0%	0.19	0.19	1.7
Exterior Lighting	Linear Fluorescent	100.0%	0.07	0.07	0.6
Refrigeration	Walk-in Refrigerator/Freezer	0.2%	2.34	0.01	0.0
Refrigeration	Reach-in Refrigerator/Freezer	1.6%	0.52	0.01	0.1
Refrigeration	Glass Door Display	0.5%	0.54	0.00	0.0
Refrigeration	Open Display Case	0.5%	3.19	0.01	0.1
Refrigeration	Icemaker	0.5%	0.88	0.00	0.0
Refrigeration	Vending Machine	0.2%	0.41	0.00	0.0
Food Preparation	Oven	0.8%	1.50	0.01	0.1
Food Preparation	Fryer	0.1%	2.17	0.00	0.0
Food Preparation	Dishwasher	1.0%	2.99	0.03	0.3
Food Preparation	Steamer	0.1%	2.19	0.00	0.0
Food Preparation	Hot Food Container	0.1%	0.41	0.00	0.0
Office Equipment	Desktop Computer	100.0%	1.55	1.55	13.5
Office Equipment	Laptop	100.0%	0.24	0.24	2.1
Office Equipment	Server	100.0%	0.46	0.46	4.0
Office Equipment	Monitor	100.0%	0.27	0.27	2.4
Office Equipment	Printer/Copier/Fax	100.0%	0.21	0.21	1.8
Office Equipment	POS Terminal	40.0%	0.12	0.05	0.4
Miscellaneous	Non-HVAC Motors	22.0%	0.19	0.04	0.4
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.82	0.82	7.1
Total				**15.44**	**134.4**

Table A-22 Large Office Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	23.5%	2.74	0.64	0.6
Cooling	Water-Cooled Chiller	23.5%	3.03	0.71	0.7
Cooling	RTU	33.4%	3.35	1.12	1.1
Cooling	Room AC	0.6%	3.44	0.02	0.0
Cooling	Air-Source Heat Pump	7.5%	3.35	0.25	0.2
Cooling	Geothermal Heat Pump	6.5%	2.04	0.13	0.1
Heating	Electric Furnace	15.7%	4.99	0.78	0.8
Heating	Electric Room Heat	14.3%	4.75	0.68	0.7
Heating	Air-Source Heat Pump	7.5%	4.57	0.34	0.3
Heating	Geothermal Heat Pump	6.5%	3.62	0.24	0.2
Ventilation	Ventilation	100.0%	2.96	2.96	2.9
Water Heating	Water Heater	68.0%	0.99	0.67	0.6
Interior Lighting	Screw-in/Hard-wire	100.0%	0.62	0.62	0.6
Interior Lighting	High-Bay Fixtures	100.0%	0.37	0.37	0.4
Interior Lighting	Linear Fluorescent	100.0%	2.74	2.74	2.7
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.14	0.14	0.1
Exterior Lighting	HID	100.0%	0.37	0.37	0.4
Exterior Lighting	Linear Fluorescent	100.0%	0.23	0.23	0.2
Refrigeration	Walk-in Refrigerator/Freezer	2.0%	1.62	0.03	0.0
Refrigeration	Reach-in Refrigerator/Freezer	14.0%	0.36	0.05	0.0
Refrigeration	Glass Door Display	4.0%	0.37	0.01	0.0
Refrigeration	Open Display Case	4.0%	2.22	0.09	0.1
Refrigeration	Icemaker	4.0%	0.61	0.02	0.0
Refrigeration	Vending Machine	2.1%	0.29	0.01	0.0
Food Preparation	Oven	10.0%	0.76	0.08	0.1
Food Preparation	Fryer	1.0%	1.10	0.01	0.0
Food Preparation	Dishwasher	12.0%	1.52	0.18	0.2
Food Preparation	Steamer	1.0%	1.11	0.01	0.0
Food Preparation	Hot Food Container	1.0%	0.21	0.00	0.0
Office Equipment	Desktop Computer	100.0%	1.96	1.96	1.9
Office Equipment	Laptop	100.0%	0.30	0.30	0.3
Office Equipment	Server	100.0%	0.19	0.19	0.2
Office Equipment	Monitor	100.0%	0.35	0.35	0.3
Office Equipment	Printer/Copier/Fax	100.0%	0.18	0.18	0.2
Office Equipment	POS Terminal	40.0%	0.03	0.01	0.0
Miscellaneous	Non-HVAC Motors	89.6%	0.21	0.19	0.2
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.83	0.83	0.8
Total				**17.54**	**17.0**

Table A-23 Restaurant Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	0.3%	3.65	0.01	0.0
Cooling	Water-Cooled Chiller	0.0%	4.03	0.00	0.0
Cooling	RTU	76.3%	4.58	3.49	1.0
Cooling	Room AC	6.6%	4.71	0.31	0.1
Cooling	Air-Source Heat Pump	6.6%	4.58	0.30	0.1
Cooling	Geothermal Heat Pump	3.3%	2.79	0.09	0.0
Heating	Electric Furnace	5.1%	6.99	0.36	0.1
Heating	Electric Room Heat	0.1%	6.66	0.01	0.0
Heating	Air-Source Heat Pump	6.6%	4.94	0.32	0.1
Heating	Geothermal Heat Pump	3.3%	3.48	0.11	0.0
Ventilation	Ventilation	100.0%	2.48	2.48	0.7
Water Heating	Water Heater	35.2%	8.81	3.10	0.9
Interior Lighting	Screw-in/Hard-wire	100.0%	2.09	2.09	0.6
Interior Lighting	High-Bay Fixtures	100.0%	0.40	0.40	0.1
Interior Lighting	Linear Fluorescent	100.0%	3.62	3.62	1.1
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.23	0.23	0.1
Exterior Lighting	HID	100.0%	1.61	1.61	0.5
Exterior Lighting	Linear Fluorescent	100.0%	0.47	0.47	0.1
Refrigeration	Walk-in Refrigerator/Freezer	74.0%	6.56	4.85	1.4
Refrigeration	Reach-in Refrigerator/Freezer	7.0%	2.94	0.21	0.1
Refrigeration	Glass Door Display	77.6%	1.51	1.17	0.3
Refrigeration	Open Display Case	26.0%	8.95	2.33	0.7
Refrigeration	Icemaker	75.9%	2.47	1.88	0.5
Refrigeration	Vending Machine	0.0%	1.16	0.00	0.0
Food Preparation	Oven	16.0%	9.79	1.57	0.5
Food Preparation	Fryer	14.0%	14.16	1.98	0.6
Food Preparation	Dishwasher	48.0%	9.75	4.68	1.4
Food Preparation	Steamer	14.0%	7.15	1.00	0.3
Food Preparation	Hot Food Container	31.0%	1.33	0.41	0.1
Office Equipment	Desktop Computer	100.0%	0.29	0.29	0.1
Office Equipment	Laptop	100.0%	0.04	0.04	0.0
Office Equipment	Server	50.0%	0.34	0.17	0.0
Office Equipment	Monitor	100.0%	0.05	0.05	0.0
Office Equipment	Printer/Copier/Fax	100.0%	0.06	0.06	0.0
Office Equipment	POS Terminal	100.0%	0.09	0.09	0.0
Miscellaneous	Non-HVAC Motors	20.0%	0.56	0.11	0.0
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	2.52	2.52	0.7
Total				**42.40**	**12.4**

Table A-24 Retail Electric Market Profile, Idaho

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	9.5%	2.80	0.27	3.2
Cooling	Water-Cooled Chiller	2.4%	3.17	0.08	0.9
Cooling	RTU	54.2%	2.31	1.25	15.2
Cooling	Room AC	2.8%	2.53	0.07	0.9
Cooling	Air-Source Heat Pump	1.7%	2.31	0.04	0.5
Cooling	Geothermal Heat Pump	1.4%	1.41	0.02	0.2
Heating	Electric Furnace	5.8%	4.81	0.28	3.4
Heating	Electric Room Heat	2.1%	4.58	0.10	1.2
Heating	Air-Source Heat Pump	1.7%	3.85	0.07	0.8
Heating	Geothermal Heat Pump	1.4%	2.62	0.04	0.4
Ventilation	Ventilation	100.0%	0.98	0.98	11.9
Water Heating	Water Heater	63.0%	0.79	0.50	6.1
Interior Lighting	Screw-in/Hard-wire	100.0%	0.85	0.85	10.3
Interior Lighting	High-Bay Fixtures	100.0%	1.02	1.02	12.4
Interior Lighting	Linear Fluorescent	100.0%	3.43	3.43	41.7
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.36	0.36	4.3
Exterior Lighting	HID	100.0%	1.30	1.30	15.8
Exterior Lighting	Linear Fluorescent	100.0%	0.87	0.87	10.6
Refrigeration	Walk-in Refrigerator/Freezer	2.0%	2.04	0.04	0.5
Refrigeration	Reach-in Refrigerator/Freezer	0.0%	0.46	0.00	0.0
Refrigeration	Glass Door Display	16.3%	0.47	0.08	0.9
Refrigeration	Open Display Case	14.0%	2.79	0.39	4.7
Refrigeration	Icemaker	7.1%	0.77	0.05	0.7
Refrigeration	Vending Machine	22.8%	0.36	0.08	1.0
Food Preparation	Oven	8.0%	2.43	0.19	2.4
Food Preparation	Fryer	1.6%	3.51	0.06	0.7
Food Preparation	Dishwasher	2.0%	4.84	0.10	1.2
Food Preparation	Steamer	1.6%	3.55	0.06	0.7
Food Preparation	Hot Food Container	1.0%	0.66	0.01	0.1
Office Equipment	Desktop Computer	100.0%	0.34	0.34	4.1
Office Equipment	Laptop	100.0%	0.05	0.05	0.6
Office Equipment	Server	82.0%	0.06	0.05	0.6
Office Equipment	Monitor	100.0%	0.06	0.06	0.7
Office Equipment	Printer/Copier/Fax	100.0%	0.05	0.05	0.6
Office Equipment	POS Terminal	100.0%	0.01	0.01	0.2
Miscellaneous	Non-HVAC Motors	40.2%	0.16	0.07	0.8
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.61	0.61	7.5
Total				**13.80**	**167.6**

Table A-25 Grocery Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	5.3%	5.20	0.28	0.5
Cooling	Water-Cooled Chiller	0.0%	5.89	0.00	0.0
Cooling	RTU	69.6%	4.30	2.99	5.8
Cooling	Room AC	0.0%	4.42	0.00	0.0
Cooling	Air-Source Heat Pump	3.1%	3.80	0.12	0.2
Cooling	Geothermal Heat Pump	0.0%	1.60	0.00	0.0
Heating	Electric Furnace	15.4%	5.62	0.86	1.7
Heating	Electric Room Heat	1.5%	5.35	0.08	0.2
Heating	Air-Source Heat Pump	3.1%	3.01	0.09	0.2
Heating	Geothermal Heat Pump	0.0%	1.93	0.00	0.0
Ventilation	Ventilation	100.0%	2.07	2.07	4.0
Water Heating	Water Heater	38.2%	2.18	0.83	1.6
Interior Lighting	Screw-in/Hard-wire	100.0%	1.93	1.93	3.7
Interior Lighting	High-Bay Fixtures	100.0%	1.70	1.70	3.3
Interior Lighting	Linear Fluorescent	100.0%	5.83	5.83	11.3
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.19	0.19	0.4
Exterior Lighting	HID	100.0%	1.16	1.16	2.2
Exterior Lighting	Linear Fluorescent	100.0%	0.48	0.48	0.9
Refrigeration	Walk-in Refrigerator/Freezer	16.0%	5.13	0.82	1.6
Refrigeration	Reach-in Refrigerator/Freezer	83.1%	0.33	0.27	0.5
Refrigeration	Glass Door Display	95.6%	3.37	3.23	6.3
Refrigeration	Open Display Case	95.6%	19.99	19.12	37.1
Refrigeration	Icemaker	66.6%	0.28	0.18	0.4
Refrigeration	Vending Machine	36.5%	0.26	0.09	0.2
Food Preparation	Oven	17.0%	2.44	0.42	0.8
Food Preparation	Fryer	13.0%	3.53	0.46	0.9
Food Preparation	Dishwasher	7.0%	4.86	0.34	0.7
Food Preparation	Steamer	13.0%	3.57	0.46	0.9
Food Preparation	Hot Food Container	16.0%	0.67	0.11	0.2
Office Equipment	Desktop Computer	100.0%	0.25	0.25	0.5
Office Equipment	Laptop	64.0%	0.04	0.03	0.0
Office Equipment	Server	100.0%	0.15	0.15	0.3
Office Equipment	Monitor	100.0%	0.04	0.04	0.1
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	0.1
Office Equipment	POS Terminal	100.0%	0.10	0.10	0.2
Miscellaneous	Non-HVAC Motors	34.6%	0.56	0.19	0.4
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	2.35	2.35	4.6
Total				**47.25**	**91.7**

Table A-26 College Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	34.8%	3.14	1.09	5.7
Cooling	Water-Cooled Chiller	8.7%	4.66	0.41	2.1
Cooling	RTU	15.6%	2.04	0.32	1.7
Cooling	Room AC	5.0%	2.09	0.10	0.5
Cooling	Air-Source Heat Pump	3.6%	2.03	0.07	0.4
Cooling	Geothermal Heat Pump	0.0%	1.24	0.00	0.0
Heating	Electric Furnace	10.5%	8.67	0.91	4.8
Heating	Electric Room Heat	29.7%	8.26	2.45	12.8
Heating	Air-Source Heat Pump	3.6%	6.15	0.22	1.2
Heating	Geothermal Heat Pump	0.0%	4.76	0.00	0.0
Ventilation	Ventilation	100.0%	1.48	1.48	7.7
Water Heating	Water Heater	26.3%	2.02	0.53	2.8
Interior Lighting	Screw-in/Hard-wire	100.0%	0.83	0.83	4.3
Interior Lighting	High-Bay Fixtures	100.0%	0.30	0.30	1.6
Interior Lighting	Linear Fluorescent	100.0%	2.04	2.04	10.7
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.01	0.01	0.0
Exterior Lighting	HID	100.0%	0.27	0.27	1.4
Exterior Lighting	Linear Fluorescent	100.0%	0.97	0.97	5.1
Refrigeration	Walk-in Refrigerator/Freezer	7.7%	0.29	0.02	0.1
Refrigeration	Reach-in Refrigerator/Freezer	13.4%	0.13	0.02	0.1
Refrigeration	Glass Door Display	8.0%	0.07	0.01	0.0
Refrigeration	Open Display Case	4.8%	0.40	0.02	0.1
Refrigeration	Icemaker	28.2%	0.22	0.06	0.3
Refrigeration	Vending Machine	8.8%	0.10	0.01	0.0
Food Preparation	Oven	13.7%	0.68	0.09	0.5
Food Preparation	Fryer	1.6%	0.98	0.02	0.1
Food Preparation	Dishwasher	11.7%	1.35	0.16	0.8
Food Preparation	Steamer	1.6%	0.99	0.02	0.1
Food Preparation	Hot Food Container	8.4%	0.19	0.02	0.1
Office Equipment	Desktop Computer	100.0%	0.51	0.51	2.7
Office Equipment	Laptop	100.0%	0.02	0.02	0.1
Office Equipment	Server	100.0%	0.06	0.06	0.3
Office Equipment	Monitor	100.0%	0.09	0.09	0.5
Office Equipment	Printer/Copier/Fax	100.0%	0.07	0.07	0.4
Office Equipment	POS Terminal	36.0%	0.02	0.01	0.0
Miscellaneous	Non-HVAC Motors	88.8%	0.14	0.12	0.6
Miscellaneous	Pool Pump	6.0%	0.01	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.01	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.61	0.61	3.2
Total				**13.93**	**72.9**

Table A-27 School Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	24.5%	2.59	0.63	7.0
Cooling	Water-Cooled Chiller	6.1%	3.83	0.23	2.6
Cooling	RTU	11.9%	1.68	0.20	2.2
Cooling	Room AC	5.0%	1.72	0.09	1.0
Cooling	Air-Source Heat Pump	8.6%	1.67	0.14	1.6
Cooling	Geothermal Heat Pump	3.9%	1.02	0.04	0.4
Heating	Electric Furnace	3.7%	9.33	0.35	3.9
Heating	Electric Room Heat	1.8%	8.88	0.16	1.8
Heating	Air-Source Heat Pump	8.6%	6.62	0.57	6.3
Heating	Geothermal Heat Pump	3.9%	5.13	0.20	2.2
Ventilation	Ventilation	100.0%	1.17	1.17	13.0
Water Heating	Water Heater	38.1%	1.63	0.62	6.9
Interior Lighting	Screw-in/Hard-wire	100.0%	0.55	0.55	6.1
Interior Lighting	High-Bay Fixtures	100.0%	0.13	0.13	1.4
Interior Lighting	Linear Fluorescent	100.0%	1.10	1.10	12.2
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.00	0.00	0.0
Exterior Lighting	HID	100.0%	0.17	0.17	1.9
Exterior Lighting	Linear Fluorescent	100.0%	0.96	0.96	10.7
Refrigeration	Walk-in Refrigerator/Freezer	19.0%	0.51	0.10	1.1
Refrigeration	Reach-in Refrigerator/Freezer	33.0%	0.23	0.08	0.8
Refrigeration	Glass Door Display	19.7%	0.12	0.02	0.3
Refrigeration	Open Display Case	11.9%	0.69	0.08	0.9
Refrigeration	Icemaker	69.7%	0.38	0.27	3.0
Refrigeration	Vending Machine	21.8%	0.18	0.04	0.4
Food Preparation	Oven	34.0%	0.58	0.20	2.2
Food Preparation	Fryer	4.0%	0.84	0.03	0.4
Food Preparation	Dishwasher	29.0%	1.15	0.33	3.7
Food Preparation	Steamer	4.0%	0.84	0.03	0.4
Food Preparation	Hot Food Container	21.0%	0.16	0.03	0.4
Office Equipment	Desktop Computer	100.0%	0.45	0.45	5.0
Office Equipment	Laptop	100.0%	0.03	0.03	0.3
Office Equipment	Server	100.0%	0.11	0.11	1.2
Office Equipment	Monitor	100.0%	0.08	0.08	0.9
Office Equipment	Printer/Copier/Fax	100.0%	0.05	0.05	0.6
Office Equipment	POS Terminal	36.0%	0.01	0.01	0.1
Miscellaneous	Non-HVAC Motors	43.7%	0.11	0.05	0.5
Miscellaneous	Pool Pump	6.0%	0.01	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.01	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.54	0.54	6.0
Total				**9.85**	**109.4**

Table A-28 Health Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	16.5%	5.72	0.94	3.4
Cooling	Water-Cooled Chiller	65.9%	7.50	4.94	18.0
Cooling	RTU	10.8%	5.49	0.59	2.2
Cooling	Room AC	0.4%	5.64	0.02	0.1
Cooling	Air-Source Heat Pump	1.1%	5.48	0.06	0.2
Cooling	Geothermal Heat Pump	0.4%	3.34	0.01	0.0
Heating	Electric Furnace	0.3%	13.21	0.04	0.1
Heating	Electric Room Heat	9.3%	12.58	1.17	4.3
Heating	Air-Source Heat Pump	1.1%	9.03	0.10	0.4
Heating	Geothermal Heat Pump	0.4%	6.62	0.02	0.1
Ventilation	Ventilation	100.0%	4.96	4.96	18.1
Water Heating	Water Heater	22.3%	4.64	1.03	3.8
Interior Lighting	Screw-in/Hard-wire	100.0%	1.54	1.54	5.6
Interior Lighting	High-Bay Fixtures	100.0%	0.35	0.35	1.3
Interior Lighting	Linear Fluorescent	100.0%	3.92	3.92	14.3
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.04	0.04	0.1
Exterior Lighting	HID	100.0%	0.46	0.46	1.7
Exterior Lighting	Linear Fluorescent	100.0%	0.16	0.16	0.6
Refrigeration	Walk-in Refrigerator/Freezer	33.0%	1.05	0.35	1.3
Refrigeration	Reach-in Refrigerator/Freezer	50.0%	0.23	0.12	0.4
Refrigeration	Glass Door Display	8.6%	0.24	0.02	0.1
Refrigeration	Open Display Case	6.7%	1.43	0.10	0.3
Refrigeration	Icemaker	21.1%	0.79	0.17	0.6
Refrigeration	Vending Machine	27.9%	0.37	0.10	0.4
Food Preparation	Oven	13.0%	2.58	0.34	1.2
Food Preparation	Fryer	10.0%	3.73	0.37	1.4
Food Preparation	Dishwasher	25.0%	5.14	1.28	4.7
Food Preparation	Steamer	10.0%	3.77	0.38	1.4
Food Preparation	Hot Food Container	10.0%	0.70	0.07	0.3
Office Equipment	Desktop Computer	100.0%	0.91	0.91	3.3
Office Equipment	Laptop	100.0%	0.06	0.06	0.2
Office Equipment	Server	100.0%	0.11	0.11	0.4
Office Equipment	Monitor	100.0%	0.16	0.16	0.6
Office Equipment	Printer/Copier/Fax	100.0%	0.10	0.10	0.4
Office Equipment	POS Terminal	100.0%	0.07	0.07	0.3
Miscellaneous	Non-HVAC Motors	74.1%	0.36	0.27	1.0
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	3.75	3.75	13.6
Total				**29.06**	**105.8**

Table A-29 Lodging Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	4.4%	1.20	0.05	0.2
Cooling	Water-Cooled Chiller	17.8%	1.56	0.28	0.8
Cooling	RTU	8.1%	2.65	0.21	0.7
Cooling	Room AC	27.5%	2.72	0.75	2.3
Cooling	Air-Source Heat Pump	17.6%	2.65	0.47	1.4
Cooling	Geothermal Heat Pump	2.5%	2.29	0.06	0.2
Heating	Electric Furnace	60.2%	4.18	2.52	7.6
Heating	Electric Room Heat	3.6%	3.98	0.14	0.4
Heating	Air-Source Heat Pump	17.6%	3.83	0.67	2.0
Heating	Geothermal Heat Pump	2.5%	2.48	0.06	0.2
Ventilation	Ventilation	100.0%	1.42	1.42	4.3
Water Heating	Water Heater	31.5%	4.81	1.51	4.6
Interior Lighting	Screw-in/Hard-wire	100.0%	3.31	3.31	10.0
Interior Lighting	High-Bay Fixtures	100.0%	0.27	0.27	0.8
Interior Lighting	Linear Fluorescent	100.0%	0.87	0.87	2.6
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.13	0.13	0.4
Exterior Lighting	HID	100.0%	0.51	0.51	1.6
Exterior Lighting	Linear Fluorescent	100.0%	0.03	0.03	0.1
Refrigeration	Walk-in Refrigerator/Freezer	3.0%	0.82	0.02	0.1
Refrigeration	Reach-in Refrigerator/Freezer	19.0%	0.18	0.03	0.1
Refrigeration	Glass Door Display	40.0%	0.19	0.08	0.2
Refrigeration	Open Display Case	0.0%	1.12	0.00	0.0
Refrigeration	Icemaker	88.9%	0.62	0.55	1.7
Refrigeration	Vending Machine	57.8%	0.29	0.17	0.5
Food Preparation	Oven	24.0%	0.83	0.20	0.6
Food Preparation	Fryer	4.0%	1.20	0.05	0.1
Food Preparation	Dishwasher	39.0%	0.82	0.32	1.0
Food Preparation	Steamer	4.0%	0.60	0.02	0.1
Food Preparation	Hot Food Container	10.0%	0.11	0.01	0.0
Office Equipment	Desktop Computer	100.0%	0.20	0.20	0.6
Office Equipment	Laptop	100.0%	0.03	0.03	0.1
Office Equipment	Server	100.0%	0.12	0.12	0.4
Office Equipment	Monitor	100.0%	0.04	0.04	0.1
Office Equipment	Printer/Copier/Fax	100.0%	0.02	0.02	0.1
Office Equipment	POS Terminal	58.0%	0.03	0.02	0.1
Miscellaneous	Non-HVAC Motors	91.3%	0.15	0.14	0.4
Miscellaneous	Pool Pump	76.0%	0.02	0.02	0.1
Miscellaneous	Pool Heater	27.0%	0.03	0.01	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.76	0.76	2.3
Total				**16.08**	**48.7**

Table A-30 Warehouse Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	4.17	0.54	3.4
Cooling	Water-Cooled Chiller	1.4%	4.78	0.07	0.4
Cooling	RTU	17.0%	4.11	0.70	4.4
Cooling	Room AC	1.1%	4.22	0.05	0.3
Cooling	Air-Source Heat Pump	1.6%	4.10	0.07	0.4
Cooling	Geothermal Heat Pump	0.0%	2.50	0.00	0.0
Heating	Electric Furnace	4.9%	7.82	0.38	2.4
Heating	Electric Room Heat	1.7%	7.45	0.13	0.8
Heating	Air-Source Heat Pump	1.6%	5.85	0.09	0.6
Heating	Geothermal Heat Pump	0.0%	4.46	0.00	0.0
Ventilation	Ventilation	100.0%	0.60	0.60	3.8
Water Heating	Water Heater	76.9%	0.61	0.47	2.9
Interior Lighting	Screw-in/Hard-wire	100.0%	0.23	0.23	1.5
Interior Lighting	High-Bay Fixtures	100.0%	0.96	0.96	6.1
Interior Lighting	Linear Fluorescent	100.0%	1.12	1.12	7.1
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.18	0.18	1.1
Exterior Lighting	HID	100.0%	0.15	0.15	0.9
Exterior Lighting	Linear Fluorescent	100.0%	0.15	0.15	1.0
Refrigeration	Walk-in Refrigerator/Freezer	1.1%	4.49	0.05	0.3
Refrigeration	Reach-in Refrigerator/Freezer	2.0%	1.01	0.02	0.1
Refrigeration	Glass Door Display	0.0%	1.03	0.00	0.0
Refrigeration	Open Display Case	0.0%	6.13	0.00	0.0
Refrigeration	Icemaker	8.3%	1.69	0.14	0.9
Refrigeration	Vending Machine	6.9%	0.80	0.05	0.3
Food Preparation	Oven	0.0%	0.28	0.00	0.0
Food Preparation	Fryer	0.0%	0.41	0.00	0.0
Food Preparation	Dishwasher	2.0%	0.56	0.01	0.1
Food Preparation	Steamer	0.0%	0.41	0.00	0.0
Food Preparation	Hot Food Container	0.0%	0.08	0.00	0.0
Office Equipment	Desktop Computer	100.0%	0.23	0.23	1.5
Office Equipment	Laptop	100.0%	0.03	0.03	0.2
Office Equipment	Server	89.0%	0.27	0.24	1.5
Office Equipment	Monitor	100.0%	0.04	0.04	0.3
Office Equipment	Printer/Copier/Fax	100.0%	0.03	0.03	0.2
Office Equipment	POS Terminal	77.0%	0.07	0.06	0.4
Miscellaneous	Non-HVAC Motors	49.9%	0.14	0.07	0.4
Miscellaneous	Pool Pump	0.0%	0.00	0.00	0.0
Miscellaneous	Pool Heater	0.0%	0.00	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.65	0.65	4.1
Total				**7.50**	**47.4**

Table A-31 Miscellaneous Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Sqft)	Usage (GWh)
Cooling	Air-Cooled Chiller	4.2%	3.89	0.16	2.0
Cooling	Water-Cooled Chiller	16.7%	4.41	0.73	9.0
Cooling	RTU	34.5%	3.22	1.11	13.6
Cooling	Room AC	4.9%	3.30	0.16	2.0
Cooling	Air-Source Heat Pump	6.2%	3.22	0.20	2.4
Cooling	Geothermal Heat Pump	1.1%	1.96	0.02	0.3
Heating	Electric Furnace	15.2%	8.92	1.36	16.6
Heating	Electric Room Heat	8.4%	8.49	0.71	8.7
Heating	Air-Source Heat Pump	6.2%	7.40	0.46	5.6
Heating	Geothermal Heat Pump	1.1%	5.74	0.07	0.8
Ventilation	Ventilation	100.0%	1.39	1.39	17.0
Water Heating	Water Heater	51.3%	2.64	1.35	16.6
Interior Lighting	Screw-in/Hard-wire	100.0%	0.75	0.75	9.2
Interior Lighting	High-Bay Fixtures	100.0%	0.25	0.25	3.0
Interior Lighting	Linear Fluorescent	100.0%	1.42	1.42	17.3
Exterior Lighting	Screw-in/Hard-wire	100.0%	0.43	0.43	5.3
Exterior Lighting	HID	100.0%	0.91	0.91	11.1
Exterior Lighting	Linear Fluorescent	100.0%	0.07	0.07	0.8
Refrigeration	Walk-in Refrigerator/Freezer	9.0%	0.98	0.09	1.1
Refrigeration	Reach-in Refrigerator/Freezer	0.0%	0.22	0.00	0.0
Refrigeration	Glass Door Display	15.0%	0.23	0.03	0.4
Refrigeration	Open Display Case	0.0%	1.34	0.00	0.0
Refrigeration	Icemaker	41.6%	0.37	0.15	1.9
Refrigeration	Vending Machine	28.6%	0.35	0.10	1.2
Food Preparation	Oven	28.0%	0.24	0.07	0.8
Food Preparation	Fryer	4.0%	0.35	0.01	0.2
Food Preparation	Dishwasher	31.0%	0.49	0.15	1.8
Food Preparation	Steamer	4.0%	0.36	0.01	0.2
Food Preparation	Hot Food Container	7.0%	0.07	0.00	0.1
Office Equipment	Desktop Computer	100.0%	0.37	0.37	4.6
Office Equipment	Laptop	100.0%	0.06	0.06	0.7
Office Equipment	Server	66.0%	0.22	0.15	1.8
Office Equipment	Monitor	100.0%	0.07	0.07	0.8
Office Equipment	Printer/Copier/Fax	100.0%	0.04	0.04	0.5
Office Equipment	POS Terminal	28.0%	0.06	0.02	0.2
Miscellaneous	Non-HVAC Motors	59.9%	0.15	0.09	1.1
Miscellaneous	Pool Pump	4.0%	0.02	0.00	0.0
Miscellaneous	Pool Heater	1.0%	0.03	0.00	0.0
Miscellaneous	Other Miscellaneous	100.0%	0.78	0.78	9.6
Total				**13.75**	**168.1**

Table A-32 Industrial Electric Market Profile, Idaho

Average Market Profiles - Electricity

End Use	Technology	Saturation	EUI (kWh)	Intensity (kWh/Employee)	Usage (GWh)
Cooling	Air-Cooled Chiller	13.0%	5,652	734	6.51
Cooling	Water-Cooled Chiller	1.4%	6,479	94	0.83
Cooling	RTU	17.0%	5,559	947	8.40
Cooling	Room AC	1.1%	5,714	64	0.57
Cooling	Air-Source Heat Pump	1.6%	5,557	89	0.79
Cooling	Geothermal Heat Pump	0.0%	3,706	0	0.00
Heating	Electric Furnace	4.9%	10,593	516	4.58
Heating	Electric Room Heat	1.7%	10,088	173	1.54
Heating	Air-Source Heat Pump	1.6%	7,918	127	1.13
Heating	Geothermal Heat Pump	0.0%	5,281	0	0.00
Ventilation	Ventilation	100.0%	807	807	7.16
Interior Lighting	Screw-in/Hard-wire	100.0%	205	205	1.82
Interior Lighting	High-Bay Fixtures	100.0%	854	854	7.58
Interior Lighting	Linear Fluorescent	100.0%	997	997	8.84
Exterior Lighting	Screw-in/Hard-wire	100.0%	162	162	1.44
Exterior Lighting	HID	100.0%	134	134	1.18
Exterior Lighting	Linear Fluorescent	100.0%	134	134	1.19
Motors	Pumps	100.0%	3,640	3,640	32.29
Motors	Fans & Blowers	100.0%	2,850	2,850	25.28
Motors	Compressed Air	100.0%	2,275	2,275	20.18
Motors	Conveyors	100.0%	10,272	10,272	91.13
Motors	Other Motors	100.0%	1,593	1,593	14.13
Process	Process Heating	100.0%	4,159	4,159	36.90
Process	Process Cooling	100.0%	1,364	1,364	12.10
Process	Process Refrigeration	100.0%	1,364	1,364	12.10
Process	Process Electro-Chemical	100.0%	2,702	2,702	23.97
Process	Process Other	100.0%	915	915	8.12
Miscellaneous	Miscellaneous	100.0%	1,494	1,494	13.26
	Total			**38,668**	**343.03**

Market Adoption (Ramp) Rates

This appendix presents the market adoption rates we applied to economic potential to estimate achievable potential.

Avista Appendix -
Market Adoption Ra

Equipment Measure Data

Please see measure-level assumptions and details in the file "*Avista Appendix- Equipment Measure Data.xlsx*"

Avista Appendix -
Equipment Measure

Non-Equipment Measure Data

Please see measure-level assumptions and details in the file "*Avista Appendix- Non-Equipment Measure Data.xlsx*"

Avista Appendix -
Non-Equipment Me

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