AVISTA

2020 Washington Annual Conservation Report

June 1, 2021

Cover: Davenport, Washington

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INTRODUCTION

Monroe Street Bridge, Spokane, Washington

INTRODUCTION

Avista has spent more than four decades developing responsible and cost-effective energy-efficiency programs. This 2020 *Annual Conservation Report* provides a synopsis of those efforts for the company's electric and natural gas customers in the state of Washington – efforts that are designed not only to provide a least-cost resource, but also to help these customers conserve energy, save money, and live more comfortably – and delivers the results of third-party assessments of Avista's efficiency program portfolio performance.

Customers continued to be the focus of Avista's Energy-Efficiency Program in 2020, though unanticipated impacts of COVID-19 caused the company to look for new avenues to reach them – while also maintaining social distancing for the safety not only of those customers, but also of business partners and employees. While Avista made changes to adaptively manage its Energy-Efficiency Program, overall conservation achievements were impacted by lower participation rates in 2020. Nevertheless, the company modified its outreach efforts, took steps to ensure customers stayed connected, and continued on its path of keeping power both affordable and reliable – efforts that are discussed in more detail in this report.

Avista also began efforts to enhance its program by identifying and measuring non-energy impacts that may be applicable to each program offered. Quantifying Non-Energy Impacts (NEIs) in a way that is useful, reliable, accurate, and applicable continues to be a significant undertaking. While energy-related impacts have a proven measurement and verification methodology, NEIs continue to be more difficult to establish. The identification and quantification of NEIs help to better inform program offerings and expand the overall value of measures incentivized.

In addition to offering a mix of programs implemented both by the company and by third-party contractors, Avista continues to support the regional market transformation effort through the Northwest Energy Efficiency Alliance (NEEA). Reported conservation energy savings, cost-effectiveness, and other related data, however, are specific to local programs unless otherwise noted.

Recommendations from these assessments, as well as the application of lessons learned through each program year, are incorporated into Avista's annual business planning process to further refine program design and improve their chances of success.

Note that the electric and natural gas savings contained in this report are provided as gross values based on all program participants.

FIGURE 1 – ELECTRIC AND NATURAL GAS SERVICE AREAS

TARIFF RIDER BALANCES

At the start of 2020, the Washington electric and natural gas (aggregate) tariff rider balances were underfunded by $7.8 million, due primarily to the high level of conservation achieved during the 2016–17 program years. During the year, $21 million in tariff rider revenue was collected to fund energy efficiency, while $15.4 million was expended to operate energy-efficiency programs. The $5.6 million excess of collections over expenditures contributed to the decrease in the underfunded balance of the tariff riders, resulting in an underfunded balance of $2.2 million by year end.

Table 1 illustrates the 2020 tariff rider activity by fuel type.

TABLE 1 – TARIFF RIDER ACTIVITY

	Electric		Natural Gas		Total	
Beginning balance (underfunded)/overfunded	**$**	**(6,886,364)**	**$**	**(908,548)**	**$**	**(7,794,912)**
Energy-efficiency funding	$	16,497,844	$	4,497,533	$	20,995,377
Net funding of operations	$	9,611,479	$	3,588,985	$	13,200,465
Energy-efficiency expenditures	$	10,871,059	$	4,547,533	$	15,418,591
Ending balances (underfunded)/overfunded	**$**	**(1,259,579)**	**$**	**(958,547)**	**$**	**(2,218,127)**

WASHINGTON ACHIEVEMENTS

- ***Electric Conservation:*** For 2020, Avista's Electric Energy-Efficiency Program achieved 24,186,197 kWh of conservation and achieved cost-effectiveness ratios of 1.30 for Total Resource Cost (TRC) and 1.75 for Utility Cost Test (UCT).
- ***Natural Gas Conservation:*** For 2020, Avista's Natural Gas Energy-Efficiency Program archived 595,332 therms of conservation and achieved cost-effectiveness ratios of 0.84 for TRC and 1.52 for UCT.

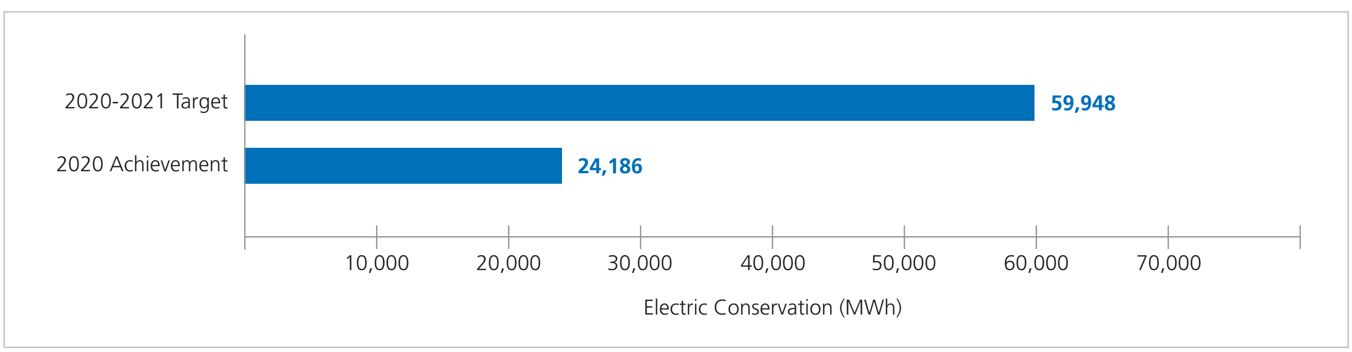
For the 2020–21 biennium, Avista's Washington Energy Independence Act (EIA) penalty threshold is 59,948 MWh, which is derived from several target elements including the conservation potential from the company's Conservation Potential Assessment (CPA) and excluding savings derived from the NEEA program. The utility-specific conservation goal is 63,590 MWh, which is also inclusive of Avista's 5 percent decoupling commitment. Table 2 summarizes the target calculation.

TABLE 2 – 2020–21 ENERGY INDEPENDENCE ACT TARGET

Category	MWh
Pro rata share of 10-year conservation potential	72,340
Distribution and street light efficiency	504
EIA target	72,844
Decoupling penalty threshold	3,642
Total utility conservation goal	76,486
Excluded programs (NEEA)	(12,896)
Utility-specific conservation goal	63,590
EIA penalty threshold	59,948

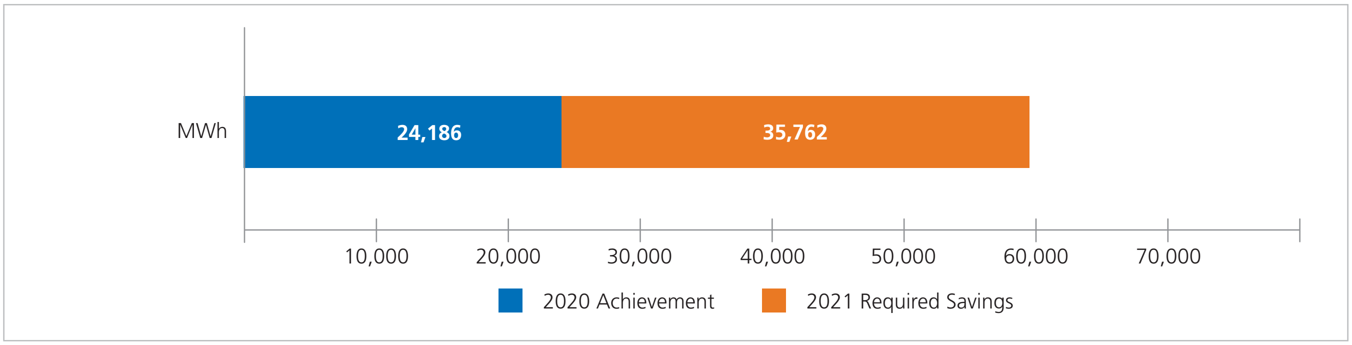
At the mid-point of the 2020–21 biennium, Avista met 40 percent of its electric conservation target, achieving 24,186 MWh of the two-year 59,948 MWh goal. The 24,186 MWh was lower than the planned savings of 49,376 MWh in the company's 2020 *Annual Conservation Plan*.

FIGURE 2 – 2020 CONSERVATION ACHIEVED VS 2020–21 ENERGY INDEPENDENCE ACT PENALTY THRESHOLD



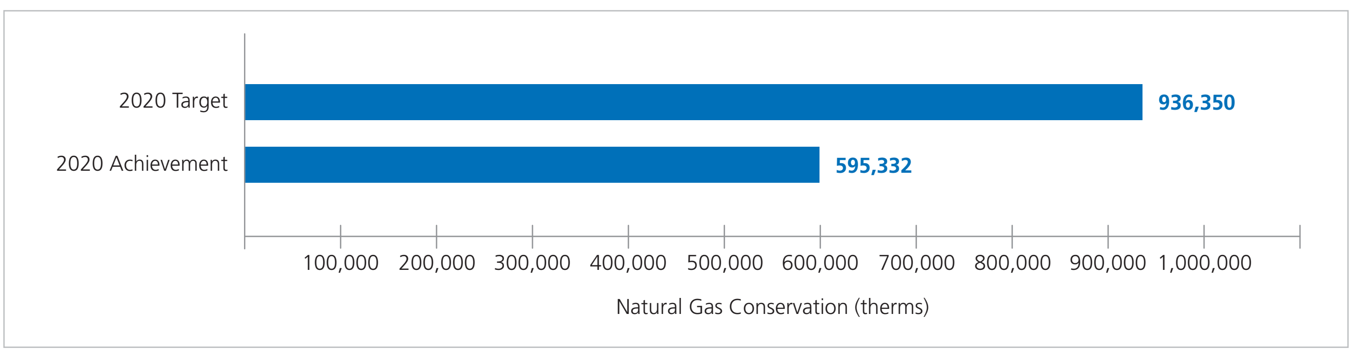
The first of the two-year biennial period had historically brought in more than 60 percent of the savings. For the current biennium, the 2020 program year produced 40 percent. While this places more importance on 2021, WAC 480-109-100 section 3(c) allows utilities to carry forward excess savings from its prior two biennia and apply those savings to its current target (up to 20 percent). Based on the excess savings available from the prior two biennial periods, Avista can apply approximately 12,000 MWh to any potential shortfall. Figure 3 illustrates Avista's estimated path toward meeting its 2020–21 target. For illustrative purposes, the 2021 level of conservation represents the required MWh to reach Avista's 2020-21 target.

FIGURE 3 – ESTIMATED BIENNIAL SAVINGS



Avista's natural gas conservation target is set according to the company's 2018 natural gas *Integrated Resource Plan* (*IRP*), which used the third year of conservation within its CPA study. Over the course of the 10-year forecasted energy-efficiency potential, the annual rate of conservation potential increases in later years. In a typical *IRP* cycle, the CPA is updated every two years, which provides a more recent forecast of conservation potential. Because of the legislation changes in Washington, however, the *IRP* was delayed, and the 2018 *IRP* study was used for the purposes of setting the conservation target. The conservation potential that informs the target was determined to be 936,350 therms in Washington.

FIGURE 4 – 2020 NATURAL GAS SAVINGS VS IRP TARGET



Note that in Avista's 2021 natural gas CPA, the first-year potential therm savings had been revised to 758,200 therms, which will be used for setting the company's 2021 natural gas target.

Program Impacts

COVID-19

COVID-19 created multiple and far-reaching impacts to Avista's customers. While the Energy-Efficiency Program saw a decline in participation, the impact was much more profound within the communities served. Many small businesses suffered financial losses, with over 100 businesses in the service territory closing permanently. Many people lost their jobs. Avista adapted its Energy-Efficiency Program to provide needed support for customers to help them through this unprecedented event.

COVID-19 Emergency Operating Plan Stages and Response

Early in 2020, Avista operated at the "Monitoring and Precautions" stage of its Emergency Operating Plan (EOP), with additional precautions put in place to protect the safety of employees and customers. At the beginning of March, the company had moved into the "Preventative" stage, which increased restrictions and limited customer interactions. By the middle of the month, Avista had skipped the "Responsive" stage and moved to "Critical," which places the highest restrictions on meetings, public interactions, travel, and customer-related work. In addition, all non-essential employees moved to a work-from-home model.

Table 3 illustrates the four stages of the COVID-19 EOP.

TABLE 3 – AVISTA COVID-19 EMERGENCY OPERATING PLAN STAGES

Stage	Monitoring and Precautions	Preventative	Responsive	Critical
Description	A regional health or safety threat exists with potential impact to Avista operations and/or employees. Avista is monitoring and preparing to take necessary actions.	Regional organizations and/or public health officials begin recommending preventative actions. Avista is mitigating risks to ensure it can continue to provide essential services to its customers.	Either the threat has affected employees or service territory directly or an impact is clearly imminent. Avista is actively responding to protect employees, customers, and essential services.	The threat to essential services is severe. Avista is taking critical measures to protect employees and essential services.
Public interactions	Precautions	Additional precautions	Limited	Critical only
Meetings	Normal	Large postponed, virtual encouraged	Virtual only	Virtual only
Travel	Discretionary/limit high-risk	Limit non-essential	Essential only	Emergency only
DSM staff desk work	Remote work voluntary	Remote work recommended	Remote work mandatory	Remote work mandatory
DSM customer site work	Call ahead to check with customer.	Ask permission to work on customer site. Go to campus only for instruments.	Ask customer for essential work only. Plan trips to Avista campus for supplies to avoid others. Meet with two or fewer people at the customer site and maintain social distance.	Request through account executive that customer send information necessary for projects. No trips to Avista campus or customer without permission from manager.

Adaptive Management During COVID-19

Installation Verification: Avista temporarily modified its approach to installation verification. For some projects that required an on-site verification that the incented equipment had been installed and is being used, Avista opted for an approach in which the customer would submit photographic evidence of the installation. For some projects, it was also requested that a live video chat would occur so Avista could virtually walk through the facility to verify the equipment. This approach enabled Avista to maintain a level of assurance of the installation while also preserving the safety of both workers and customers.

Multifamily Direct Install Pilot: The Multifamily Direct Install (MFDI) program has historically been a high-touch approach to allowing customers to lower their energy use. The program focuses on the direct installation of LED lighting, faucet aerators, low-flow showerheads, and other low-cost energy-saving measures. In March, Avista's EOP response put restrictions on the program's ability to be in close proximity with customers; it was therefore put on hold for the remainder of the year. In its place, the company worked with its implementer to develop a pilot program that enabled customers to drop off their old equipment and pick up energy-efficient items. This pilot is discussed in more detail later in the report.

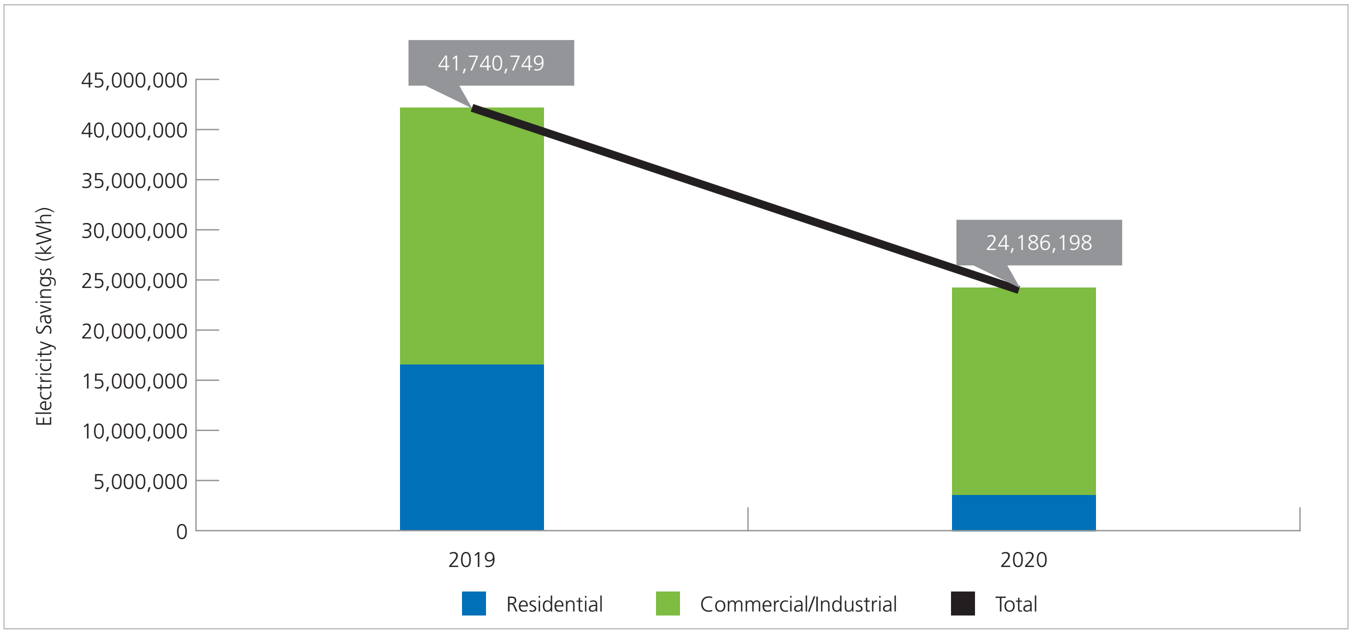
Account Executives: Avista's account executive (AE) team is responsible for the close interactions with commercial and industrial customers. As expected, COVID-19 presented challenges for the AE team. (Avista's EOP "Critical" phase significantly limited face-to-face meetings; many business customers had similar restrictions.) Impacts ranged from customers closing operations for months, operating under reduced hours and workforce, and, in some cases, increased demand for business and product. Customers have consequently had to re-evaluate energy-efficiency projects and how to fund them. A number of them have delayed or canceled capital expenditures, directly affecting energy-efficiency projects. In response, the AE team pursued every opportunity to continue to engage with customers while adhering to the restrictions.

Customer Outreach: Energy fairs and outreach events were canceled, leaving a significant hole in Avista's ability to be in the communities it serves. The company developed outreach kits that contained low-cost, energy-saving items, and partnered with Meals on Wheels to help distribute them. The kits included window plastic, LED lamps, nightlights, energy-saving tips, and information on assistance programs.

Portfolio Trends

As shown in Figure 5, Avista's energy savings achieved in 2020 were lower than in 2019 (41,740,749 kWh vs. 24,186,198 kWh). Savings acquired through the company's residential programs decreased 83 percent, which is chiefly attributed to the impact of COVID-19 restrictions on program offerings and the loss of the Simple Steps program. Commercial/industrial programs decreased from 25,433,281 kWh in 2019 to 20,584,356 kWh in 2020, a decrease of 19.1 percent.

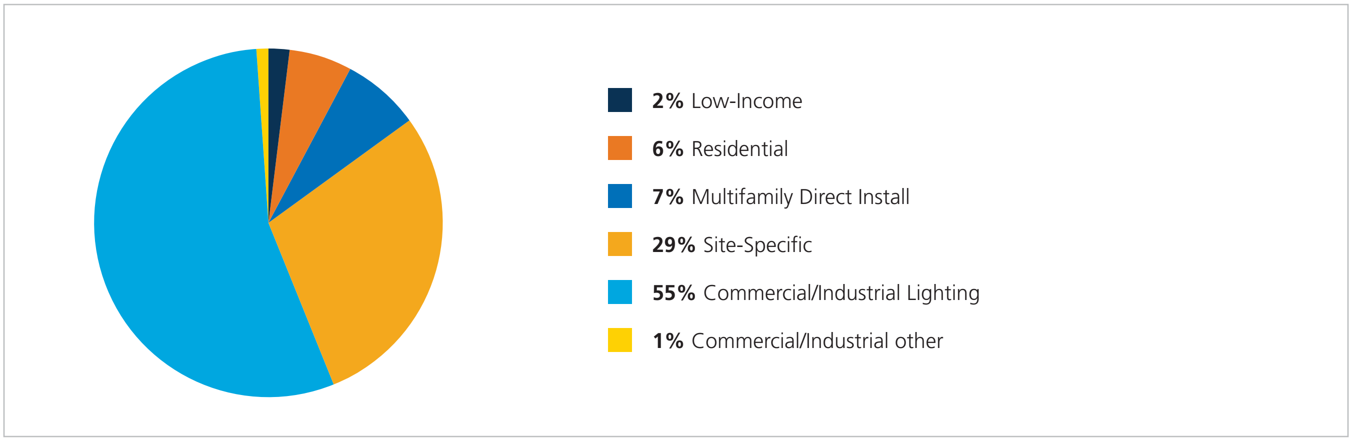
FIGURE 5 – ELECTRIC ENERGY SAVINGS (2019–2020)



Program Segment	2019	2020
Residential (including low-income programs)	16,307,468	3,601,842
Commercial/industrial	25,433,281	20,584,356
Total	**41,740,749**	**24,186,198**

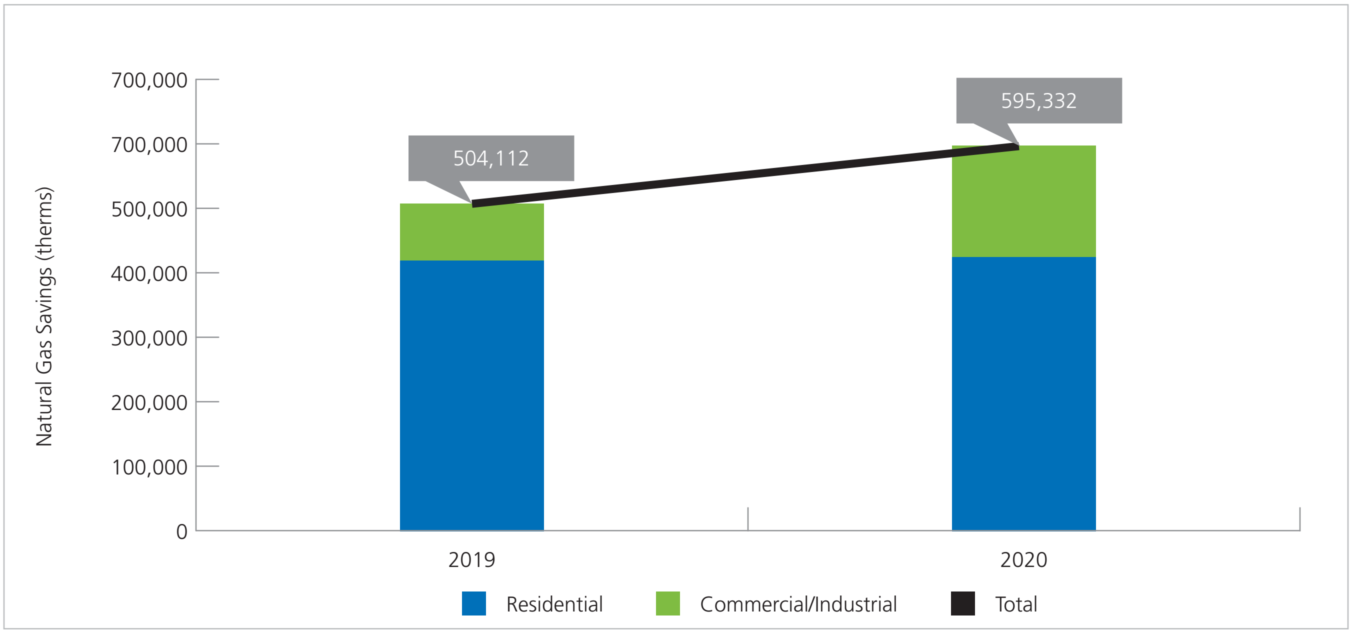
Of Avista's overall electric portfolio in 2020, the commercial/industrial prescriptive lighting program achieved 55 percent of savings; site-specific programs, 29 percent. All other programs combined achieved the remaining 16 percent (see Figure 6).

FIGURE 6 – ELECTRIC SAVINGS PORTFOLIO



As shown in Figure 7, Avista's natural gas portfolio experienced an overall decrease in savings in 2020 compared to the prior year. Savings acquired through the company's non-residential programs, however, increased from 85,567 therms in 2019 to 172,357 in 2020, or 101 percent. Much of the change is attributed to the commercial/industrial sector making more efforts toward reaching customers. As Avista addresses clean building requirements per House Bill 1257, its efforts to ensure customers are in compliance will remain a priority for the energy efficiency team. Overall the natural gas portfolio savings increased by 18 percent over the prior year, which illustrates those additional efforts.

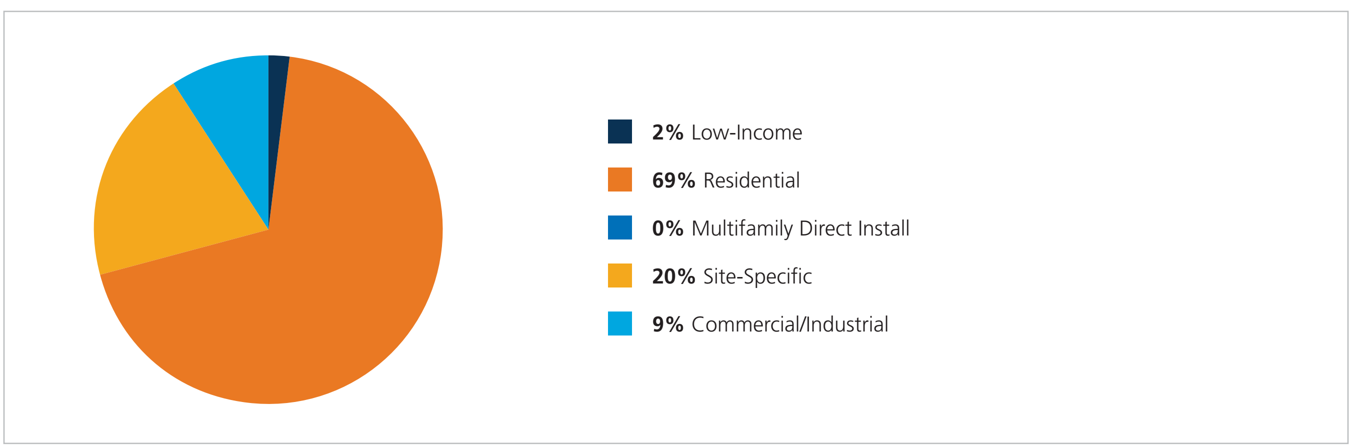
FIGURE 7 – NATURAL GAS ENERGY SAVINGS (2019–2020)



	2019	2020
Residential	418,545	422,975
Commercial/industrial	85,567	172,357
Total	**504,112**	**595,332**

Residential programs obtained 69 percent of the natural gas savings portfolio in 2020. This is attributed primarily to high-efficiency natural gas furnace measures, which were installed in 2,519 homes and achieved 286,703 therms. Site-specific programs achieved 20 percent of the overall total; and low-income, MFDI, and other commercial/industrial programs made up the remaining 11 percent (see Figure 8).

FIGURE 8 – NATURAL GAS SAVINGS PORTFOLIO



Verified Savings

As part of the Evaluation, Measurement and Verification (EM&V) process, Avista's evaluators review the reported savings provided by the company and make adjustments where necessary. The details of these adjustments are included in the impact evaluation reports which have been appended to this report. In 2020, the electric energy-efficiency portfolio reported savings of 26,044 MWh and achieved evaluated savings of 24,186 MWh, which results in a realization rate of 93 percent. The natural gas portfolio reported 575,991 therms and achieved evaluated savings of 595,332 therms, which resulted in a 103 percent realization rate.

Tables 4 and 5 illustrate the reported and evaluated savings and the resulting realization rates.

TABLE 4 – ENERGY-EFFICIENCY SAVINGS BY SECTOR – ELECTRIC

Sector	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Commercial/industrial	22,723,395	20,584,356	91%
Residential	2,976,079	3,260,565	110%
Low-Income	344,745	341,277	99%
Total	**26,044,219**	**24,186,197**	**93%**

TABLE 5 – ENERGY-EFFICIENCY SAVINGS BY SECTOR – NATURAL GAS

Sector	Reported Savings (therms)	Gross Evaluated Savings (therms)	Realization Rate
Commercial/industrial	187,787	172,357	92%
Residential	375,601	408,525	109%
Low-Income	12,603	14,450	115%
Total	**575,991**	**595,332**	**103%**

Expenditures

While the 2020 *Annual Conservation Plan* provides an expectation for operational planning, Avista is required to pursue all cost-effective measures under Tariff Schedules 90 and 190. Because of this, variances may exist between the level of planned spending and the actual spending that occurs. For 2020, the program saw a lower level of participation, which caused a sizable variance with actual spending being lower than planned.

Since customer incentives are the largest component of expenditures, customer demand can easily affect the funding level of the tariff riders. Table 6 provides a detailed comparison of budgeted to actual energy-efficiency expenditures by fuel type.

TABLE 6 – ANNUAL CONSERVATION PLAN BUDGET TO ACTUAL EXPENDITURES COMPARISON

	Electric		Natural Gas	
2020 Annual Conservation Plan				
Incentives budget	$	9,181,456	$	5,062,757
Non-incentives and labor	$	5,088,332	$	639,089
NEEA, CPA, EM&V	$	2,156,000	$	490,000
Total budgeted expenditures	**$**	**16,425,788**	**$**	**6,191,846**
Actual 2020 Expenditures				
Incentives	$	5,750,446	$	3,520,943
Non-incentives and labor	$	3,259,145	$	608,999
NEEA, CPA, EM&V	$	1,861,467	$	417,591
Total actual expenditures	**$**	**10,871,059**	**$**	**4,547,533**
Variance	**$**	**(5,554,730)**	**$**	**(1,644,313)**

Table 7 illustrates the top five programs with the highest impact on the expenditure variance. As expected, the largest variance occurs with programs that have historically had the most incentive expenditures. The Site-Specific program, which outside of Prescriptive Lighting is the portfolio's largest, had a variance of over $2 million. Other areas with significant impacts were related to natural gas programs, which chiefly consist of the installation of high-efficiency furnaces in residential homes.

TABLE 7 – PROGRAMS WITH HIGHEST IMPACT ON EXPENDITURE VARIANCE

Program	Planned		Actual		Variance		Variance Percentage
Site-Specific	$	3,776,125	$	1,783,761	$	1,992,365	53%
Multifamily Direct Install	$	2,499,610	$	1,648,834	$	850,776	34%
Residential Prescriptive (Natural Gas programs)	$	3,249,126	$	2,139,121	$	1,110,005	34%
Commercial/Industrial Lighting	$	3,863,324	$	3,193,261	$	670,064	17%
Low-Income (Natural Gas programs)	$	1,664,688	$	1,318,017	$	346,671	21%

EVALUATION APPROACH

Because evaluation is a critical component of any successful energy conservation program, Avista employs EM&V protocols to validate and report verified energy savings related to its energy-efficiency measures and programs. Those protocols include comprehensive analyses and assessments necessary to supply useful information to both management and stakeholders. (EM&V includes impact and process, and, taken as a whole, are analogous with industry standard terms such as *portfolio evaluation* or *program evaluation*.)

Program evaluations are generally conducted by third-party EM&V firms, selected on a biennial basis through a competitive bidding process managed by Avista's supply chain management group. The scope of work for selected evaluators is defined and managed by the company's planning and analytics team. Third-party evaluators provide recommendations pertaining to specific programs and related processes in impact and process evaluation report outputs. Avista incorporates recommendations to improve program performance, enact changes to programs, and make decisions to phase out programs and measures.

For 2020, Avista retained two separate firms to conduct impact and process evaluations of electric and natural gas programs in the utility's Washington program portfolio. Cadmus conducted impact evaluations of the commercial/industrial program portfolio and process evaluations of the entire program portfolio; ADM performed impact evaluations of residential and low-income programs. Evaluations took a portfolio-wide approach to provide a benchmark against which future years can be compared. Impact and process evaluations for most programs were also completed at the program level, so that customer experience could be better delineated and realization rates understood.

Several guiding EM&V documents are maintained and published to support planning and reporting requirements. These include the Avista EM&V framework, an annual EM&V plan, and EM&V contributions within other demand side management (DSM) and Avista corporate publications. Program-specific EM&V plans are created to inform and benefit the DSM activities. These documents are reviewed and updated as necessary to improve the processes and protocols for energy-efficiency measurement, evaluation, and verification.

EM&V efforts are also used to evaluate emerging technologies and applications in consideration of their inclusion in Avista's energy-efficiency portfolio. In its electric portfolio, Avista may spend up to 10 percent of its conservation budget on programs whose savings impacts have not yet been measured if the overall conservation portfolio passes the applicable cost-effectiveness test. These programs may include educational, behavioral change, and other investigatory projects. Specific activities can include product and application document reviews, development of formal evaluation plans, field studies, data collection, statistical analysis, and solicitation of user feedback.

Both Avista and its customers benefit from activities and resources related to energy efficiency and conservation. To contribute to regional efforts, one Avista employee has a voting role and a second a corresponding member role on the Regional Technical Forum – the advisory committee to the Northwest Power and Conservation Council (NPCC) and a primary source of information regarding the standardization of energy savings and measurement processes for electric applications in the Pacific Northwest. This knowledge base provides Avista with energy efficiency data, metrics, non-energy benefits, and references for inclusion in the company's *Technical Reference Manual* relating to acquisition planning and reporting. Avista also works with other northwest utilities and NEEA in a number of pilot projects and subcommittee evaluations; portions of the energy-efficiency savings acquired through the latter's regional programs are attributable to Avista's portfolio.

COST-EFFECTIVENESS

Avista's portfolio offerings are evaluated at implementation and also at the conclusion of the program year to gauge the level of cost-effectiveness. Cost-effectiveness tests determine whether that program is beneficial both from the company's and from customers' perspectives. Avista uses four metrics to evaluate cost-effectiveness: the UCT, the TRC, the Participant Cost Test (PCT), and the Ratepayer Impact Test (RIM). For Washington electric programs, the TRC is the most important; the UCT is most important for natural gas programs. Avista's cost-effectiveness goal for both the electric and natural gas program portfolios is to have a UCT above 1.00, which indicates that the benefits to the utility exceed the costs of implementing the program. In 2020, the TRC benefit/cost ratios were 1.30 for electric and 0.84 for natural gas, while the UCT ratios were 1.75 for electric and 1.52 for natural gas.

TABLE 8 – PORTFOLIO COST-EFFECTIVENESS RESULTS – ELECTRIC

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 17,026,048	$ 13,069,307	1.30
UCT	$ 15,316,468	$ 8,761,858	1.75
PCT	$ 30,947,840	$ 10,047,326	3.08
RIM	$ 15,316,468	$ 23,346,115	0.66

TABLE 9 – PORTFOLIO COST-EFFECTIVENESS RESULTS – NATURAL GAS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 7,131,618	$ 8,468,752	0.84
UCT	$ 6,392,555	$ 4,198,841	1.52
PCT	$ 8,867,812	$ 7,790,853	1.14
RIM	$ 6,392,555	$ 18,391,442	0.35

COMMERCIAL/INDUSTRIAL SECTOR

Davenport, Washington

COMMERCIAL/INDUSTRIAL SECTOR

Overview

The commercial/industrial energy-efficiency market is served through a combination of prescriptive and site-specific programs. Any savings measure not offered through the Prescriptive program – and/or that does not meet its parameters – is automatically eligible for treatment through the Site-Specific program path.

The prescriptive program path is selected for smaller, straightforward equipment installations that generally have similar operating characteristics (such as lighting, simple HVAC systems, food service equipment, and variable frequency drives).

The site-specific program path is reserved for more unique or complex projects that require custom savings calculations and technical assistance from Avista's energy engineers (such as compressed air, process equipment and controls, and comprehensive lighting retrofits). In certain instances, a performance basis approach is used.

- ***1,828 commercial/industrial electric measures in 2020:*** Total savings of 20,584 MWh, a decrease of 24 percent from the previous year (27,056 MWh). Most of this decrease was due to a year-over-year reduction in LED lighting measures.
- ***108 commercial/industrial natural gas measures in 2020:*** Total savings of 172,357 therms in 2020, an increase of 101 percent from 2019 (85,567 therms). This increase is attributed to site-specific projects achieving more HVAC efficiency than in the past. HVAC heating contributed 87,545 therms, which accounts for almost half of all commercial/industrial therm savings.

TABLE 10 – COMMERCIAL/INDUSTRIAL VERIFIED SAVINGS BY PROGRAM

Commercial/Industrial	Program Type	Electric Savings (kWh)	Natural Gas Savings (therms)
Exterior Lighting	Prescriptive	5,482,211	-
Food Services	Prescriptive	54,257	30,123
Green Motors	Prescriptive	11,978	-
Interior Lighting	Prescriptive	7,731,720	-
Motor Control HVAC (VFD)	Prescriptive	166,470	-
HVAC	Prescriptive	-	18,126
Shell	Prescriptive	35,587	6,880
Appliance	Site-Specific	9,828	-
C&I Process	Site-Specific	53,882	-
Compressed Air	Site-Specific	1,206,192	-
HVAC Combined	Site-Specific	400,380	22,757
HVAC Cooling	Site-Specific	405,291	-
HVAC Heating	Site-Specific	-	87,545
Motor Controls Industrial	Site-Specific	100,200	-
New Construction – Water Heat	Site-Specific	-	2,696
New Construction – Windows Shell	Site-Specific	34,787	13
New Construction – Lighting	Site-Specific	224,758	-
New Construction – HVAC	Site-Specific	-	4,218
Other	Site-Specific	181,581	-
Exterior Lighting	Site-Specific	615,119	-
Interior Lighting	Site-Specific	3,870,114	-
Total Commercial/Industrial		**20,584,356**	**172,357**

Marketing

To assist commercial customers during the COVID-19 pandemic, Avista developed communications materials that included tip sheets – e.g. "HVAC System Changes Q&A" – plus checklists for saving energy when shutting buildings down and when re-entering. To support small businesses, a flyer was created identifying sources of local, state, and federal help available in Washington. Electronic newsletters containing information on Avista's energy-efficiency programs and related content were also sent to commercial and small business customers. Vendors were mailed updates about program information. New email templates were created for Avista's account executives, providing a customizable tool that could be used to promote various rebate programs to their customers.

Ongoing updates to Avista's website regarding energy-efficiency programs, as well as COVID-19 information, continued throughout the year.

FIGURE 9 – COMMERCIAL/INDUSTRIAL HVAC SYSTEM CHANGES Q&A IN RESPONSE TO COVID-19 FLYER

HVAC System Changes Q&A in Response to COVID-19

Please use this information to answer customer questions regarding HVAC systems changes to reduce viral possibilities. We give special thanks to Coffman Engineers for their expertise in this matter.

What is the required percentage of outside air supply (OSA) according to code?

Minimum OSA rates are based on type of usage and square footage; however, outside air rates are not limited to 10% above design airflow. As COVID-19 is a special case, facility operators could choose to take emergency measures for the safety of staff.

If you choose to increase outside air rates, we recommend that you ensure the equipment and building are operating properly. All equipment should be operating within their respective design envelopes, and building pressure is to be maintained by an equal amount of exhaust/relief air leaving the building. Special pressurization and operating conditions also must be maintained for labs, hospitals, restrooms, workspaces, etc.

Will increasing the flow of outside air improve the air quality in office settings?

Yes, increasing the OSA rate will improve air quality, and we would encourage increased outside air flow if possible. Air flow should only be increased to the level that the HVAC equipment is rated. Increasing outside air flow beyond the equipment limits can cause insufficient building heating/cooling, as well as damage to HVAC equipment and possibly the building. Outside temperatures can also dip below freezing, so you need to guard against the possibility of freeze damage from cold outside air.

Fan speeds should not be increased above rated speeds or fan bearings may be damaged. We do not recommend adjusting individual room diffusers, since that could cause balance issues in the overall building. Building pressure should be maintained by an equal amount of exhaust/relief air exiting the building.

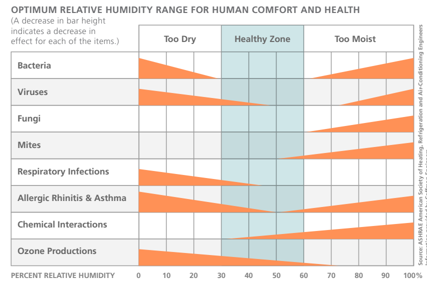
What would be the impact to our utility costs if we set the outside air-flow at 100%?

Utility costs would increase based on additional fan use and natural gas usage to heat OSA to room temperature. Based on an average outside air temperature of 40°F, we estimate natural gas use could double.

HVAC System Changes Q&A in Response to COVID-19

What recommendations do you have to ease concerns of staff about supply air?

The supply and ventilation air rates of commercial HVAC systems are designed to mitigate the transmission of cold and flu viruses, but there is no way to completely eliminate the risk. Air humidity plays a large role in stopping the transmission of bacteria and viruses through the air.



As shown in the graph above, there is a sweet spot around 55-60% humidity that reduces viruses and respiratory infections while still keeping other agents, such as fungi, in check. We encourage increasing building humidification or having employees keep a humidifier in their work area.

Avista recommends following the CDC guidelines for businesses:
cdc.gov/coronavirus/2019-ncov/community/guidance-business-response.html

Should we install a special HEPA filter on RTUs/AHUs?

Increased filtering on the return/supply air can improve air quality and safety (more filtering on the outside air will not help). High efficiency filters, like HEPA filters, would increase the pressure drop in air ducting which could impede air flow. Poor airflow could defeat the purpose of providing fresh ventilation and could also damage natural gas heating elements in the HVAC equipment. We recommend that you improve filtering if possible but follow the equipment manufacturers' filter guidelines.

FIGURE 10 – COMMERCIAL/INDUSTRIAL BUILDING SHUTDOWN CHECKLIST

Building Shutdown Checklist

GENERAL BEST PRACTICES

- ☐ Review this checklist one week prior to shutdown to ensure all arrangements are made to complete a successful shutdown of each building.
- ☐ Check that all windows and doors to the outside are closed and locked.
- ☐ Cooling Season: Lower and close all blinds to prevent solar heat gain.
- ☐ Heating Season: Open blinds to allow for warming (unless this creates a security issue).*
- ☐ Make a quick walkthrough of your building at the end of the last day of operation to see how you're doing and identify any potential problems. Listen/feel for any equipment that is running.
- ☐ Consolidate building activities during shutdown period and instruct occupants on set-back procedures.

*This is at the building owner's discretion (providing safety allows).

WATER

- ☐ Check all drinking fountains, faucets, showers and toilets for water leaks.
- ☐ Turn off any automatic flushing systems.
- ☐ Check water meters to verify there is not use (movement of the meter) due to water leaks.
- ☐ Turn off all water heaters that will not be needed.
- ☐ If possible, turn off or unplug drinking fountains containing individual refrigeration units.

LIGHTING

- ☐ Check that timers are working and set correctly for exterior lights that will be in operation during the break.
- ☐ Turn off all display-case lighting.
- ☐ Wherever possible, turn off all interior lights except exit/security lighting.
- ☐ Where lighting controls exist, adjust scheduling to be in accordance with new operation schedules.

HVAC

- ☐ Heating Season: Set temperatures to 45-50 degrees in all parts of the building.
- ☐ Cooling Season: Set temperatures to 80-85 degrees in all parts of the building or just shut off AC system.
- ☐ Ensure that all HVAC equipment is set to "auto," not "on." If individual rooms have working HVAC controls, check each room.
- ☐ Adjust your HVAC timers according to required schedules; review building automation system to ensure that schedules are updated for unoccupied period.
- ☐ Ensure that nothing is stacked on supplies or returns.
- ☐ Turn off all automatic and manual exhaust fans.
- ☐ Review the need for building ventilation and shut down all unnecessary ventilation fans.

ELECTRICITY

- ☐ Check to make sure that all unnecessary electrical appliances are turned off and unplugged. This includes copiers, computers, printers, televisions, fax machines, radios, water coolers, sound systems and task lighting.*
- ☐ For schools, check that all electrical appliances in the teachers' lounge are turned off and unplugged.
- ☐ Unplug vending machines (be sure to inform the vendor).
- ☐ Check computer rooms. Turn off and unplug computers, monitors, speakers, projectors and printers.
- ☐ Turn off intercom and conference room systems.

KITCHENS & WORKSHOPS

- ☐ Confirm that all kitchen equipment, both gas and electric, is turned off.
- ☐ Consolidate items from multiple refrigerators into one and clean out, open and unplug others.*
- ☐ Milk coolers not in use should be turned off.*
- ☐ Turn off electric water heaters at circuit box.
- ☐ Turn off any hot water boosters for kitchen dishwashers.
- ☐ Turn off domestic hot water circulating pumps, if feasible.
- ☐ Check to see that all compressors used in facilities or other shops are turned off.

*Send e-mail to appropriate staff requesting they take these steps prior to leaving.

FIGURE 11 – COMMERCIAL/INDUSTRIAL TIPS TO SAVE ENERGY WHEN SHUTTING DOWN COMMERCIAL BUILDINGS FLYER

AVISTA

Save energy when shutting down commercial buildings

Save energy when leaving a building unoccupied. Just follow these simple energy-saving tips from Avista. The larger your facility, the more you can save.

Leaving Lights On

If you are concerned about security, it's smart to leave at least one light on to deter burglars (or to put a few lights on an automatic timer). If you do leave any lights on, just make sure they are all LEDs, which use the least amount of energy. Businesses with a security fence should turn off all their lighting. Just make sure to close and lock your fence.

Unplug Energy-Nabbing Devices

Few people realize it, but electronics and appliances use energy even when they are off. These "parasitic load" devices include printers, scanners, personal entertainment systems, personal computers and other at-the-ready equipment that may be located throughout your offices. Unplugging these devices before you leave will save energy while you're temporarily away.

Curtains and Blinds

Save on heating and cooling by making sure all the windows of your building are closed and locked and that curtains and blinds are shut. This helps heat from coming in during the summer and prevents heat loss in the winter.

Refrigeration

A refrigerator can use up to $80 a year in electricity—even if it's not opened. To save energy, empty the contents of all refrigerators, unplug them, and open the doors (block them so they stay open). The same goes for any miniature refrigerators as well, and be sure to turn off lights in walk-in refrigerators. Also check to see if you have other types of refrigeration systems that can be shut off. You'll save money by pulling the plug on water coolers not being used, as well. If your business uses air compressors, shut them all off if there is not work occurring in the building. Although air compressors may not sound as if they're running, they will come on every time there is a slight drop in pressure. Last but not least, as you turn devices off, put sticky notes on them to remind people that they should be off (and as a reminder for you to turn them back on when you return).

HVAC Systems

If you must shorten the occupancy hours of your building, also shorten the operating time of your HVAC system and automated lighting systems by changing the programming in your EMS system, programmable thermostats, or manual thermostats. If your building will be unoccupied for several weeks, consider lowering your HVAC heating set point to 45°F. This will create a noticeable drop in HVAC usage and should not pose a problem to the building, as long as you monitor for extended periods of freezing temperatures.

Water Heater

Save electricity or natural gas by turning down your water heater when you leave. A water heater consumes 25% of its energy to keep the tank of water warm—even if hot water is not being used. When lowering the water temperature, set it above 115°F or below 75°F to prevent the growth of Legionella bacteria, which can cause illness.

If you think you'll be away for an extended period, shut off your water heater completely. Make sure your circulation pumps are off, as well.

FIGURE 12 – COMMERCIAL/INDUSTRIAL PREPARATIONS FOR WORKFORCE RE-ENTRY CHECK LIST

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Preparations for Workforce Re-Entry

GENERAL BEST PRACTICES

- ☐ Begin completing these checklist tasks a week early for a successful reopening.
- ☐ Restart larger or hastily closed buildings earlier as they take more time to recommission.
- ☐ Send emails to educate building occupants about restarting procedures.
- ☐ Restart systems and equipment backward from shutdown order to avoid damage.
- ☐ Complete a complete facility inspection a day before reopening.

ELECTRICITY AND GAS

- ☐ Check all circuit breakers/fuses to ensure they are not tripped/blown.
- ☐ Ensure natural gas valves are open and that fittings do not leak.
- ☐ Plug in all office equipment, such as copiers, computers, printers, sound systems, task lighting, breakroom appliances, etc.
- ☐ Turn on intercom and conference room systems.
- ☐ Inspect and plug in refrigerated water fountains and water coolers.
- ☐ Plug in vending machines (be sure to inform the vendor).
- ☐ Ensure all gas appliances have relit pilot lights and are operational.
- ☐ Test the building security system.

LIGHTING

- ☐ Check all lighting controls and adjust settings to new operational schedules.
- ☐ Ensure exit and security lights are working.
- ☐ Turn on all display-case lighting.

WATER

- ☐ Flush water through all lines, especially drinking and potable sources, before use.
- ☐ Make sure all water fountain, faucet, toilet and shower valves are open and do not leak.
- ☐ Turn on all automatic flushing systems.
- ☐ Turn on water heaters and set temperatures at or above 120° F to meet safety requirements.
- ☐ Ensure hot-water recirculating pumps are turned on and operational.
- ☐ Turn on any hot water boosters for kitchen dishwashers.
- ☐ Ensure facility and shop compressors are turned on.

HEATING & AC/REFRIGERATION

- ☐ Inspect ductwork for holes/leaks as well as rodent or other animal nests.
- ☐ Replace dirty filters with higher-efficiency filters that are sealed properly.
- ☐ Ensure required vents are open.
- ☐ Turn on all necessary ventilation fans.
- ☐ Test economizers to ensure they are not stuck open or closed.
- ☐ Ensure all HVAC equipment and timers, including programmable thermostats, are operating properly. (Remember to check rooms with individual HVAC controls.)
- ☐ Gradually adjust temperature settings to suit occupancy levels (adjust a few degrees each day over a week).
- ☐ Maximize the introduction of outside air (per CDC guidelines) to dilute airborne contaminants/viruses while maintaining indoor comfort.
- ☐ Aim for 40-60% relative humidity, which is considered ideal for containing the virus.
- ☐ Apply additional ASHRAE measures, including those for high-risk situations, found at **ashrae.org/technical-resources/commercial**
- ☐ Check equipment refrigerant levels to ensure there are no leaks. (Turn on milk coolers, if applicable.)

TRAFFIC EFFORT/SIGNAGE

- ☐ Place signs on all entrance doors reminding occupants not to enter if they have COVID-19 symptoms. Encourage personal health monitoring for employees as well.
- ☐ Suggest (or require) face masks for all occupants, visitors and maintenance personnel as part of entrance-sign messaging.
- ☐ Install signs listing CDC guidelines for COVID-19 in breakrooms and other highly used rooms. See "Print Resources" at **cdc.gov/coronavirus/2019-ncov/communication**
- ☐ Install signs that encourage safe physical distancing and respiratory etiquette (cover sneezes) in high-traffic and confined areas.
- ☐ Install signs that urge 20-second handwashing in common areas and restrooms.
- ☐ Consider 6-foot physical-distance markings on floors.

POINTS OF CONTACT/TOUCH

- ☐ Limit elevator capacity where possible.
- ☐ Provide open access to stairwells where security requirements allow.
- ☐ Prop open interior doors that do not pose a security or safety risk in order to provide hands-free traffic.
- ☐ Remove some tables and seating in breakrooms/conference areas for added physical distancing, and keep disinfectant wipes nearby to clean tables, handles and other equipment after each use.
- ☐ Consider staggering employee breaks so fewer people are in breakroom areas at the same time.
- ☐ Consider installing automated faucets, soap dispensers and towel dispensers in bathrooms.
- ☐ Consider installing ultraviolet disinfection lighting to create sterile environments.

JANITORIAL/MAINTENANCE

- ☐ Focus on cleaning and disinfecting high-touch surfaces using EPA-recommended products which eliminate SARS-CoV-2, the virus that causes COVID-19.
- ☐ Install stations with alcohol-based (70%) hand sanitizer in common areas with high-touch surfaces such as elevator buttons and door handles.
- ☐ Supply additional soap and paper towels in breakrooms.
- ☐ Frequently clean and disinfect breakroom refrigerator, microwave, coffee station, etc.
- ☐ Close blinds during cooling season to prevent solar heat gain. Open blinds during heating season to do the opposite.
- ☐ Perform building inspections/non-urgent repairs when rooms and offices are least crowded. Instruct nearby staff to wear masks when appropriate.

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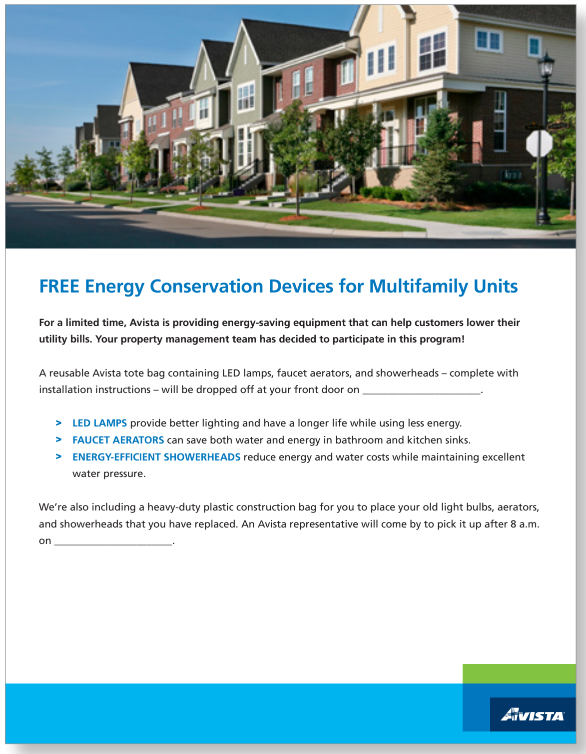
FIGURE 13 – COMMERCIAL/INDUSTRIAL SUPPORT FOR SMALL BUSINESSES DURING THE COVID-19 CRISIS FLYER

FIGURE 14 – COMMERCIAL/INDUSTRIAL ACCOUNT EXECUTIVES EMAIL TEMPLATE

FIGURE 15 – COMMERCIAL/INDUSTRIAL FREE ENERGY CONSERVATION PRODUCTS FOR MULTIFAMILY UNITS FLYER



FREE Energy Conservation Devices for Multifamily Units

For a limited time, Avista is providing energy-saving equipment that can help customers lower their utility bills. Your property management team has decided to participate in this program!

A reusable Avista tote bag containing LED lamps, faucet aerators, and showerheads – complete with installation instructions – will be dropped off at your front door on ____________________.

- **LED LAMPS** provide better lighting and have a longer life while using less energy.
- **FAUCET AERATORS** can save both water and energy in bathroom and kitchen sinks.
- **ENERGY-EFFICIENT SHOWERHEADS** reduce energy and water costs while maintaining excellent water pressure.

We're also including a heavy-duty plastic construction bag for you to place your old light bulbs, aerators, and showerheads that you have replaced. An Avista representative will come by to pick it up after 8 a.m. on ____________________.

Business Partner Program

The Business Partner Program (BPP) began in fall 2019 as an outreach effort designed to target small business customers in Avista's rural service territories. Initiated with an introductory letter followed by a site visit, it was updated in March 2020 to a mail campaign only due to the COVID-19 pandemic. The BPP brings awareness of Avista's services to rural small business customers in Washington and Idaho, and includes information on energy audits, budget billing plans, energy-efficiency rebates, and, most recently, COVID-19 related information.

To further support communities through the COVID-19 pandemic, Avista was able to leverage funding from the Community Energy Efficiency Program (CEEP) to match incentive funding for energy efficiency improvements for businesses in rural communities. Avista made a concerted effort in 2020 to reach all 63 Washington communities to spread the word about this program. In 2020, over a dozen properties received CEEP match funding for energy efficiency projects. Keeping these businesses operating with lower energy costs allowed these businesses to continue to support their communities through the pandemic.

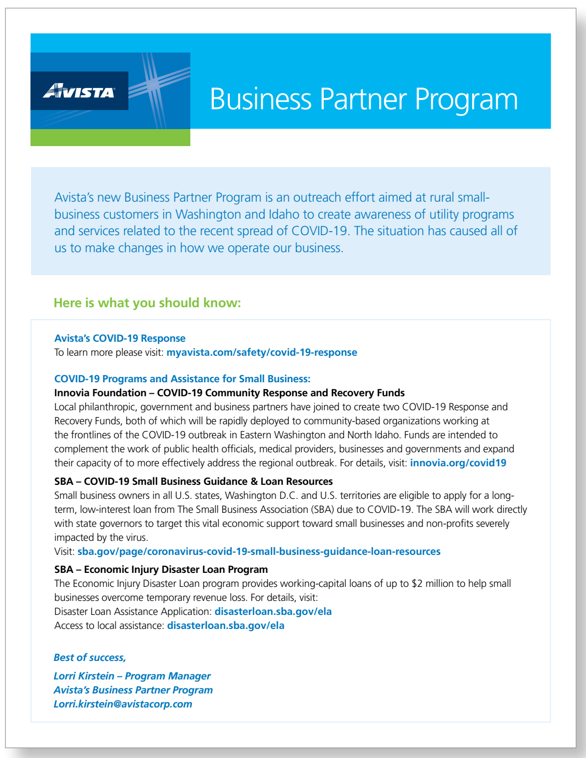
By the end of 2020, the BPP had reached 2,555 small businesses in 22 Washington rural service territories. Outreach communication included mail, email, phone calls, and some initial site visits. Sixteen audits were performed, and 120 incandescent lamps were replaced with LEDs for a savings of 15,672 kWh.

In April of 2020, Avista introduced a Trade Ally Bid program, in which the company arranges for various vendors (e.g. lighting, HVAC, window, and insulation) to provide cost estimates to customers for energy-efficiency upgrades to their facilities. This service also helps to educate and empower business owners and their employees to use less energy. Avista has collaborated with trade ally partners to help customers identify energy conservation projects by performing audits, walking through the efficiency incentive process, and helping customers obtain bids for projects. The Trade Ally Bid program has enabled Avista to reach small business customers who may not have the time, budget, or access to contractors to make efficiency improvements. By the end of 2020, the program provided cost estimates to 11 small business customers in Washington.

In spring of 2020, in response to the pandemic, Avista also pivoted its Business Concierge program to focus on COVID-19 resources. Avista customer service representatives contacted over 2,600 business customers by phone to share information on resources available during the shutdown including efficiency assistance, flexible repayment options, and information on Avista's shutoff suspension policy. This program helped connect business customers to critical resources, and also helped inform Avista's ongoing response to the COVID-19 pandemic.

The outreach forecast for 2021 includes communication with 41 Washington communities reaching 2,528 small business customers.

FIGURE 16 – COMMERCIAL/INDUSTRIAL BUSINESS PARTNER PROGRAM NEWSLETTER



Business Partner Program

Avista's new Business Partner Program is an outreach effort aimed at rural small-business customers in Washington and Idaho to create awareness of utility programs and services related to the recent spread of COVID-19. The situation has caused all of us to make changes in how we operate our business.

Here is what you should know:

Avista's COVID-19 Response
To learn more please visit: **myavista.com/safety/covid-19-response**

COVID-19 Programs and Assistance for Small Business:
Innovia Foundation – COVID-19 Community Response and Recovery Funds
Local philanthropic, government and business partners have joined to create two COVID-19 Response and Recovery Funds, both of which will be rapidly deployed to community-based organizations working at the frontlines of the COVID-19 outbreak in Eastern Washington and North Idaho. Funds are intended to complement the work of public health officials, medical providers, businesses and governments and expand their capacity of to more effectively address the regional outbreak. For details, visit: **innovia.org/covid19**

SBA – COVID-19 Small Business Guidance & Loan Resources
Small business owners in all U.S. states, Washington D.C. and U.S. territories are eligible to apply for a long-term, low-interest loan from The Small Business Association (SBA) due to COVID-19. The SBA will work directly with state governors to target this vital economic support toward small businesses and non-profits severely impacted by the virus.
Visit: **sba.gov/page/coronavirus-covid-19-small-business-guidance-loan-resources**

SBA – Economic Injury Disaster Loan Program
The Economic Injury Disaster Loan program provides working-capital loans of up to $2 million to help small businesses overcome temporary revenue loss. For details, visit:
Disaster Loan Assistance Application: **disasterloan.sba.gov/ela**
Access to local assistance: **disasterloan.sba.gov/ela**

Best of success,

Lorri Kirstein – Program Manager
Avista's Business Partner Program
Lorri.kirstein@avistacorp.com

Performance and Savings Goals

Overall, the sector achieved 20,584 MWh, or 75 percent of the savings goal. While the commercial/industrial sector did not meet the combined prescriptive and site-specific program paths' electric savings goal of 36,071 MWh, it maintained a high level of cost-effectiveness for both the TRC and UCT. These ratios indicate that more flexibility can be taken in future program designs.

For natural gas programs, the commercial/industrial sector also fell short of the annual therm savings goal for combined prescriptive and site-specific programs, achieving 172,357 therms (64 percent of the natural gas savings goal of 268,727).

Cost-Effectiveness

Tables 11 and 12 show the commercial/industrial sector cost-effectiveness results by fuel type.

TABLE 11 – COMMERCIAL/INDUSTRIAL COST-EFFECTIVENESS RESULTS – ELECTRIC

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 12,904,537	$ 8,253,943	1.56
UCT	$ 11,731,398	$ 5,040,889	2.33
PCT	$ 24,149,314	$ 6,654,693	3.63
RIM	$ 11,731,398	$ 12,680,254	0.93

TABLE 12 – COMMERCIAL/INDUSTRIAL COST-EFFECTIVENESS RESULTS – NATURAL GAS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 1,124,949	$ 1,640,539	0.69
UCT	$ 1,022,680	$ 734,806	1.39
PCT	$ 1,235,315	$ 1,313,292	0.94
RIM	$ 1,022,680	$ 777,741	1.31

Program-by-Program Summaries

Commercial/Industrial Site-Specific Program

TABLE 13 – COMMERCIAL/INDUSTRIAL SITE-SPECIFIC PROGRAM METRICS

Site-Specific – Electric		2020
Participation, Savings, and Costs		
Conservation projects		316
Overall kWh savings		7,102,132
Incentive spend	$	1,230,300
Non-incentive utility costs	$	553,461
Washington energy-efficiency rider spend	$	1,783,761
Site-Specific – Natural gas		**2020**
Participation, Savings, and Costs		
Conservation projects		11
Overall therm savings		117,228
Incentive spend	$	274,356
Non-incentive utility costs	$	214,178
Washington energy-efficiency rider spend	$	488,534

Description

The commercial/industrial energy-efficiency market is delivered through a combination of prescriptive and site-specific offerings. Any measure not offered through a prescriptive program is automatically eligible for treatment through the site-specific program, subject to the criteria for participation in that program. Avista's account executives work with commercial/industrial customers to provide assistance in identifying energy-efficiency opportunities. Customers receive technical assistance in determining potential energy and cost savings as well as identifying and estimating incentives for participation. Site-specific projects include appliances, compressed air, HVAC, industrial processes, motors (non-prescriptive), shell, and lighting, with the majority being HVAC, lighting, and shell.

Program Activities

- ***Electric:*** Savings of 7,102,132 kWh, or 29 percent of the overall electric savings – a decrease of approximately 27 percent from 2019 (9,720,506 kWh). Of the overall savings, over 63 percent was derived from exterior and interior lighting projects.
- ***Natural Gas:*** Savings of 117,228 therms, or 20 percent of the overall natural gas savings. This level of savings is 429 percent higher than the 22,168 therms acquired in 2019. The largest contributor to this increase comes from HVAC programs for new and existing buildings, with HVAC heating accounting for 87,545 of the total.

Measure type and savings are listed in Figures 17 and 18.

FIGURE 17 – COMMERCIAL/INDUSTRIAL SITE-SPECIFIC INCENTIVE DOLLARS BY MEASURE – ELECTRIC

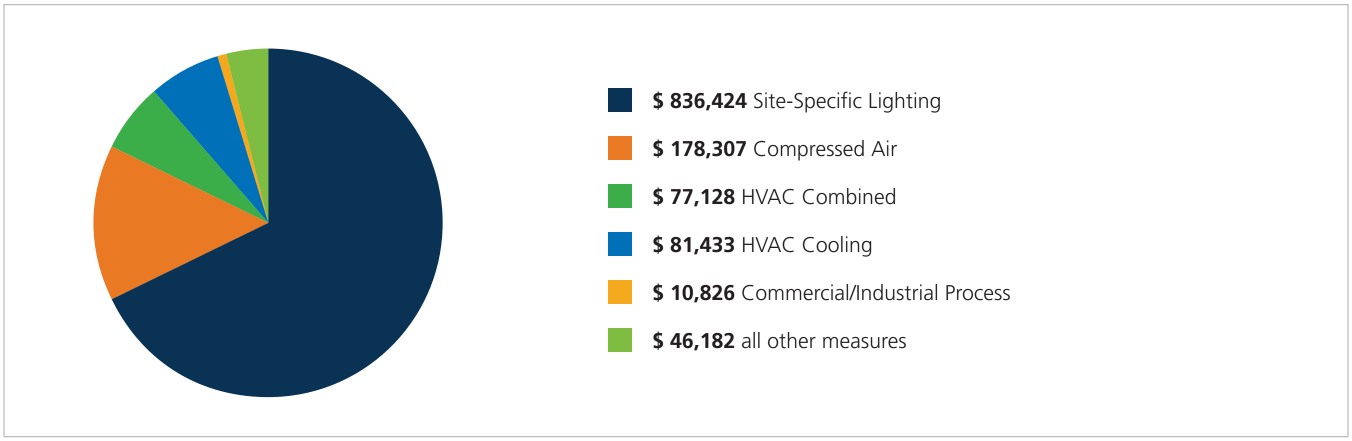
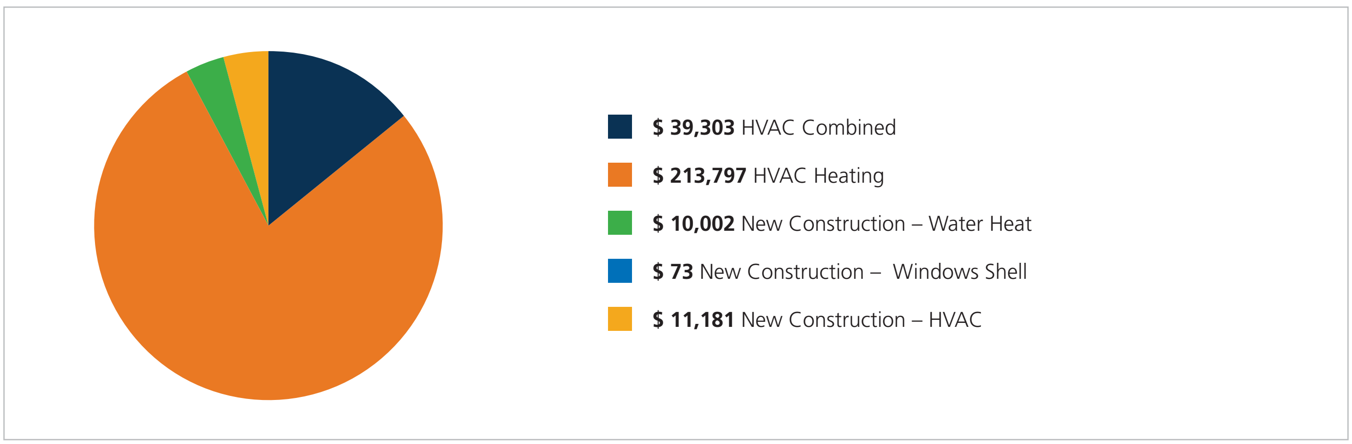


FIGURE 18 – COMMERCIAL/INDUSTRIAL SITE-SPECIFIC INCENTIVE DOLLARS BY MEASURE – NATURAL GAS



Program Changes

In 2020, Avista made no changes to the Site-Specific program. The company continues to offer an incentive for any qualifying electric or natural gas energy-saving improvements with a 15-year simple payback or less.

Plans for 2021

Avista plans to continue to offer the Site-Specific program in Washington for both electric and natural gas customers in 2021, and will assess the current measurement and verification process to determine whether process improvements need to be made.

Avista continues to offer the BPP, which is designed to reach a larger percentage of small- and medium-sized business customers, reminding them about the availability of basic scoping energy audits, budget billing plans, and energy-efficiency rebate programs. The Trade Ally Bid program – a collaboration between Avista and its trade ally partners to offer bid assistance for energy-efficiency upgrades – is offered in conjunction with the BPP. Avista also plans to continue to offer CEEP funding for rural businesses, if funding is made available for 2021.

Commercial/Industrial Prescriptive Lighting Programs

TABLE 14 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE LIGHTING PROGRAMS METRICS

Prescriptive Lighting Program Summary	2020	
Participation, Savings, and Costs		
Conservation measures		1,479
Overall kWh savings		13,213,931
Incentive spend	$	2,174,804
Non-incentive utility costs	$	1,018,457
Washington energy-efficiency rider spend	$	3,193,261

Description

This program is intended to prompt commercial electric customers to increase the energy efficiency of their lighting equipment through direct financial incentives. It indirectly supports the infrastructure and inventory necessary to ensure that the installation of high-efficiency equipment is a viable option for the customer.

There is opportunity for lighting improvements in commercial facilities – and, to streamline the process and make it easier for customers and vendors to participate, Avista developed a prescriptive approach in 2004. This program provides for many common retrofits to receive a predetermined incentive amount, which is calculated using a baseline average for existing wattages and the average replacement wattages from the previous year's project data. Claimed energy savings is calculated based on actual customer run times and qualified product lighting data.

This streamlined approach makes program participation easier, especially for smaller customers and vendors. The measures included in the prescriptive lighting program include fluorescent lamps and fixtures, HID, MR16, and incandescent can fixture retrofits to more energy-efficient LED light sources and controls.

Program Activities

2020 savings for prescriptive lighting was 13,213,931 kWh, or 55 percent of portfolio savings. The level of savings was a 22 percent decrease compared to 2019 savings of 16,950,058 kWh.

As seen in Figure 19, lighting throughput was minimally affected by COVID-19 shutdowns in the spring months of 2020, which is observed by comparing the savings in April and May of 2019 and 2020. There was also a noticeable shift toward exterior lighting projects in the months of March and April, as well as the fourth quarter of 2020. In the summer of 2020, the company also saw an overall lower throughput of projects, but had higher savings and incentive payouts per job.

FIGURE 19 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE LIGHTING PROGRAM SAVINGS BY MONTH

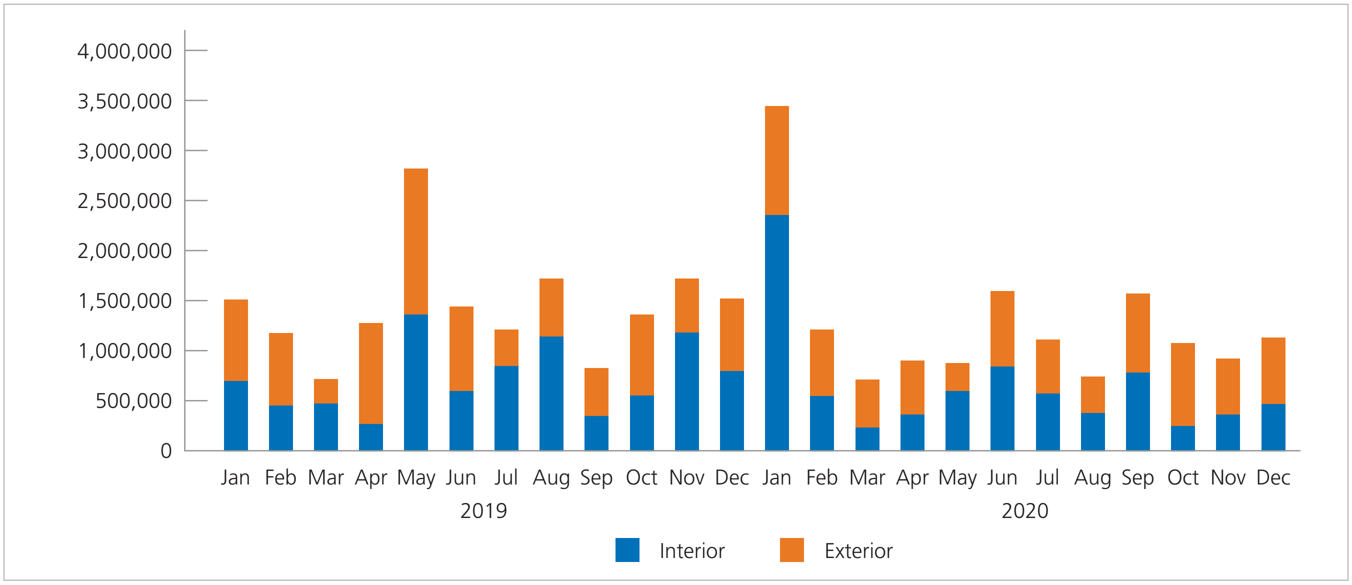


FIGURE 20 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE INTERIOR LIGHTING KWH SAVINGS BY MEASURE

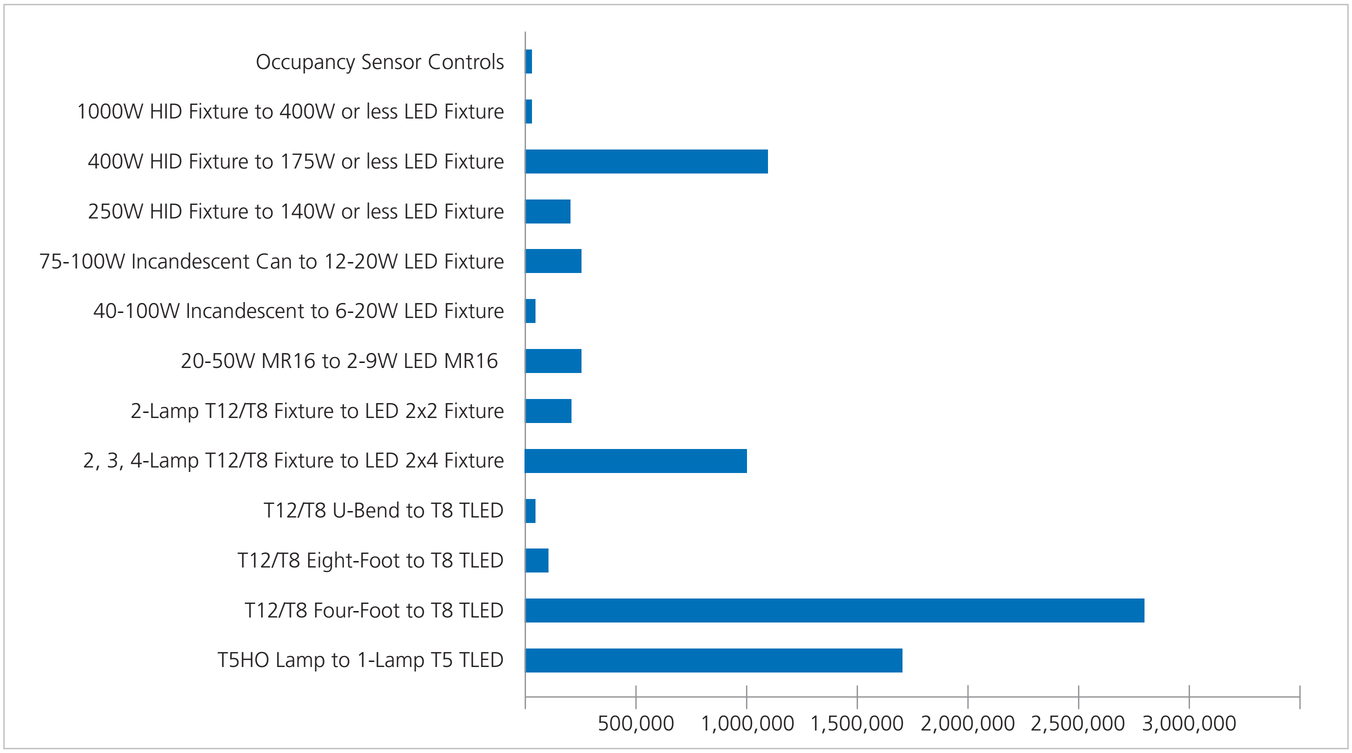
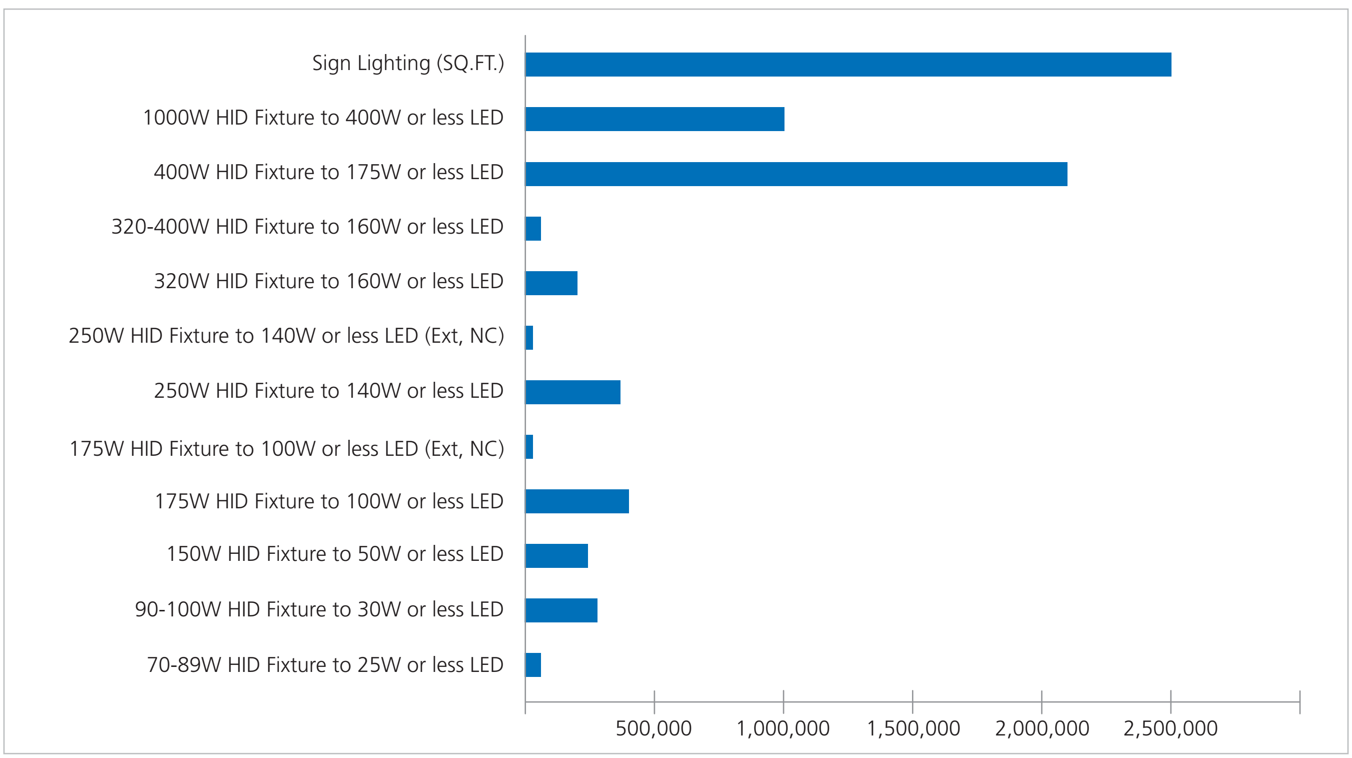


FIGURE 21 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE EXTERIOR LIGHTING KWH SAVINGS BY MEASURE



Program Changes

Table 15 shows the changes Avista made to the program in 2020.

TABLE 15 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE LIGHTING PROGRAM CHANGES

2020 Changes to Commercial Exterior Lighting Rebates	2019	2020	Notes
Exterior Lighting			
Replacement HID Lighting (Pole, Wallpack, or Canopy) – Requires at Least 4,288 Hours of Use per Year – Must Be DLC-Rated *Eligible only if ballast and all other existing electrical components are removed.			
70-89W HID fixture to ≤ 25W LED fixture, retrofit kit, or lamp	$ 60	$ 65	Incentive Increase
90-100W HID fixture to ≤ 30W LED fixture, retrofit kit, or lamp	$ 80	$ 85	Incentive Increase
150W HID fixture to ≤ 50W LED fixture, retrofit kit, or lamp	$ 125	$ 130	Incentive Increase
175W HID fixture to ≤ 100W LED fixture, retrofit kit, or lamp	$ 130	$ 130	
250W HID fixture to ≤ 140W LED fixture, retrofit kit, or lamp	$ 140	$ 160	Incentive Increase
320W HID fixture to ≤ 160W LED fixture, retrofit kit, or lamp	$ 180	$ 195	Incentive Increase
400W HID fixture to ≤ 175W LED fixture, retrofit kit, or lamp	$ 255	$ 280	Incentive Increase
750W HID fixture to ≤ 300W LED fixture, retrofit kit, or lamp	$ 450	$ 490	Incentive Increase
1000W HID fixture to ≤ 400W LED fixture, retrofit kit, or lamp	$ 610	$ 610	
New Construction Fixtures HID Lighting – Requires at Least 4,288 Hours of Use per Year – Must Be DLC-Rated			
175W code HID fixture to ≤ 100W LED fixture	$ 130	$ 130	
250W code HID fixture to ≤ 140W LED fixture	$ 140	$ 160	Incentive Increase
320W code HID fixture to ≤ 160W LED fixture	$ 250	$ 195	Incentive Decrease
Sign Lighting Retrofit – Requires at Least 4,288 Hours of Use per Year			
T12 to LED sign lighting	$ 17/SQFT	$ 22/SQFT	Incentive Increase

2020 Changes to Commercial Exterior Lighting Rebates	2019	2020	Notes
Interior Lighting			
Fluorescent Tubular Lamps – Must Be DLC-Rated			
T5HO four-foot TLED	$ 15.00	$ 12.50	Incentive Decrease
T8 four-foot TLED	$ 6.50	$ 6.50	
U-bend LED	$ 8.00	$ 10.00	Incentive Increase
T8 eight-foot TLED	$ 13.00	$ 11.50	Incentive Decrease
Fluorescent Fixtures – Must Be DLC-Rated			
2, 3, or 4-Lamp T12/T8 fixture to LED-qualified 2x4 fixture	$ 40.00	$ 28.00	Incentive Decrease
2-Lamp T12/T8 fixture to LED-qualified 2x2 fixture	$ 30.00	$ 20.00	Incentive Decrease
HID Lighting – Must Be DLC-Rated *Eligible only if ballast and all other existing electrical components are removed.			
250W HID fixture to ≤ 140W LED fixture or lamp	$ 155.00	$ 125.00	Incentive Decrease Removed Hourly Requirement
400W HID fixture to ≤ 175W LED fixture or lamp	$ 205.00	$ 185.00	Incentive Decrease Removed Hourly Requirement
1000W HID fixture to ≤ 400W LED fixture or lamp	$ 460.00	$ 270.00	Incentive Decrease Removed Hourly Requirement
Incandescent Replacement Lamps			
6-20W LED lamp	$ 8.00	$ 0.00	Measure Discounted
50-60W LED fixture	$ 55.00	$ 0.00	Measure Discounted
MR16 (GU10 Base) – Must Be ENERGY STAR-Rated			
2-9W MR16 lamp	$ 10.00	$ 5.50	Incentive Decrease
Can Light Kit – Must Be ENERGY STAR-Rated			
12-20W LED fixture retrofit	$ 20.00	$ 20.00	
Controls			
Occupancy sensor controls with built-in relays	$ 40.00	$ 25.00	Incentive Decrease (must control at least 170W)
DLC-qualified LLLC fixture	Site-Specific	$ 35.00	New Measure (must control at least 300W, must be DLC qualified)

Program Marketing

Key to the success of the prescriptive lighting program is clear communication to lighting supply houses, distributors, electricians, and customers on incentive requirements and forms. The Avista website communicates program requirements and highlights opportunities for customers. In addition, the company's regionally based account executives are an integral component of delivering the prescriptive lighting program to commercial and industrial customers. Any changes to the program typically include advance notice of 90 days to submit under the old requirements and/or incentive levels. This usually includes – at a minimum – direct email communication to trade allies as well as website updates.

Plans for 2021

In the company's third year with more sophisticated measure level detail in iEnergy, Avista has been able to update interior and exterior lighting measures annually to reflect market conditions. Significant changes to the program aren't anticipated in 2021, but the company will be more flexible in making mid-year changes as needed. Avista has also been able to use the more refined data from the Site-Specific program to add three new measures into the prescriptive offerings. The company plans a more thorough examination of networked lighting controls and to increase its prescriptive incentive amount for Luminaire Level Lighting Controls (LLLC) to encourage more participation and gather more data.

Commercial/Industrial Non-Lighting Prescriptive Programs

TABLE 16 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE NON-LIGHTING PROGRAM METRICS

Prescriptive Non-Lighting Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		33
Overall kWh savings		268,292
Incentive spend	$	36,535
Non-incentive utility costs	$	27,333
Washington energy-efficiency rider spend	$	63,868
Prescriptive Non-Lighting Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		97
Overall therm savings		55,129
Incentive spend	$	133,203
Non-incentive utility costs	$	113,069
Washington energy-efficiency rider spend	$	246,272

Description

Commercial Food Service Equipment Program – The Commercial Food Service Equipment program helps encourage customers to purchase energy-efficient equipment, and is available for replacing existing or purchasing new equipment. If Avista provides the fuel type of the equipment installed, customers are eligible when equipment meets the efficiency requirement. For equipment that requires hot water heat, Avista must provide that heat source for eligibility. This program offers a variety of electric and natural gas food service equipment. Customers who meet the requirements must submit rebate paperwork within 90 days of project completion. Incentives are disbursed after receipt of documentation and verification of equipment eligibility.

Commercial Insulation Program – The Commercial Insulation program is a retrofit program to encourage customers to increase the insulation in an existing building. It addresses three building areas: wall, attic, and roof, and is available to Avista commercial customers who have an annual heating footprint of at least 340 therms or 8,000 kWh. Insulation must be installed by a licensed contractor and meet the eligibility guidelines for existing and new R-values. Customers who meet the requirements must submit rebate paperwork with accompanying insulation certificate and invoice within 90 days of project completion. Incentives are disbursed after receipt of documentation.

AirGuardian – The AirGuardian program was developed to offer a prescriptive path for Avista electric customers with a 15 HP or greater rotary screw compressor. It offers a free walk-through audit to identify energy-saving opportunities and the direct installation of a compressed air leak reduction device. Energy savings are generated by reducing the impact of compressed air leaks during off-hour periods. The program is currently delivered by 4Sight Energy Group, LLC. Savings are determined on an individual basis with pre- and post-logging. After logging is complete, a site report is presented with detailed project data and an invoice for kWh savings payment to 4Sight Energy Group, LLC.

Commercial Natural Gas HVAC Program – The Commercial Natural Gas HVAC program encourages Avista commercial natural gas customers to save energy by choosing to install energy-efficient natural gas furnaces and boilers. It offers six different equipment types that customers may select from to best fit their business needs and save energy dollars. Incentives are paid by the input kBtu and the efficiency of the equipment selected. Customers must submit rebate forms with proof-of-purchase invoices and AHRI certificates within 90 days of project completion. Incentives are disbursed after receipt of documentation.

Green Motors Rewind – The Green Motors Rewind program offers Avista commercial electric customers an instant rebate off their service center invoice for a green rewind of an existing motor. Qualifying motors must fall between 15 and 5,000 horsepower and be used in an industrial capacity. The program pays $1 per HP to the service center and another $1 per HP off the invoice for the customer. Green Motors Practices Group is the third party that manages this program and is paid an administrative fee of $.05 per kWh savings per customer rewind. Program participation is presented monthly by Green Motors Practices Group in the form of an invoice accompanied by detailed service center information per project.

Fleet Heat – The Fleet Heat program is provided to Avista commercial electric customers who use uncontrolled block heaters to keep fleet engines warm when their vehicles are not running during colder months, typically from the end of October to the end of March. This program offers a product that provides an engine-mounted remote thermostat with an ambient temperature thermostat in a Twinstat cord to maximize energy efficiency. Upon receiving the rebate form, Avista will order the cords for customers from Hotstart according to the information provided on the form. Avista delivers the cords to the customer. The customer is responsible for the installation of the cords and the initial payment to Hotstart. After installation verification, Avista refunds the customer’s Twinstat cord costs.

Commercial Grocer – The Commercial Grocer program is offered to Avista commercial electric customers with a range of retrofit energy-savings measures associated with commercial refrigeration. The incentives within this program offer specific measures that can be installed and applied for after project completion. Customers may install any of the eligible measures from display case lighting, motors, controls, strip curtains, or gaskets, and apply for an incentive by submitting a rebate form with associated invoicing and providing proof of purchase and installation.

Commercial VFD Retrofit – The Commercial HVAC Variable Frequency Drive (VFD) program is offered to encourage customers to increase the energy efficiency of their HVAC fan or pump applications with a variable frequency drive. Installing a VFD on an existing unit of equipment allows that equipment to be more energy-efficient. This program is available for Avista commercial electric customers. The incentive is calculated at $130 per HP of the motor the VFD is installed on. Post-installation verification is required before payment may be issued for all VFD projects. Customers may apply for this incentive after they install a VFD on an existing piece of eligible equipment and submit required documentation. Incentive disbursement will be processed after an installation inspection has occurred.

Program Activities

- **_Electric:_** Savings of 268,292 kWh, a decrease of 30 percent over 2019. The majority of electric savings came from motor control HVAC programs.
- **_Natural Gas:_** Savings of 55,129 therms in 2020. This is a 13 percent decrease in savings relative to the 63,399 therms achieved in 2019. The majority of savings were derived from the Food Services program, which achieved 30,123 therms during the 2020 program year.

FIGURE 22 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE INCENTIVE DOLLARS BY MEASURE – ELECTRIC

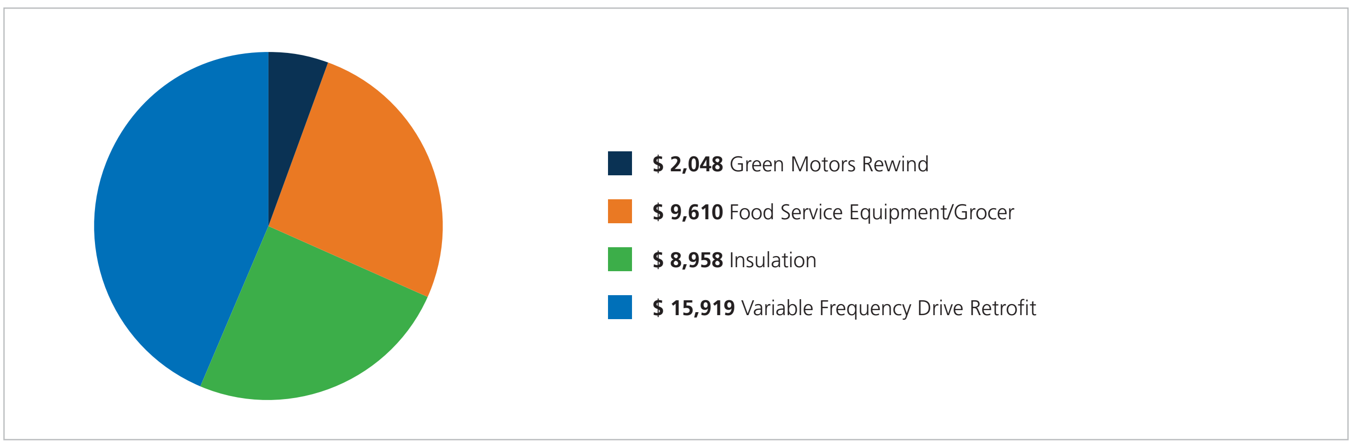
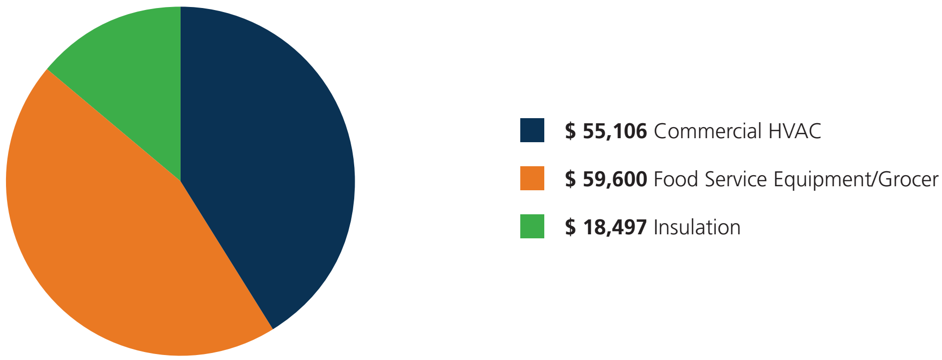


FIGURE 23 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE INCENTIVE DOLLARS BY MEASURE – NATURAL GAS



Program Changes

The only program that had any changes was the Commercial Insulation program.

Commercial Insulation – Several measures were modified from 2019 to 2020. The wall R11 to R18 measure was decreased to $0.35 from $0.40 per square foot. The attic up to R44 measure was increased from $0.20 to $0.50 and R45 or greater from $0.25 to $0.60. Roof insulation was increased from $0.25 to $0.40 per square foot.

TABLE 17 – COMMERCIAL/INDUSTRIAL PRESCRIPTIVE NON-LIGHTING PROGRAM REBATE CHANGES, INSULATION

Commercial Insulation Program	2019	2020	Notes
Insulation Retrofit			
Less than R11 attic insulation to R30-R44 attic insulation	$ 0.20	$ 0.50	Incentive Increase
Less than R11 attic insulation to R45+ attic insulation	$ 0.25	$ 0.60	Incentive Increase
Less than R11 roof insulation to R30+ roof insulation	$ 0.25	$ 0.40	Incentive Increase
Less than R4 wall insulation to R11-R18 wall insulation	$ 0.40	$ 0.35	Incentive Decrease

Program Marketing

Avista account executives market this program, which is also featured on the Avista efficiency website and used by trade allies as a marketing tool.

Plans for 2021

Avista is considering increasing incentive levels to encourage more participation in the Commercial Insulation and VFD programs. The company is considering adding a measure for 92 percent AFUE natural gas unit heaters to the Commercial HVAC program, and will be revamping the current AirGuardian program to the Commercial Compressed Air Line Isolation program.

Oakesdale, Washington

RESIDENTIAL SECTOR

Overview

Avista's residential sector portfolio is composed of several approaches that encourage customers to consider energy-efficiency improvements within their homes. Prescriptive rebate programs are the main component of the portfolio and are augmented by a variety of additional interventions, including upstream buy-down of low-cost lighting and water-saving measures, select distribution of low-cost lighting and weatherization materials, direct-installation programs, and a multifaceted, multichannel outreach and customer engagement effort.

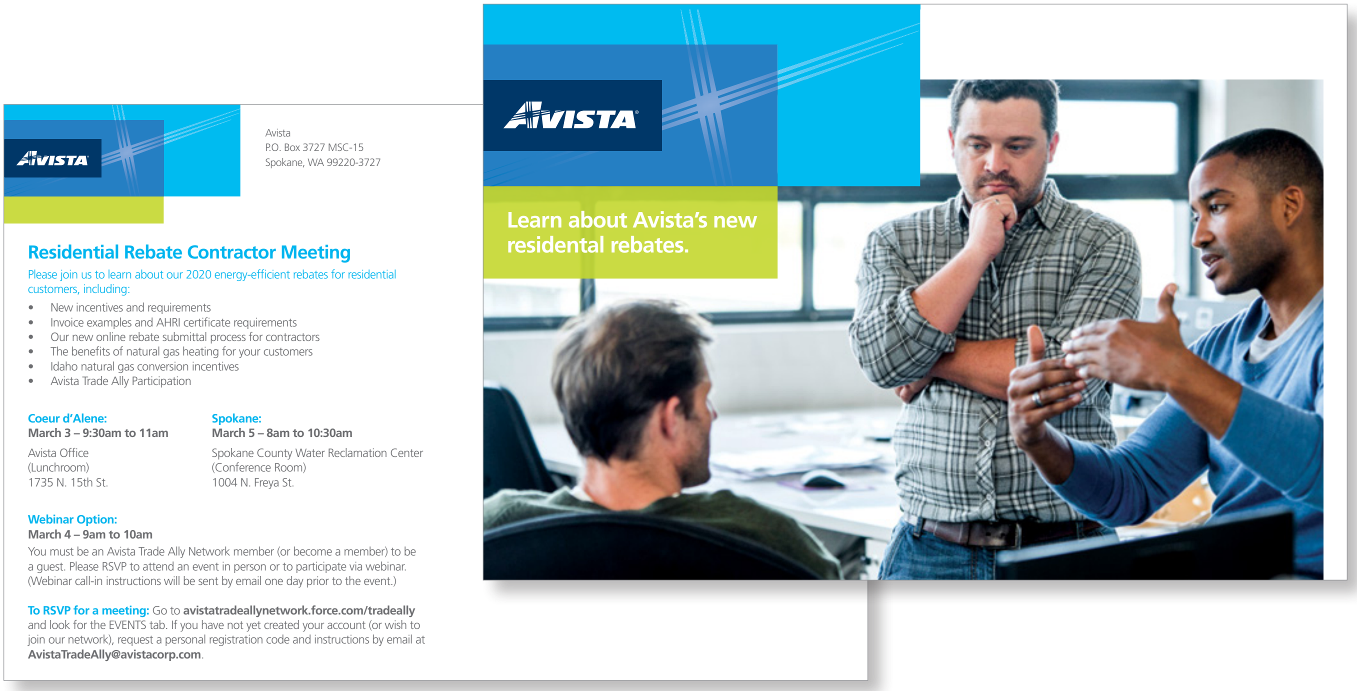
Nearly $3 million in rebates and direct customer benefits were provided to Washington residential customers to offset the cost of implementing these energy-efficiency measures in 2020. All programs within the residential sector portfolio combined contributed 3,260,565 MWh and 408,525 therms to the annual energy savings.

TABLE 18 – RESIDENTIAL SAVINGS BY PROGRAM

Program By Sector	Energy Efficiency Savings	
Residential	**Electric Savings (kWh)**	**Natural Gas Savings (therms)**
ENERGY STAR Homes	84,256	670
Multifamily Direct Install	1,740,162	376
Residential HVAC	527,574	330,929
Residential Water Heat	148,557	28,629
Residential Shell	610,472	47,875
Simple Steps, Smart Savings	149,544	46.96
Total Residential	**3,260,565**	**408,525**

To help educate contractors on Avista's new residential rebates, a webinar was conducted – as well as a meeting in Spokane – to present information and provide a forum for questions.

FIGURE 24 – RESIDENTIAL REBATES CONTRACTOR MEETING

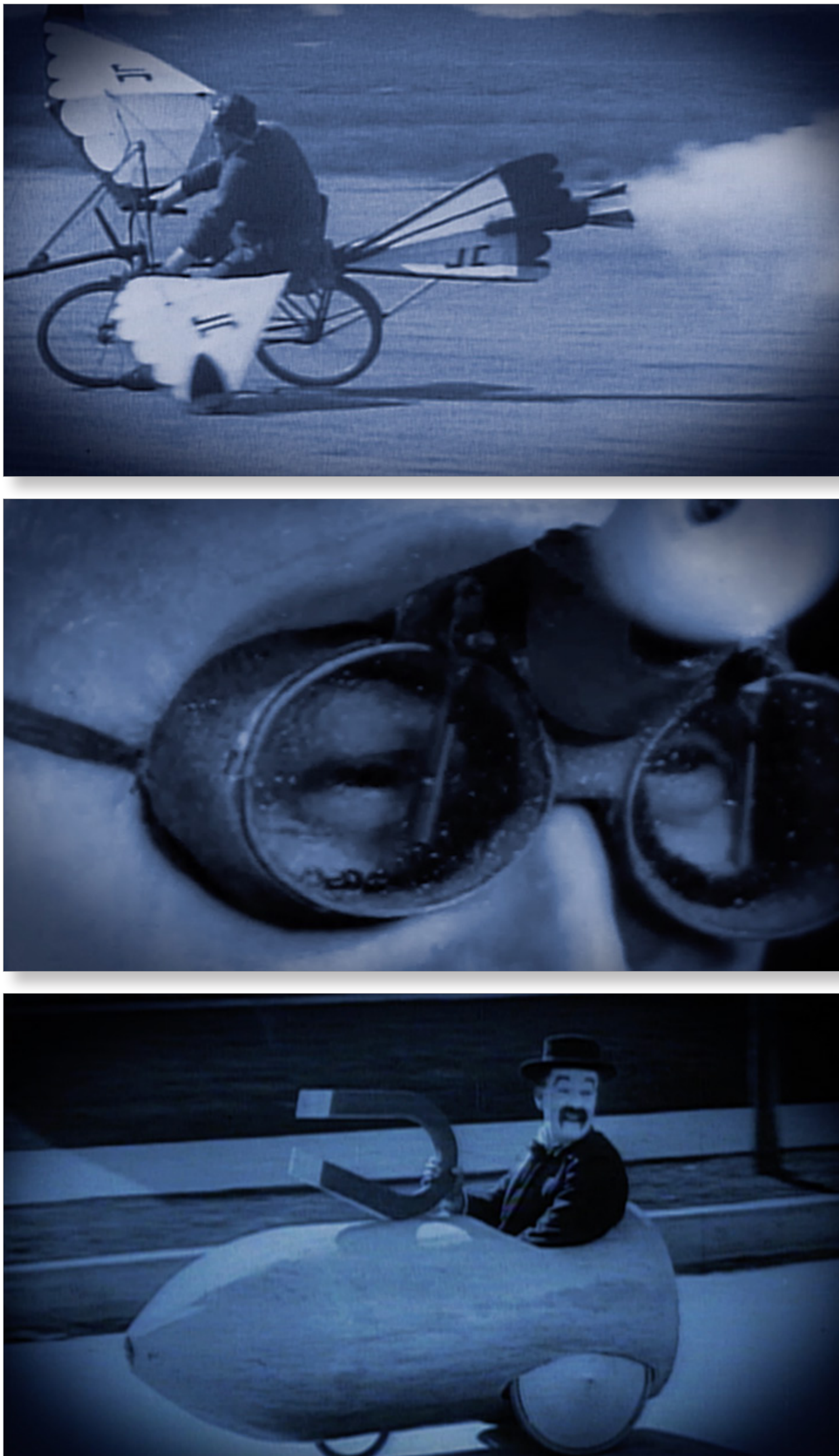


Marketing

The spring "Way to Save" advertising campaign included TV, digital, search engine marketing, and social media. It began March 7 and was scheduled to continue through May 3. The campaign was pulled on March 16, however, because the majority of Avista's rebates require professional installation, and many HVAC contractors and vendors were not working due to the stay-at-home order.

Even though the campaign was cut short, it was effective in driving website traffic while it ran. Average page views on Avista's Washington rebates page had been 189 per day; from March 7-16, when the ads were running, that number jumped to 982 per day – an increase of 420 percent.

FIGURE 25 – RESIDENTIAL “WAY TO SAVE” TELEVISION COMMERCIALS



To help customers during the coronavirus pandemic, additional communications were developed that included energy-efficiency tips while at home and website updates.

FIGURE 26 – RESIDENTIAL ENERGY SAVINGS TIPS WHILE AT HOME FLYER

AVISTA

Energy-saving tips while at home

To help prevent the spread of COVID-19, government officials have issued a stay-at-home order throughout our region. People working from home—as well as students of all ages in the house—can mean an increase in energy use. You can help take charge of your energy use with these simple home energy-efficiency tips.

Living Spaces

Concerned about the virus in your home? During this time of uncertainty, you can help keep your air cleaner by cracking windows or opening the fresh-air damper on your furnace intake to let in more outside air. Also, continuously run your furnace fan at a low speed and change furnace filters often.

Set your thermostat no higher than 68 degrees. Also lower it an extra five degrees at night unless you have a heat pump.

Keep heat registers free of obstructions. Drapes, furniture and plants can all block air flow.

Close doors to unoccupied rooms if you have zoned heat like baseboards. You'll save space-heating costs. Do not shut off registers or block returns with a forced air system. It will increase fan energy usage and may cause damage to your equipment.

Turn off unnecessary lights. Use sunlight during the daytime if possible. Make sure your exterior lights are off during the day.

Let the sun warm your home. Open your drapes/blinds on south-facing windows to let in sunlight. Close them in rooms that receive no sun to insulate against cold drafts. At night, close coverings to retain heat.

Clean or replace your furnace filters. If you do not have filters on hand, it's still possible to order them for pick-up from local stores. Or, enroll in Avista's Furnace Filter Program to receive reminders, get valuable coupons and have new filters delivered right to your door. Go to **myavista.com/changemyfilter**

Make sure your fireplace is used properly. If you are using another heat source for your home, close off the damper on your fireplace to avoid energy loss up the flue.

Electronics

Turn off TVs and other electronics after use. They may continue to consume power even when appearing off. Also, plug your home electronics into a single power strip so you can switch it off and cut power to all of them at once.

Activate power-saving settings on your game console. Adjusting these settings on your console, and using power strips, can address the phantom loads associated with standby modes. Also, some game consoles use more energy than other dedicated devices to stream HD movies. Check the manufacturer's website for more information.

Energy-saving tips while at home

Kitchen

Set your fridge temperature between 37 and 40 degrees. Keep the freezer section at 5 degrees. Also vacuum exposed coils located on the back or underneath the appliance. Regular cleaning can improve efficiency up to 15% or more.

Set your stand-alone freezer to 0 degrees. A full freezer also retains cold better than an empty one.

Don't put warm foods directly into the refrigerator. Allow hot foods to cool, then refrigerate. Cooked meats, however, should be refrigerated immediately.

Always use a sink stopper or dishpan. Washing or rinsing dishes under running hot water wastes energy.

Run a full dishwasher. If your dishwasher has an automatic energy-savings/cool-dry cycle, use that setting. Otherwise, turn it off after the final rinse and let dishes air dry.

Water Heating

Set your water heater temperature to 120 degrees. That's plenty hot and won't scald. Do not set the water temperature below 115 degrees to prevent Legionnaires' disease.

Take short showers. You'll use less hot water than a bath.

Fix leaky faucets. A small drip can waste a bathtub full of hot water each month.

Laundry

Wash only full loads of clothes. Wash full loads using the proper water levels. Some experts also advise washing clothes in hot water to reduce the chance of virus strands clinging to your clothes (this may increase your energy consumption).

Clean your dryer's lint filter after every load. Clogged filters increase drying time.

Don't overload your dryer. Clothes will take longer to dry.

Humidity Level

Add humidity to your home if it has under 30% relative humidity. Keeping your home's humidity between 40% and 50% will make you feel warmer and reduce the chance of viral spread. If you don't own a device that displays the humidity level inside your home, here are ways to increase humidity indoors as well as how to assess your relative humidity.

How to increase humidity. You can increase humidity indoors using a humidifier. If you don't own one or prefer to save energy, however, you can place water-filled vases on sunny windowsills. The sunshine will slowly evaporate the water, releasing moisture into the air. Hang your clothes to dry inside your home to take advantage of incidental moisture release. A steamy kettle on the stove beats using a microwave.

THE ICE CUBE HUMIDITY TEST

1. Place two or three ice cubes into a glass, add tap water and stir.
2. Wait three to four minutes and then observe the glass.
3. Examine the outside of the glass. If moisture does not form, the air is too dry. If the outside of the glass shows a fog of water vapor, the relative humidity is correct. If water has condensed on the outside of the glass with drops rolling down, the relative humidity is high.

NOTE: Conduct this test in any room where humidity is a concern except the kitchen, as cooking vapors may produce inaccurate results.

FIGURE 27 – RESIDENTIAL ENERGY USE AND SAVINGS GUIDE FOR RESIDENTIAL CUSTOMERS

AVISTA

Energy Use and Savings Guide

For Residential Customers

pical Energy Use in Your Home

energy bill for a **typical U.S. single family** home
ges $2,200 per year. Where does all this money go?
ost of heating and cooling your home can represent 40%
% of your total energy bill. The chart to the right shows
eakdown of energy use by category and starts to give
sense of where savings can be found. Reducing energy
mption by just 15% could save you over $300 a year in
costs.

Your Energy Budget

vays a good
dget starts with
source needs.
food, clothing,
rgy to run your
your energy usage
ng that portion
his booklet,
saving tips to
esources.

as and suggestions
— and better
sumption.
ar with some
gestions,
e you.

Individual lifestyle and energy use habits, number and age of occupants, as well as the size, design, levels of insulation and heating system in your home, all combine to determine how much energy you will use for heating.

The statistics in this booklet are based on national averages. The wattage or energy usage and efficiencies of your appliances, your own use habits, as well as the size of your family will vary. Keep this in mind when you're reviewing your own energy use.

Understanding This Guide

Listed below are terms and definitions that will be used throughout this guide. All numbers and costs included are a representation based on national average use with average Avista rates.

Kilowatt Hours (kWh): We measure electrical energy in watt hours. One kilowatt hour equals 1,000 watt hours. The kilowatt hours on your bill equals the rate or speed of use (kilowatts) x the length of time electricity was used. Running a 5,000-watt (5 kilowatt) clothes dryer for 1 hour uses 5 kilowatt hours of electricity. Burning a 100-watt light bulb for 10 hours uses 1 kilowatt hour.

Therms: Your gas energy use is measured in a unit called therms. Therms identify the heating value provided by gas. One therm equals the heating capacity of approximately 100,000 wooden kitchen matches.

Approximate Watts: The wattage is the consumption rate of electricity a device exhibits while operating. This energy consumption may occur when a computer is turned on, when a kitchen mixer is in use or when light bulbs are turned on in a light fixture.

Monthly kWh Usage: The monthly kWh usage for each device is based on an assumed typical month of operation, estimating the hours the device is operating in conjunction with its power consumption as noted in the watt rating.

Estimated Monthly Cost: The estimated monthly cost is based on the energy consumption at $0.10 per kilowatt hour for electricity or $0.80 per natural gas therm which are typical for Avista residential customers.

Page 5

Heating and Cooling

Heating and Cooling Energy Saving Tips

Fireplace dampers should be kept closed when you're not using the fireplace. A chimney can draw off as much as 25% of the heated air in your house if the damper is left open. Safely block off unused fireplaces when possible.

On sunny winter days, open your **draperies** to get full benefit of sun shining through the windows. In summer, close the draperies to help keep out unwanted heat.

Turn down the heat in winter. Keep your **thermostat** at or below 68° F; setting your thermostat three degrees lower in the winter can reduce your bill by about 10%.

When selecting an **air conditioning unit**, both room or central, check its Seasonal Energy Efficiency Ratio (SEER). The SEER indicates a unit's relative energy efficiency. Most units are tagged with this information, or your dealer can help you determine the SEER. The higher the SEER, the better. A SEER of 13 or above is preferred, 18 or above is exceptional.

When selecting a **heat pump**, check its Heating Seasonal Performance Factor (HSPF). The HSPF indicates a heat pump's relative

Page 8

Heating and Cooling

Energy Saving Checklist

- ☐ **Block drafts.** Check caulking and weather stripping around windows and doors. If you see cracks, light, or feel a draft, make repairs where needed.
- ☐ **Seal leaks.** Ductwork exposed to outside air or in unconditioned spaces should be sealed using mastic paste and wrapped securely with insulation; insulation joints should be sealed with insulation tape.
- ☐ **Check furnace filter.** Check filters at least once a month; clean or replace them when dirty.
- ☐ **Bring in a professional.** A qualified serviceman should check heating and cooling equipment at the beginning of each season to ensure efficient operation.
- ☐ **Use drapes or shades.** Window coverings are one of the easiest ways to help insulate your house. Keep them closed on cold days and open on sunny ones.
- ☐ **Use fans in the summer.** Try using fans in the summer before switching on the air conditioning. Old A/C equipment can be equivalent to using 30 or more fans. If you must use your air conditioner, set it at 78° F; each degree over 78° in the summer will save you approximately 3% on your cooling bill.
- ☐ **Program your thermostat.** Adjust temperature settings according to a preset schedule. This way you can warm up or cool down your rooms when you know you'll be awake or at home. Consider a Wi-Fi enabled smart thermostat that learns your settings.

Reading Your Meter

Electric and natural gas meters are not difficult to read and they

Water Heating

Water Heating Energy Saving Tips

If you do not have access to natural gas, consider a **heat pump water heater** to save energy.

Showers generally take less hot water than baths and **dishwashers** generally take less water than hand washing.

Buy **ENERGY STAR** appliances.

If you don't have hard water or you do have a water softener, consider a **tankless natural gas water heater** that reduces standby losses.

Page 12 Energy Use and Savings Guide

Water Heating

Energy Saving Checklist

- ☐ **Keep showers short.** Try to keep your shower to no longer than five minutes.
- ☐ **Adjust your temperature settings.** Set your water heater at 120° F.
- ☐ **Replace washers on faucets that drip.** A leaky faucet can waste 2,500 gallons of hot water per year at a rate of one drip per second.
- ☐ **Install a low-flow shower head.** It can reduce your home water consumption as much as 50%, and reduce your energy cost of heating the water also by as much as 50%. When purchasing a new shower head you should look for shower heads that use no more than 1.5 gallons per minute (water consumption) and preferably no more than 0.6 gallons per minute.

Energy Use Guide–Electric

Water heater, 50-gallon heat pump	182.9	$18.29
Water heater, 50-gallon high-efficiency	385.2	$38.52
Water heater, 50-gallon standard-efficiency	404.8	$40.48

Assuming 25 gallons per day

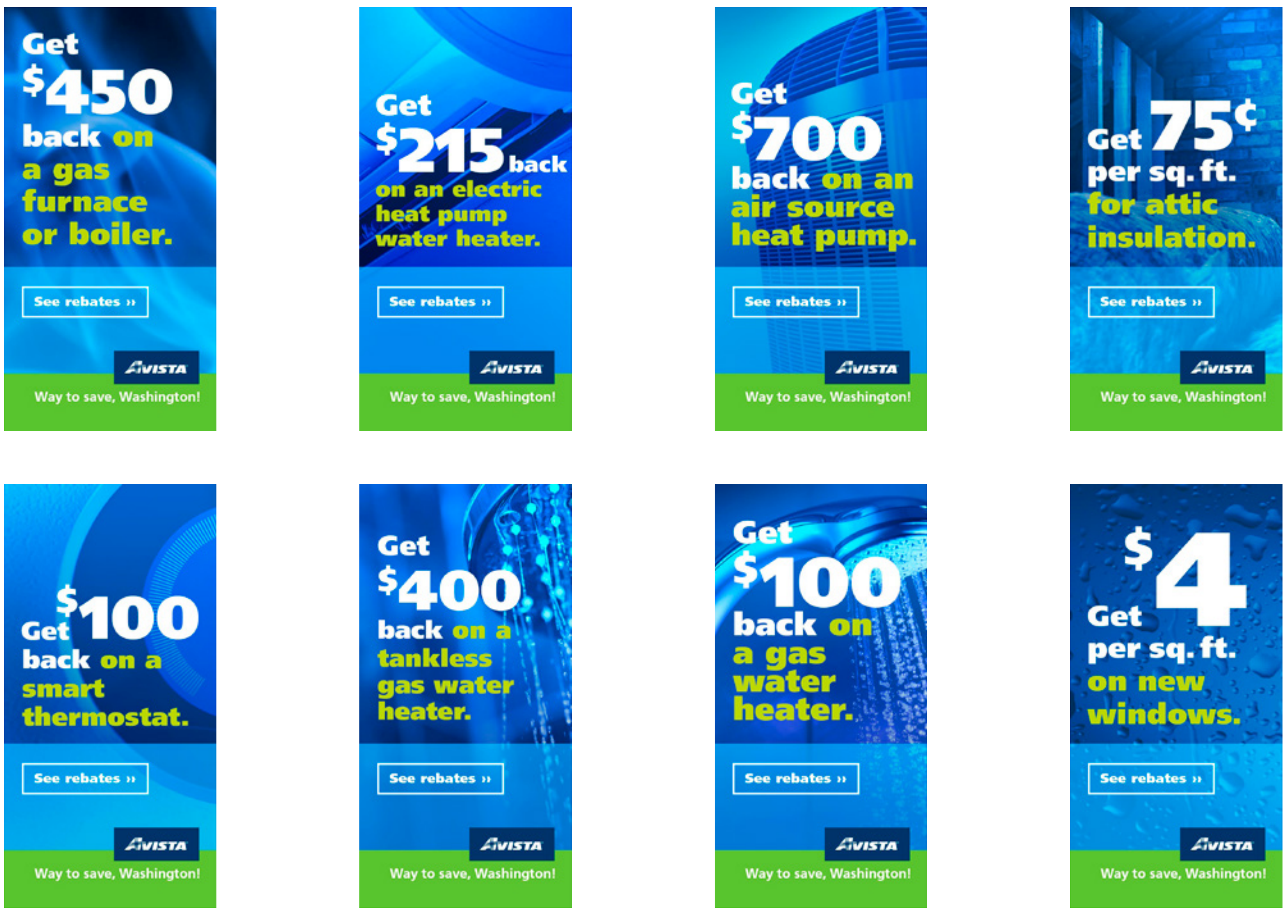
Energy Use Guide–Natural Gas

Water heater, 50-gallon	20	$16.00
Water heater, 40-gallon	17.5	$14.00
Instantaneous water heater	11.5	$9.20

Page 13

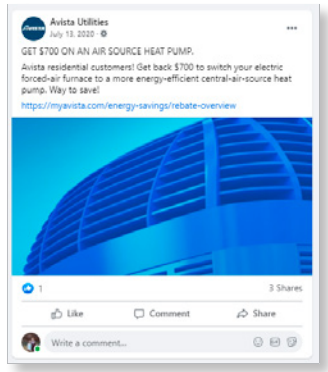
As businesses opened up in the summer, Avista placed its "Way to Save" digital advertising campaign to help increase awareness of the company's rebates. The advertising included social media, search engine marketing, and online banner ads. It ran June 22–August 31 and proved successful in driving customer engagement. When looking at the weeks prior to the campaign (May 1–June 21), page views on the Washington rebates page totaled 4,435; when the campaign ran, including the two weeks following the advertising (June 22–September 14), page views totaled 59,302 – an increase of 1,237 percent.

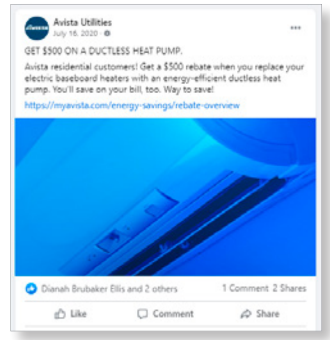
FIGURE 28 – RESIDENTIAL "WAY TO SAVE" DIGITAL ADS AND SOCIAL MEDIA



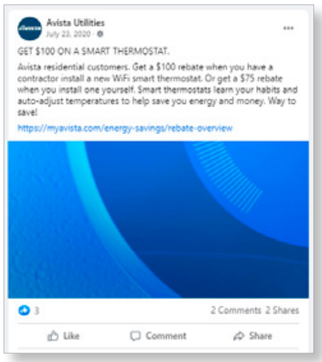

Avista Utilities
October 21, 2020
GET $400 ON A TANKLESS GAS WATER HEATER.
Avista residential customers! Get $400 back from Avista when you buy an efficient #naturalgas tankless water heater (≥.82 UEF). Heats up water faster than electricity, saving you energy and money. Way to save! myavista.com/rebates
3
3 Comments 1 Share
Like
Comment
Share


Avista Utilities
October 27, 2020
GET $100 ON A GAS WATER HEATER.
Avista residential customers! Get a $100 Avista rebate on a new #naturalgas water heater (≥.65 UEF/55 gallons or less). Efficient natural gas heats up water faster than electric tanks, so you don't run out.
myavista.com/rebates
4
Like
Comment
Share
Write a comment...

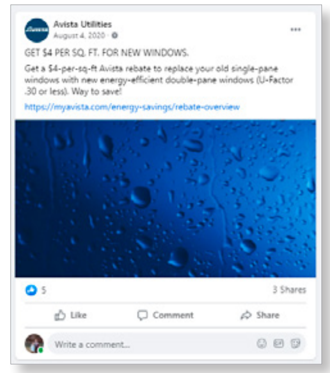

Avista Utilities
July 13, 2020
GET $700 ON AN AIR SOURCE HEAT PUMP.
Avista residential customers! Get back $700 to switch your electric forced-air furnace to a more energy-efficient central-air-source heat pump. Way to save!
https://myavista.com/energy-savings/rebate-overview
1
3 Shares
Like
Comment
Share
Write a comment...


Avista Utilities
July 16, 2020
GET $500 ON A DUCTLESS HEAT PUMP.
Avista residential customers! Get a $500 rebate when you replace your electric baseboard heaters with an energy-efficient ductless heat pump. You'll save on your bill, too. Way to save!
https://myavista.com/energy-savings/rebate-overview
Dianah Brubaker Ellis and 2 others
1 Comment 2 Shares
Like
Comment
Share


Avista Utilities
July 21, 2020
GET 75¢ PER SQ. FT. FOR ATTIC INSULATION.
Avista residential customers! Lower your heat bills with proper attic insulation. Get a $.75-per-sq-ft Avista rebate. Consult a contractor on your home's insulation needs (existing insulation <R11).
https://myavista.com/energy-savings/rebate-overview
Kim Vollan and 2 others
3 Shares
Like
Comment
Share
Write a comment...


Avista Utilities
July 23, 2020
GET $100 ON A SMART THERMOSTAT.
Avista residential customers. Get a $100 rebate when you have a contractor install a new WiFi smart thermostat. Or get a $75 rebate when you install one yourself. Smart thermostats learn your habits and auto-adjust temperatures to help save you energy and money. Way to save!
https://myavista.com/energy-savings/rebate-overview
3
2 Comments 2 Shares
Like
Comment
Share


Avista Utilities
July 9, 2020
GET $450 ON A GAS FURNACE OR BOILER.
Avista residential customers! Get a $450 Avista rebate on an efficient natural gas furnace or boiler with 90% AFUE or better. You'll enjoy lower heat bills and greater comfort, too. Way to save!
https://myavista.com/energy-savings/rebate-overview
4
1 Share
Like
Comment
Share
Write a comment...


Avista Utilities
August 4, 2020
GET $4 PER SQ. FT. FOR NEW WINDOWS.
Get a $4-per-sq-ft Avista rebate to replace your old single-pane windows with new energy-efficient double-pane windows (U-Factor .30 or less). Way to save!
https://myavista.com/energy-savings/rebate-overview
5
3 Shares
Like
Comment
Share
Write a comment...


Avista Utilities @AvistaUtilities · Jul 29, 2020
Avista residential customers! Get a $100 rebate on a natural gas water heater (≥.65 UEF/55 gallons or less). Natural gas heats up to double the hot water in the same amount of time as do electric models. Way to save!
myavista.com/energy-savings...
1


Avista Utilities @AvistaUtilities · Dec 21, 2020
GET $400 ON A TANKLESS GAS WATER HEATER.
Avista residential customers! Get $400 back from Avista when you buy an efficient #naturalgas tankless water heater (≥.82 UEF). Heats up water faster than electricity, saving you energy. Way to save! myavista.com/rebates
1
1


Avista Utilities @AvistaUtilities · Aug 5, 2020
GET $4 PER SQ. FT. FOR NEW WINDOWS.
Get a $4-per-sq-ft Avista rebate to replace your old single-pane windows with new energy-efficient double-pane windows (U-Factor .30 or less). Way to save!
myavista.com/energy-savings...


Avista Utilities @AvistaUtilities · Jul 27, 2020
GET $100 ON A SMART THERMOSTAT.
Avista residential customers. Get a $100 rebate when you have a contractor install a new WiFi smart thermostat. Or get a $75 rebate when you install one yourself. Way to save!
myavista.com/energy-savings...


Avista Utilities @AvistaUtilities · Jul 21, 2020
GET 75¢ PER SQ. FT. FOR ATTIC INSULATION.
Avista residential customers! Lower your heat bills with proper attic insulation. Get a $.75-per-sq-ft Avista rebate. Consult a contractor on your home's insulation needs (existing insulation <R11).
myavista.com/energy-savings...

As cold weather moved in, Avista's "Smart Winter Giveaway" campaign was implemented to remind customers of energy-saving tips for the heating season. Communication tactics included the *Connections* newsletter, emails, a bill insert, the website, and social media. The campaign proved successful in driving customer engagement, with more than 43,000 entrants.

FIGURE 29 – "SMART WINTER" BROCHURE

Avista Kids

With more children at home due to the pandemic, it was a good time to develop new material to help educate this younger audience about energy efficiency. A complete creative refresh was done to existing materials, with new lessons designed to teach kids how to conserve energy while having fun at the same time. They included pictures to color and activities such as puzzles, word searches, mazes, and fun science experiments – all designed to build energy-saving habits for life. The printable coloring pages and activities content can be found on the website at myavista.com/kids, categorized for ages 4–8 and 9–12. In addition, customers can request a free Kids Activities Kit, which includes a printed version of the activities book along with crayons and pencils. The kit offer is promoted on Avista's website, in the *Connections* newsletter, and through social media channels.

FIGURE 30 – KIDS CAN SAVE ENERGY TOO COLORING AND ACTIVITY BOOK

Performance and Savings Goals

The electric residential program saw the largest change from the prior year, achieving 3,260,565 kWh, which is an 80 percent decrease from 2019. This change is attributed to the discontinuation of Simple Steps, Smart Savings and the COVID-19 impacts on the MFDI program.

The natural gas program experienced a lot less volatility in achieving 408,525 therms, an increase of 3 percent over 2019's savings (397,602 therms).

- Simple Steps, Smart Savings was discontinued at the beginning of 2020. The resulting achievements are from one month's worth of residual activity from the program in January. The company's *ACP* did not estimate savings from this program so no value was included for savings goals.
- MFDI and MFDI supplemental lighting programs provided 53 percent of evaluated savings, again mostly through lighting measures.
- The residential natural gas HVAC program accounted for 81 percent of evaluated therm savings.

Table 19 shows savings goals assigned to Avista's residential sector programs for 2020, as well as verified savings and the goal portion achieved in 2020.

TABLE 19 – RESIDENTIAL PROGRAMS REPORTED SAVINGS – ELECTRIC

Program	Savings Goals (kWh)	Verified Savings (kWh)	Percentage of Goal
Simple Steps, Smart Savings	0	149,544	NA
HVAC	1,347,166	527,574	39%
Shell	765,250	610,472	80%
ENERGY STAR Homes	165,750	84,256	51%
Water Heat	233,200	148,557	64%
Multifamily Direct Install	3,865,237	1,740,162	45%
Residential Total	**6,376,603**	**3,260,565**	**51%**

The natural gas segment of the portfolio achieved 64 percent of the goal for 2020.

Table 20 shows savings goals assigned to Avista's residential sector programs for 2020, as well as verified savings and the goal portion achieved in 2020.

TABLE 20 – RESIDENTIAL PROGRAMS REPORTED SAVINGS – NATURAL GAS

Program	Savings Goals (therms)	Verified Savings (therms)	Percentage of Goal
Simple Steps, Smart Savings	-	47	NA
HVAC	516,023	330,929	64%
Shell	65,116	47,875	74%
ENERGY STAR Homes	670	670	100%
Water Heat	60,050	28,629	48%
Multifamily Direct Install	1,074	376	35%
Residential Total	**642,933**	**408,525**	**64%**

Housing Type

The residential program consists of measures that aim to maximize the inclusion of all customers while remaining cost-effective. While this approach is effective, Avista maintains a goal of maximizing participation from all customer segments. For 2020, the company's residential prescriptive program provided rebates to over 6,000 customers. Of this amount only 33 participants were identified within Avista's system as having a housing type of "manufactured"; an additional 33 participants were identified as living in a multifamily residence (duplex or fourplex). Table 21 illustrates the housing data from 2020 participants in the residential prescriptive program.

TABLE 21 – RESIDENTIAL PROGRAMS REBATES BY HOUSING TYPE

Program	Manufactured	Multifamily	Single Family	Total
HVAC	16	20	4,357	4,393
Shell	13	10	1,289	1,312
Water Heat	2	1	564	567
ENERGY STAR Homes	2	-	66	68
Total	**33**	**31**	**6,276**	**6,340**

As part of Avista's 2021 program offerings, a new segment was created to focus on multifamily units and offer weatherization measures specifically for that housing type. We anticipate that more customers will participate in the company's programs as it continues to identify barriers and provide opportunities for hard-to-reach markets.

Note that Avista's MFDI program, which is not included above, is specifically focused on treating multifamily customers and, during 2020, installed more than 43,000 individual energy-saving measures in Washington customers' homes.

Cost-Effectiveness

Tables 22 and 23 show the residential sector cost-effectiveness results by fuel type.

TABLE 22 – RESIDENTIAL COST-EFFECTIVENESS RESULTS – ELECTRIC

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 3,540,375	$ 3,284,423	1.08
UCT	$ 3,202,058	$ 2,106,699	1.52
PCT	$ 5,007,234	$ 2,152,640	2.33
RIM	$ 3,202,058	$ 8,230,887	0.39

TABLE 23 – RESIDENTIAL COST-EFFECTIVENESS RESULTS – NATURAL GAS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 5,549,761	$ 5,491,426	1.01
UCT	$ 5,045,053	$ 2,146,018	2.35
PCT	$ 6,413,321	$ 5,382,655	1.19
RIM	$ 5,045,053	$ 15,727,041	0.32

Program-by-Program Summaries

Residential HVAC Program

TABLE 24 – RESIDENTIAL HVAC PROGRAM METRICS

HVAC Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		221
Overall kWh savings		527,574
Incentive spend	$	68,970
Non-incentive utility costs	$	180,363
Washington energy-efficiency rider spend	$	249,333
HVAC Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		4,172
Overall therm savings		330,929
Incentive spend	$	1,295,595
Non-incentive utility costs	$	71,272
Washington energy-efficiency rider spend	$	1,366,867

Description

Through the HVAC program, Avista encourages residential customers to select a high-efficiency solution when making energy upgrades to their homes.

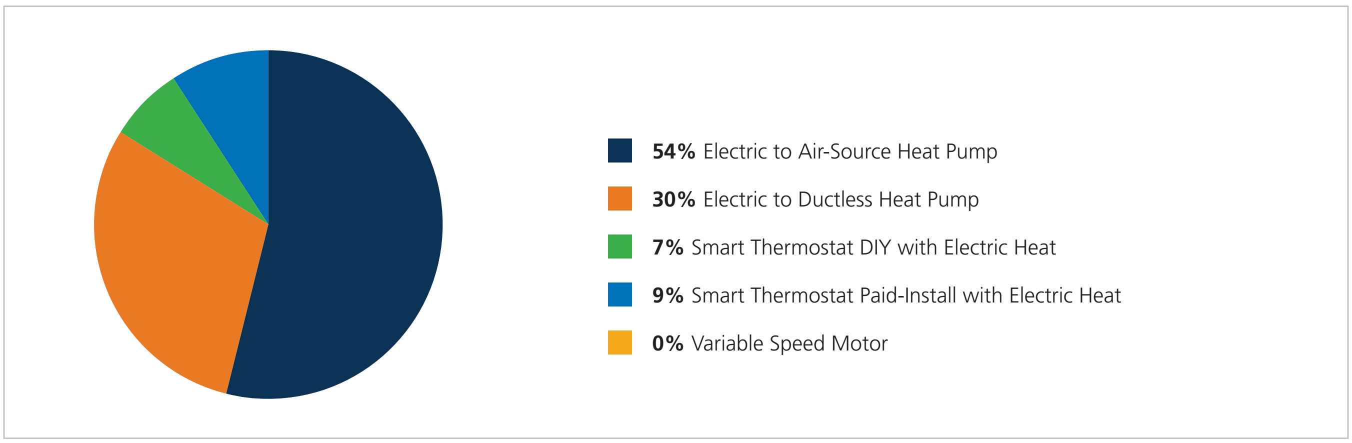
Washington electric customers (Schedule 1) who heat their homes with Avista electricity may be eligible for a rebate for installing a variable speed motor on their forced-air heating equipment or for converting their electric straight-resistance space heating to an air-source heat pump. Any Washington residential natural gas customers (Schedule 101) who heat their homes with natural gas may be eligible for a rebate for installing a high-efficiency natural gas furnace or boiler. Avista reviews energy usage as part of the program eligibility requirements: Customers must demonstrate a heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 therms for replacement of electric straight-resistance to air-source heat pumps and ductless heat pumps. High-efficiency natural gas furnaces and boilers must have 90 percent AFUE or greater, tankless water heaters must have an efficiency of 0.82 UEF or higher, ductless heat pumps must be 10.0 HSPF or greater, air-source heat pumps must have an efficiency of 9.0 HSPF or greater, and heat pump water heaters must have an efficiency of UEF or higher. The supporting documentation required for participation includes, but may not be limited to, copies of project invoices and an Air Conditioning, Heating, and Refrigeration Institute (AHRI) certification.

This prescriptive rebate approach issues payment to the customer after the measure has been installed. Energy-efficiency marketing efforts build considerable awareness of opportunities in the home and drive customers to the website for rebate information. Vendors generate participation using the rebate as a sales tool for their services. Additional communication methods that encourage program participation include utility website promotion, vendor training, retail location visits, and presentations at various customer events throughout the year.

Program Activities

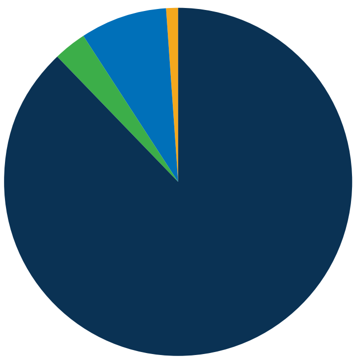
- ***Electric:*** Savings of 527,574 kWh in 2020, which is 16 percent of the overall savings achieved in Avista's residential portfolio. The program had a 70 percent decrease over the 1,764,855 kWh achieved in 2019. The decline is primarily due to the removal of the variable-speed motor (VSM) as an efficiency measure for 2020 (they're now standard equipment on natural gas forced air furnaces). In 2019, VSMs were 45 percent of the electric heating portfolio; their removal as an incentive in 2020 affected the savings. COVID-19 contractor activity shutdown also had a significant impact on the number of completed projects in 2020.
- ***Natural Gas:*** Savings of 330,929 therms in 2020 represent 81 percent of the overall residential savings, a 13 percent increase relative to the 294,075 therms achieved in 2019.

FIGURE 31 – RESIDENTIAL HVAC INCENTIVE DOLLARS BY MEASURE – ELECTRIC



Overall, 2020 was a good year for the Residential HVAC program, especially considering the COVID-19 shutdown. For electric incentives, air-source heat pumps comprised approximately 54 percent of residential HVAC electric incentives. Air-source heat pumps continue to be popular with customers.

FIGURE 32 – RESIDENTIAL HVAC INCENTIVE DOLLARS BY MEASURE – NATURAL GAS



High-efficiency natural gas furnaces continued to provide the largest portion of natural gas savings in the residential sector portfolio, comprising approximately 88 percent of Avista's 2020 residential HVAC incentives. Smart thermostats continued to be popular, with 1,754 installed in the Washington service territory (1,630 for natural gas HVAC systems, 124 for electric HVAC systems).

In 2020, Avista program managers kept in regular contact with trade allies via topical, focused email blasts. These notified trade allies of upcoming program changes and deadlines. Avista program managers also held two trade ally engagement events – in person and via email – to review program changes, encourage program participation, and answer questions. Trade ally engagement continues to be a core marketing strategy for this program.

Program Marketing

The program was included on the "Way to Save" advertising campaign to increase awareness and drive program participation. See pages 36-41.

Plans for 2021

Avista will continue to encourage installations of high-efficiency natural gas furnaces as well as smart thermostats. Smart thermostats will have an incentive increase to further promote the program participation of customers. The new multifamily incentive program will also incentivize line voltage thermostats.

Residential Shell Program

TABLE 25 – RESIDENTIAL SHELL PROGRAM METRICS

Shell Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		260
Overall kWh savings		610,472
Incentive spend	$	135,318
Non-incentive utility costs	$	533,830
Washington energy-efficiency rider spend	$	669,148
Shell Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		1,052
Overall therm savings		47,875
Incentive spend	$	585,447
Non-incentive utility costs	$	27,119
Washington energy-efficiency rider spend	$	612,566

Description

Through the Residential Shell program, Avista encourages residential customers to improve their home's shell or exterior by upgrading windows and storm windows. This prescriptive rebate approach issues payment to the customer after the measure has been installed. Energy-efficiency marketing efforts build considerable awareness of opportunities in the home and drive customers to the website for rebate information. Vendors generate participation using the rebate as a sales tool for their services. Additional communication methods that encourage program participation include utility website promotion, vendor training, retail location visits, and presentations at various customer events throughout the year.

Washington residential electric customers (Schedule 1) who heat their homes with Avista electric are eligible to apply, as are Washington residential natural gas customers (Schedule 101) who heat their homes with natural gas.

Storm windows (interior/exterior) must be new, the same size as the existing window, and not be in direct contact with the existing window; exterior window low-e coating must be facing the interior of the home. Glazing material emissivity must be less than 0.22 with a solar transmittance greater than 0.55. Windows must have a U-factor rating of 0.30 or lower.

In 2019, insulation rebates for attics, walls, and floors were added to the available energy-efficiency measures. In 2020, the shell measures had significant increase.

Avista will review energy usage as part of the program eligibility requirements. Customers in Washington with electric-heated homes must demonstrate a heating season usage of 8,000 kWh; those with natural gas-heated homes must demonstrate a heating season usage of 340 therms.

Program Activities

- ***Electric:*** Savings of 610,472 kWh in 2020 (19 percent of the overall residential savings), a 111 percent increase over the 288,806 kWh achieved in 2019.
- ***Natural Gas:*** Savings of 47,875 therms in 2020, or 12 percent of the overall residential savings. The program had a 29 percent decrease in savings relative to the 67,016 therms achieved in 2019.

The savings derived from the Residential Shell program for both natural gas and electric homes are primarily attributed to single-pane window replacements. Shell program participants had been inclined to replace existing windows with regular windows rather than storm windows.

Program Changes

The attic, wall, and floor insulation incentives helped achieve the increase in savings. The window U-factor is now required to be 0.29.

Program Marketing

The program was included in the "Way to Save" advertising campaigns to increase awareness and drive participation. See pages 36-41.

Plans for 2021

In 2021, the Residential Shell program will also be extended to include multifamily properties of five units or less with electric service through Schedule 01.

Residential Water Heating Program

TABLE 26 – RESIDENTIAL WATER HEATING PROGRAM METRICS

Water Heat Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		117
Overall kWh savings		148,557
Incentive spend	$	25,370
Non-incentive utility costs	$	35,275
Washington energy-efficiency rider spend	$	60,645
Water Heat Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		450
Overall therm savings		28,629
Incentive spend	$	150,900
Non-incentive utility costs	$	6,033
Washington energy-efficiency rider spend	$	156,933

Description

Washington electric customers (Schedule 1) who heat their homes with Avista electricity or natural gas may be eligible for a rebate for the installation of a high-efficiency electric heat pump water heater, natural gas tankless water heater, or natural gas high-efficiency water heater. Efficiencies for space- and water-heating equipment are verified according to the contractor invoice or the AHRI.

Program Activities

- ***Electric:*** Residential water heating program savings were 148,557 kWh in 2020, a 24 percent decrease over the 194,385 kWh of savings achieved in 2019.
- ***Natural Gas:*** Overall savings were 28,629 therms, a decrease of 12 percent over 2019's savings of 32,713.

Program Marketing

The program was included in the "Way to Save" advertising campaigns to increase awareness and drive participation. See pages 36-41.

Plans for 2021

Avista plans to continue offering water heater rebates in 2021.

Residential ENERGY STAR Homes Program

TABLE 27 – RESIDENTIAL ENERGY STAR HOMES PROGRAM METRICS

ENERGY STAR Homes Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		34
Overall kWh savings		84,256
Incentive spend	$	19,500
Non-incentive utility costs	$	46,257
Washington energy-efficiency rider spend	$	65,757
ENERGY STAR Homes Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		34
Overall therm savings		670
Incentive spend	$	2,600
Non-incentive utility costs	$	155
Washington energy-efficiency rider spend	$	2,755

Description

The ENERGY STAR Manufactured Homes program takes advantage of the regional and national effort surrounding the U.S. Department of Energy and U.S. Environmental Protection Agency's ENERGY STAR label. Avista and partnering member utilities of NEEA have committed significant resources to develop and implement this program to set standards, train contractors, and provide third-party verification of qualifying homes. NEEA, in effect, administers the program and Avista pays the rebates for homes that successfully complete the process and are labeled ENERGY STAR.

After the launch of NEEA's regional effort, the manufactured homes industry established manufacturing standards and a labeling program to obtain Northwest Energy-Efficient Manufactured Housing program certified (NEEM-certified) manufactured homes. While the two approaches are unique, they both offer 15–25 percent savings versus the baseline.

The ENERGY STAR Manufactured Homes program promotes to builders and homeowners a sustainable, low-operating-cost, environmentally friendly structure as an alternative to traditional home construction. In Washington, Avista offers both electric and natural gas energy-efficiency programs, and, as a result, has structured the program to account for homes where either a single fuel or both fuels are used for space and water heating needs. Avista continues to support the regional program to encourage sustainable building practices.

Any Washington residential electric customer (Schedule 1) with an NEEM-certified home that has Avista electric and/or Avista residential natural gas (Schedule 101) for space and water heating is eligible.

An NEEM-certified ENERGY STAR manufactured home with Avista electric or both Avista electric and natural gas service provides energy savings beyond code requirements for space heating, water heating, shell measures, lighting, and appliances. Space-heating equipment can be either electric forced air or electric heat pump, or a natural gas furnace. This rebate may not be combined with other Avista individual measure rebate offers (such as high-efficiency water heaters).

Program Activities

The ENERGY STAR Manufactured Homes program accounted for less than 1 percent of program savings for both electric and natural gas programs.

- ***Electric:*** Savings of 84,256 kWh in 2020 (3 percent of the overall residential savings), a 56 percent decrease over the savings of 192,270 kWh achieved in 2019.
- ***Natural Gas:*** Savings of 670 therms in 2020. The program had a 900 percent increase in savings relative to the 67 therms achieved in 2019.

Program Marketing

The program is included on Avista's website and took advantage of the "Way to Save" advertising campaigns to increase awareness of the company's residential rebate programs. See pages 36-41.

Program Changes for 2021

The 2021 incentive for ENERGY STAR manufactured homes was increased to $1,000 per unit for electric-only and natural gas with electric customers. The natural gas-only customer incentive was increased to $400.

Residential Multifamily Direct Install Program and Supplemental Lighting

TABLE 28 – RESIDENTIAL MULTIFAMILY DIRECT INSTALL PROGRAM AND SUPPLEMENTAL LIGHTING PROGRAM METRICS

Multifamily Direct Install Program Summary – Electric	2020	
Participation, Savings, and Costs		
Conservation projects (individual measures)		42,669
Overall kWh savings		1,740,162
Incentive spend	$	715,646
Non-incentive utility costs	$	217,542
Washington energy-efficiency rider spend	$	933,188
Multifamily Direct Install Program Summary – Natural Gas	**2020**	
Participation, Savings, and Costs		
Conservation projects (individual measures)		346
Overall therm savings		376
Incentive spend	$	2,705
Non-incentive utility costs	$	4,192
Washington energy-efficiency rider spend	$	6,897

Note that the MFDI program has been tracked by total measures installed, which include LED lamps, faucet aerators, showerheads, smart strips, and pipe wrap.

Description

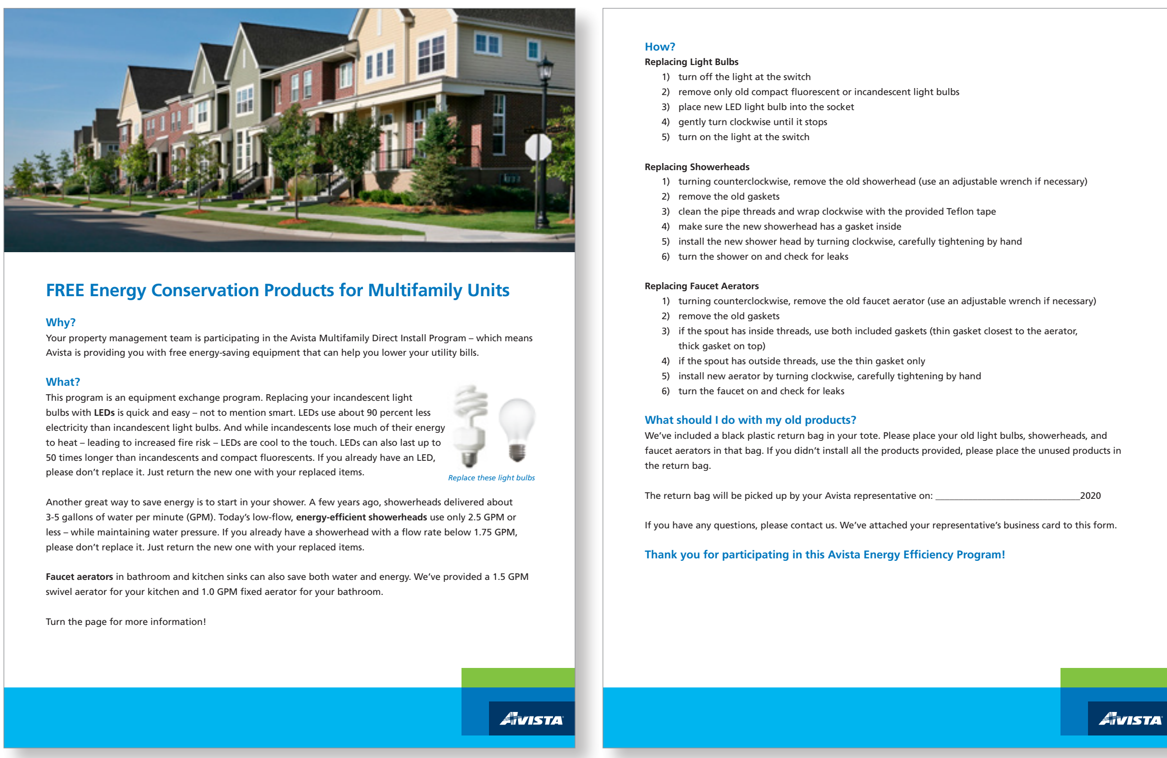
The MFDI program is designed to help hard-to-reach customers save energy. Field installers coordinate with property managers of multifamily complexes of five units or more to directly install small energy savers such as LED lamps, faucet aerators, showerheads, and smart power strips, as well as vending misers in common areas. During the first site visit with properties, installers audit the complex not only for tenant needs, but also for any eligible common area lighting, which would include stairwell lighting used 24/7, exterior lamps and fixtures on a daylight sensor, and conversions from interior fluorescent T12s and T8s to LEDs used 24/7. Direct installations are completed at the complex and the supplemental lighting information is passed on to lighting contractors contracted to work in various areas. Lighting contractors communicate with the property managers to audit and put together project data that is sent to SBW, the program implementer, and Avista to ensure the project is cost-effective, after which the project is completed.

Program Activities

The MFDI program began as a pilot in 2018. The program did not have any measure changes from 2019 to 2020. 2020 did bring other challenges with the COVID-19 shutdown, however, with Avista pausing the entire program in March. In the late summer the company allowed the supplemental lighting contractors to complete any already-identified projects that had exterior lighting only. Avista also tried different delivery methods for the direct installation. One identified three small complexes and dropped off a tote bag of items for each unit containing lamps, showerheads, and aerators, as well as program and installation information. Bags were included for tenants to return old or unneeded items within a period of four weeks. Another method was to identify three complexes with a facility manager who would help perform installations for tenants. Program and installation information was updated and the return timeline tightened. As results were analyzed, Avista allowed supplemental lighting contractors to split the already-identified projects that had a mix of interior and exterior lighting to complete the exterior portion of the projects.

This program is marketed by Avista and SBW, and by property managers through word of mouth. Avista tries to have a controlled spread of the program to provide a timely scheduling process.

FIGURE 33 – RESIDENTIAL MULTIFAMILY DIRECT INSTALL PROGRAM FLYER



FREE Energy Conservation Products for Multifamily Units

Why?
Your property management team is participating in the Avista Multifamily Direct Install Program – which means Avista is providing you with free energy-saving equipment that can help you lower your utility bills.

What?
This program is an equipment exchange program. Replacing your incandescent light bulbs with **LEDs** is quick and easy – not to mention smart. LEDs use about 90 percent less electricity than incandescent light bulbs. And while incandescents lose much of their energy to heat – leading to increased fire risk – LEDs are cool to the touch. LEDs can also last up to 50 times longer than incandescents and compact fluorescents. If you already have an LED, please don't replace it. Just return the new one with your replaced items.

Replace these light bulbs

Another great way to save energy is to start in your shower. A few years ago, showerheads delivered about 3-5 gallons of water per minute (GPM). Today's low-flow, **energy-efficient showerheads** use only 2.5 GPM or less – while maintaining water pressure. If you already have a showerhead with a flow rate below 1.75 GPM, please don't replace it. Just return the new one with your replaced items.

Faucet aerators in bathroom and kitchen sinks can also save both water and energy. We've provided a 1.5 GPM swivel aerator for your kitchen and 1.0 GPM fixed aerator for your bathroom.

Turn the page for more information!

AVISTA

How?
Replacing Light Bulbs
1) turn off the light at the switch
2) remove only old compact fluorescent or incandescent light bulbs
3) place new LED light bulb into the socket
4) gently turn clockwise until it stops
5) turn on the light at the switch

Replacing Showerheads
1) turning counterclockwise, remove the old showerhead (use an adjustable wrench if necessary)
2) remove the old gaskets
3) clean the pipe threads and wrap clockwise with the provided Teflon tape
4) make sure the new showerhead has a gasket inside
5) install the new shower head by turning clockwise, carefully tightening by hand
6) turn the shower on and check for leaks

Replacing Faucet Aerators
1) turning counterclockwise, remove the old faucet aerator (use an adjustable wrench if necessary)
2) remove the old gaskets
3) if the spout has inside threads, use both included gaskets (thin gasket closest to the aerator, thick gasket on top)
4) if the spout has outside threads, use the thin gasket only
5) install new aerator by turning clockwise, carefully tightening by hand
6) turn the faucet on and check for leaks

What should I do with my old products?
We've included a black plastic return bag in your tote. Please place your old light bulbs, showerheads, and faucet aerators in that bag. If you didn't install all the products provided, please place the unused products in the return bag.

The return bag will be picked up by your Avista representative on: ______________________2020

If you have any questions, please contact us. We've attached your representative's business card to this form.

Thank you for participating in this Avista Energy Efficiency Program!

AVISTA

Plans for 2021

This program is currently scheduled to run through 2021 as originally planned and as COVID-19 restrictions are lifted. In the meantime, Avista is still exploring best options to continue to serve customers while adhering to COVID-19 related restrictions.

Residential Simple Steps, Smart Savings Program

TABLE 29 – RESIDENTIAL SIMPLE STEPS, SMART SAVINGS PROGRAM METRICS

Simple Steps, Smart Savings Program Summary – Electric	2020	
Participation, Savings, and Costs		
Conservation projects		10,658
Overall kWh savings		149,544
Incentive spend	$	10,113
Non-incentive utility costs	$	38,622
Washington energy-efficiency rider spend	$	48,734
Simple Steps, Smart Savings Program Summary – Natural Gas	**2020**	
Participation, Savings, and Costs		
Conservation projects		30
Overall therm savings		47
Incentive spend	$	0
Non-incentive utility costs	$	0
Washington energy-efficiency rider spend	$	0

Description

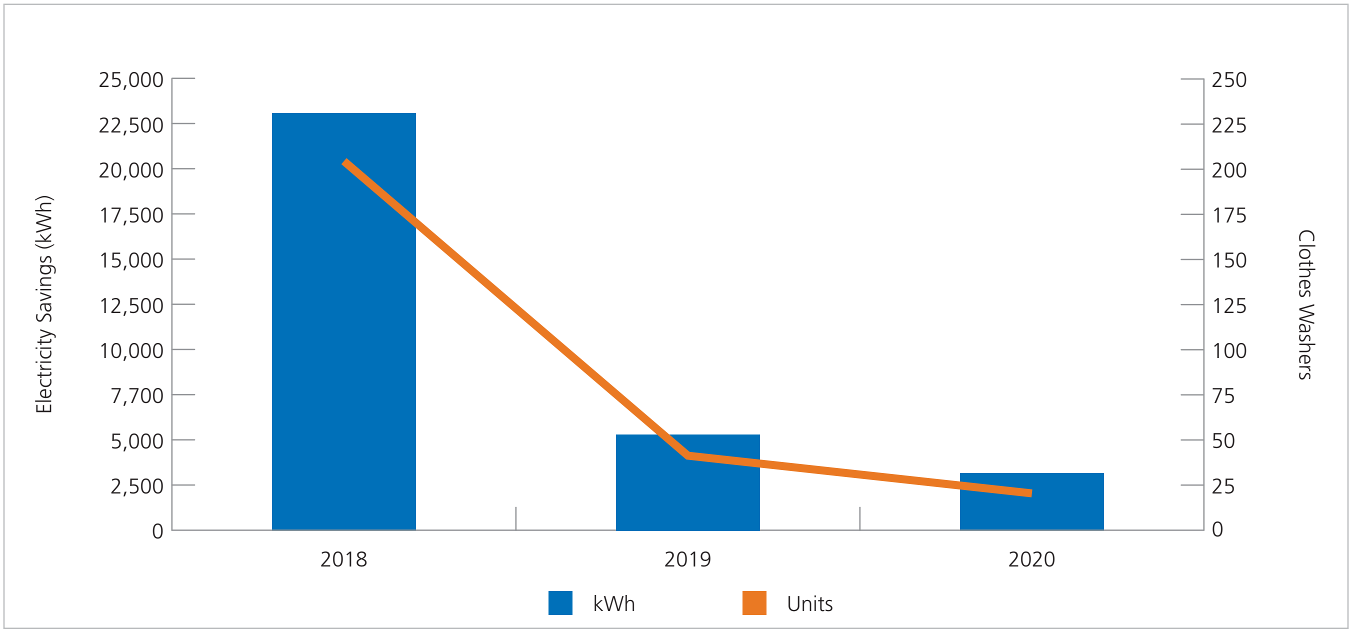
Avista collaborates with Bonneville Power Administration (BPA) on Simple Steps, Smart Savings, a regional program designed to increase the adoption of energy-efficient residential products. To achieve energy savings, residential consumers are encouraged to purchase and install high-quality LEDs, light fixtures, energy-saving showerheads, and ENERGY STAR appliances. While Washington participates only in the clothes washer program, 2020 did see some carryover of lighting throughput in the state while retail point-of-purchase materials were being removed.

Program Activities

Key to delivering on the objectives of this program are the incentives to encourage customers’ interest and the marketing efforts to drive them to use the program. CLEAResult is contracted by Avista to provide the manufacturer and retail coordination. They are responsible for organizing program marketing efforts, performing outreach to retailers, ensuring that the proper program tracking is in place, and managing all implementation aspects of the program. Big-box retailers carry the ENERGY STAR appliances and clearly identify the qualifying models with point-of-purchase tags.

In 2020, savings for clothes washers fell slightly as the four participating retailers saw pandemic-related impacts both on the economy and on consumer trends. Furthermore, there was no throughput or savings in Q4 as the appliance program was terminated with the rest of the Simple Steps, Smart Savings regional program at the end of September.

FIGURE 34 – RESIDENTIAL SIMPLE STEPS, SMART SAVINGS PROGRAM – CLOTHES WASHERS KWH SAVINGS



Program Changes

Lighting and showerhead incentives were discontinued in 2020 and remained stable for clothes washers.

TABLE 30 – RESIDENTIAL SIMPLE STEPS, SMART SAVINGS PROGRAM INCENTIVES CHANGES

Product Category	Incentive Per Unit	
	2019	2020
LED bulb	$ 0.50 - 3.00	$ -
LED fixture	$ 0.50 - 4.00	$ -
Showerhead	$ 2.00 - 6.00	$ -
Clothes washer	$ 25.00	$ 25.00

Program Marketing

Lighting and showerhead incentives were discontinued in 2020; there was no marketing conducted for the clothes washer program in 2020.

Plans for 2021

For 10 years, Simple Steps, Smart Savings has been a source of significant savings for Avista. In 2019 it became clear that the lighting and appliance markets have transformed drastically over the years. Where once only inefficient products lined the shelves, energy-efficient products are now widespread in the Northwest. As a result, the Simple Steps, Smart Savings lighting program was terminated in Washington on December 31, 2019 and the appliance program on September 30, 2020.

Northport, Washington

LOW-INCOME SECTOR

Program-by-Program Summaries

Low-Income Program (including Community Energy Efficiency Program projects)

TABLE 31 – LOW-INCOME PROGRAM METRICS

Low-Income Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		262
Overall kWh savings		341,277
Incentive spend	$	1,323,321
Non-incentive utility costs	$	841,250
Washington energy-efficiency rider spend	$	2,164,571
Low-Income Program Summary – Natural Gas		**2020**
Participation, Savings, and Costs		
Conservation projects		401
Overall therm savings		14,450
Incentive spend	$	1,076,136
Non-incentive utility costs	$	241,881
Washington energy-efficiency rider spend	$	1,318,017

For 2020, the Low-Income program served 262 electric and 401 natural gas customers.

Program participation for low-income programs is quantified in the number of installed units or square feet of installed insulation or windows.

Description

Avista partners with six Community Action Partnership (CAP) agencies and one Tribal Housing Authority to deliver low-income energy-efficiency programs throughout the company's service territory. All of these organizations have the infrastructure in place to income-qualify customers as well as provide access to a variety of funding sources to make energy-efficiency improvements to their homes. An annual funding amount of $3 million is allocated across the organizations and is based on meter count in the counties they serve.

The agencies may spend their contract amount at their discretion on either electric or natural gas efficiency measures. Improvements to the home's shell (e.g. insulation, windows) or to heat pump systems requires that the home demonstrates a minimum level of energy use of either Avista or natural gas for space heating purposes. Within the annual funding allocation is a 30 percent reimbursement for both administrative (10 percent) and program support (20 percent) costs. Agencies may also choose to use up to 30 percent of their annual allocation for home repair as well as other health and safety improvements.

To guide the agencies toward projects that are most beneficial to Avista's energy-efficiency efforts, the company provides an approved list of measures that are both cost-effective and allow for full reimbursement of the installation.

A list of qualified measures allows for partial reimbursement of those efficiency improvements that may not be cost-effective but may be vital for the home's functionality. These measures are compensated with an amount that is equal to the utility's avoided cost of the energy savings associated with the energy-efficiency improvement. To allow additional flexibility to their funds, the agencies may also use the health, safety, and repair dollars to fully fund the remaining cost of the qualified measure.

Program Activities

In 2020, the program achieved 341,277 kWh of reported electric savings in Washington. This amount is inclusive of Community Energy Efficiency Program (CEEP) projects completed in 2020.

Table 32 and 33 shows Avista savings goals for the low-income sector for 2020, as well as reported savings and goal portions achieved in 2019.

TABLE 32 – LOW-INCOME VERIFIED SAVINGS – ELECTRIC

Program	Savings Goals (kWh)	Verified Savings (kWh)	Percentage of Goal
Low-Income	441,452	341,277	77%
Low-Income – Total	**441,452**	**341,277**	**77%**

TABLE 33 – LOW-INCOME VERIFIED SAVINGS – NATURAL GAS

Program	Savings Goals (therms)	Verified Savings (therms)	Percentage of Goal
Low-Income	25,743	14,450	56%
Low-Income – Total	**25,743**	**14,450**	**56%**

Avista continued to reimburse the agencies for 100 percent of the cost for installing most energy-efficiency measures defined on the approved measure list (see Table 34). Avista deemed these measures as cost-effective during the 2020 *Annual Conservation Plan* development.

TABLE 34 – LOW-INCOME PROGRAM APPROVED MEASURE LIST

Electric Measures	Natural Gas Measures
Air infiltration Air-source heat pump (9.0 HSPF) Attic insulation Doors (ENERGY STAR-rated) Duct insulation Duct sealing Floor insulation LED lamps Wall insulation Windows (ENERGY STAR-rated) Electric to air-source heat pump Electric to ductless heat pump	Air infiltration Attic insulation Boiler (96% Doors (ENERGY STAR-rated) Duct insulation Duct sealing Floor insulation Furnace (95%) Water heater – storage <55 gallon .65 Water heater – tankless .82 EF Windows (ENERGY STAR-rated)

Measures that did not meet the cost-effectiveness test were listed on the qualified rebate list and the agency was eligible to receive a partial reimbursement for their installation. The reimbursement amount was equal to the avoided cost-energy value of the improvement. This approach focused agencies toward installing measures that had the greatest cost-effectiveness from the utility's perspective. To allow for additional flexibility, agencies may also choose to use their health and safety dollars to fully fund the cost of the measures on the qualified rebate list.

TABLE 35 – LOW-INCOME PROGRAM REBATE MEASURE LIST

Electric Measures	Natural Gas Measures
Heat pump water heater (any size; tiers 2–3) Refrigerator – ENERGY STAR-rated	(none at this time)

Program Changes

The agencies started the year with a total funding allocation of $2.35 million, which was increased to $3 million on August 1, 2020. Along with the increase came an adjustment to amounts related to administrative costs and health and safety from 15 to 30 percent. The administration allocation has been modified to include program support with an allocation for each category (10 percent, administration; 20 percent, program support). Other 2020 program changes include an update of measures eligible for either full or partial funding. This update is based on the company's business plan evaluation completed in Q4 2019. A list of all measures are summarized in Tables 34 and 35.

While not a change to the program, the COVID-19 pandemic certainly had an effect on homes served. When Washington's stay-at-home orders were announced, agencies stopped serving customers in their homes from mid-March until late July, with one agency not returning until late September. Safe-start plans were developed and filed with the Department of Commerce and Avista. These plans not only included personal protection and contact-tracing initiatives, but also limited the types of customers they could serve and eliminated the blower door test, a common means of assessing a home's air leaks. Most of the agencies were not operating at full capacity as they took the precautions necessary to keep their employees and clients safe. With each county in the state operating in a different phase for re-opening, the additional protocols in place and the inability to serve seniors or those with compromised health conditions resulted in lower numbers of homes being treated than in a typical year. It was anticipated that the agencies would not be able to spend much of their Avista contract amount. Approximately half of the $3 million was spent; two of the agencies were unable to spend any portion of their allocation.

Customer Outreach

Customers who participate in the low-income weatherization program are often referred through the partner community action agencies' energy-assistance programs. Avista provides referrals each year from its customer service department and the company's Customer Assistance Referral and Evaluation Services program, which provides support for disabled, elderly, and low-income customers, or customers experiencing hardships related to employment, health, or finances.

Other referrals are the result of various outreach events Avista hosts or is invited to attend. In partnership with the company's energy-efficiency efforts, its community and economic vitality department conducts conservation education and outreach for low-income customers, seniors, individuals living with disability, and veterans. The Avista outreach team reaches this target population through workshops, energy fairs, and mobile and general outreach. Each method includes demonstrations and distribution of low- and no-cost materials with a focus on energy efficiency, conservation tips and measures, and information regarding energy assistance that may be available through agencies. One low-income and senior outreach goal is to increase awareness of energy-assistance programs such as the Low-Income Home Energy-Assistance program and Project Share.

In a usual year, Avista recognizes several educational strategies as being efficient and effective activities for delivering energy efficiency and conservation outreach:

- Energy conservation workshops for groups of Avista customers where the primary target audiences are senior and low-income participants.
- Energy fairs where attendees can receive information about low- and no-cost methods to weatherize their homes through demonstrations and limited samples. In addition, fair attendees can learn about bill assistance and watch demonstrations of the online account and energy management tools. Community partners that provide services to low-income populations and support to increase personal self-sufficiency are invited, at no cost, to host a booth and provide information about their services and accessibility. Multiple communication channels are used to promote Avista's energy fairs. Tactics included news releases, direct mail, email, flyers, community calendars, social media, signage, and print and radio advertising.

- Mobile outreach is conducted through the Avista energy resource vans, where visitors can learn about effective tips to manage their energy use, bill payment options, and community assistance resources.
- General outreach provides energy management information and resources at events (such as resource fairs) and through partnerships that reach the target populations. General outreach also includes outlining bill payment options and assistance resources in senior and low-income publications.

In 2020, Avista suspended outreach activity due to COVID-19. The outreach team, with managerial oversight, came up with ways to reach customers in the midst of the pandemic in a manner that safeguarded employee, customer, and the public's safety and well-being.

To serve customers in a safe manner, the outreach team dropped off energy-saving items and information at food banks, participated in mobile food bank drive-through events, partnered with community-based organizations to provide home energy kits to their clients, and mailed kits to customers who responded to a business reply card from a targeted mailing to customers with past-due account balances. In addition to receiving a free energy kit, they could also request a free energy use guide (page 39) and the new kid's activities book (page 41).

With the program delivery modifications, all energy fairs were canceled, and workshops were suspended after mid-March. The team conducted and participated in 60 events that reached 5,540 Washington residents. Table 36 shows an overview of the different activities in Washington.

TABLE 36 – VULNERABLE CUSTOMERS OUTREACH ACTIVITIES AND LED GIVEAWAY SUMMARY

Description	Number of Events/ Activities	Contacts	LEDs
Energy fairs	0	0	0
General outreach	49	4,801	19,326
Mobile outreach	4	455	1,584
Workshops	7	224	574
Total	**60**	**5540**	**21,484**

Snapshot of the instruction sheet that was included in the home energy kits distributed through community partners to their clients:

FIGURE 35 – LOW-INCOME HOME ENERGY SAVINGS KIT DIRECT MAIL

FIGURE 36 – LOW-INCOME HOME ENERGY SAVINGS KIT BROCHURE

Marketing

Multiple communication channels were used to increase awareness of Avista's bill assistance options and programs throughout the year. Tactics included a bill insert, email, flyers, Avista's website, social media, and advertising (print and online). The flyers were produced in a digital format as well as printed, and a print ad was developed and placed to promote Avista's Rate Discount program (for seniors and people on disability in Washington).

In May, the company received a media inquiry from the Spokane *Journal of Business* regarding requests for payment assistance in the midst of the coronavirus. Avista worked with its consumer affairs program manager to prepare for the interview and help educate the reporter on the growing need, as well as what Avista was doing to help. Messaging reinforced how the company has been working to create and publicize payment options for customers whose ability to pay had been affected by the pandemic, and that approximately 25 percent of all incoming calls were from customers seeking assistance in paying their bills. The article included Avista's partnership with the city of Spokane to raise approximately $150,000 for Project Share and the UHelp municipal program, and that, in addition to its regular assistance programs, SNAP received authorization from Avista and the federal government to provide additional emergency relief funds.

Direct marketing was also used to invite customers in Grant and Adams Counties to participate in a virtual energy assistance day, in partnership with the Opportunities Industrialization Center of Washington.

FIGURE 37 – RESIDENTIAL WE'RE HERE TO HELP ENERGY BILL ASSISTANCE BROCHURE

FIGURE 38 – RESIDENTIAL ENERGY BILL ASSISTANCE BILL INSERT

FIGURE 39 – RESIDENTIAL ENERGY BILL ASSISTANCE POSTCARD

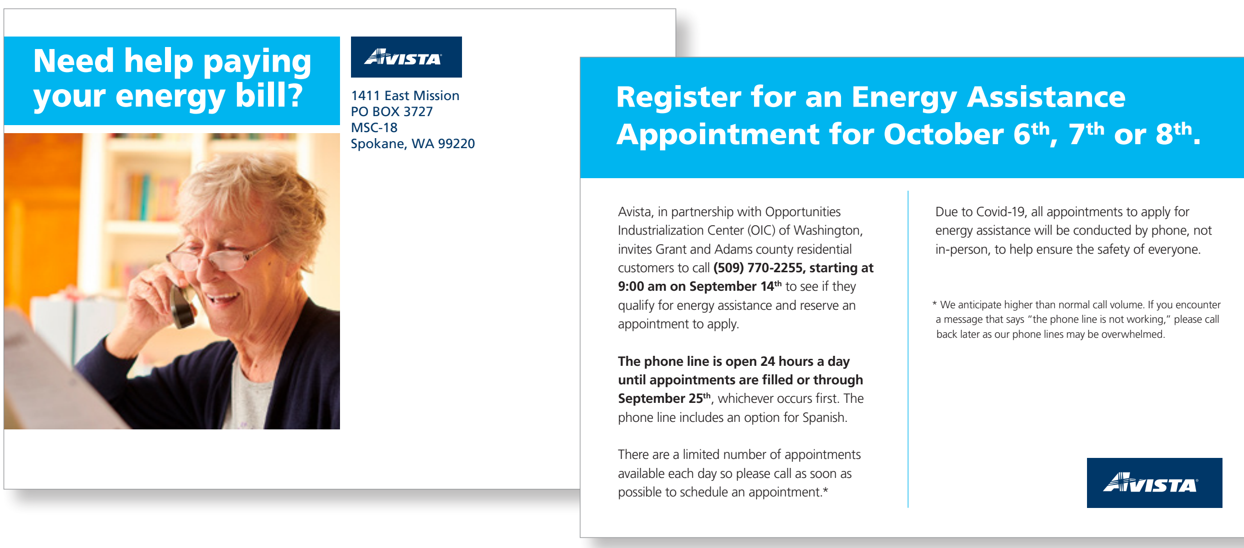


FIGURE 40 – RESIDENTIAL ENERGY BILL ASSISTANCE FLYER

Looking for energy bill assistance? We have options.

Avista has a variety of ways to help you with your bill. One of those options is bill assistance for income-qualified customers and those experiencing financial hardship. Please call us at 800-227-9187 to discuss how we may be able to help.

BILLING OPTIONS

Comfort Level Billing smooths out the seasonal highs and lows of energy bills by dividing yearly usage into 12 equal monthly payments. Your account must be in good standing with at least 12 months of usage history to qualify for this program.

Preferred Due Date can help align the billing due date with payday. We may be able to adjust the payment due date, depending on account status and specific situation (some restrictions apply).

Paperless Billing lets you receive your bills via e-mail and set due-date reminders and other notifications.

PAYMENT OPTIONS

Payment Arrangements can be made on an individual basis for those in need. Give us a call or login to our website at myavista.com to make payment arrangements online.

Auto Pay automatically withdraws your Avista payment from your checking or savings account each month or charges your debit or credit card.

FINANCIAL HELP

Energy Assistance Grants, such as Project Share, are available to residential customers who meet the eligibility guidelines. These funds are distributed to qualifying customers through local community agencies.

Visit myavista.com/assistance to find your local Community Action office.

(See additional information on back.)

OTHER WAYS TO HELP MANAGE YOUR ENERGY BILL

Online Energy-Management Tools can make accessing billing and energy information fast and simple. Online customers have a variety of tools at their fingertips and it's easy to sign up. Sign into your online account at myavista.com.

Bill and Usage Insights provides energy-saving tips and helps explain what could be impacting your most recent bill – find it on the Compare Your Bills page.

Energy and Savings Profile takes it one step further for a more comprehensive energy analysis and a complete list of ways to save energy. By completing the Energy Profile, you'll see a more precise breakdown of how your energy is being used. Sign into your online account at myavista.com.

Bill Comparison shows any bill compared to previous bills and identifies how bills are impacted by weather and the number of days in the billing period. Sign into your online account at myavista.com.

Energy Efficiency is an important part of managing energy costs for both the short and long terms. Avista offers energy-efficiency tips, rebates and information on making homes as efficient as possible at myavista.com/waytosave.

Avista Outreach includes our Energy Resource Van that travels to areas throughout Washington and Idaho distributing energy-conservation materials.

Visit myavista.com/outreach to see if there is an event near you.

FIGURE 41 – RESIDENTIAL SENIOR RATE DISCOUNT PRINT AD

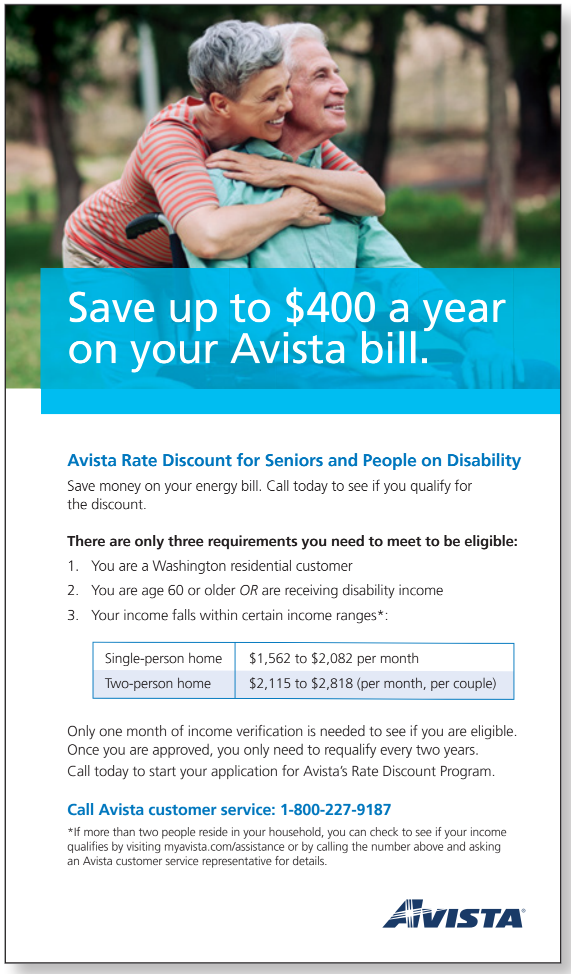
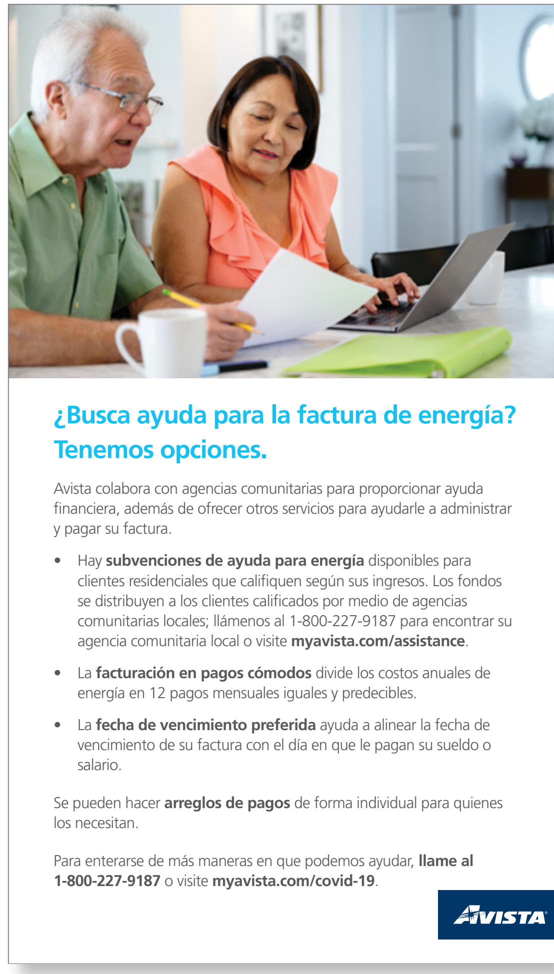


FIGURE 42 – RESIDENTIAL ENERGY BILL ASSISTANCE PRINT ADS



Cost-Effectiveness

Tables 37 and 38 show the low-income sector cost-effectiveness results by fuel type.

TABLE 37 – LOW-INCOME COST-EFFECTIVENESS RESULTS – ELECTRIC

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 581,136	$ 1,530,941	0.38
UCT	$ 383,012	$ 1,614,270	0.24
PCT	$ 1,791,292	$ 1,239,993	N/A*
RIM	$ 383,012	$ 2,434,974	0.16

*Low Income is offered at no cost to participants; PCT is not calculable.

TABLE 38 – LOW-INCOME COST-EFFECTIVENESS RESULTS – NATURAL GAS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
TRC	$ 456,908	$ 1,336,787	0.34
UCT	$ 324,822	$ 1,318,017	0.25
PCT	$ 1,219,176	$ 1,094,906	N/A*
RIM	$ 324,822	$ 1,886,660	0.17

*Low Income is offered at no cost to participants; PCT is not calculable.

Plans for 2021

The agencies will start the year with new contracts and a full allocation of funds as a result of the increase granted in August 2020. It is anticipated that a seventh community action agency will participate in Avista funding in Q1 2021 to serve a small number of residential customers located in Franklin County.

The measures available for full reimbursement will include everything mentioned previously with the exception of two measures that will fall under the qualified rebate list: heat pump water heaters and replacement air-source heat pumps.

As a dual-fuel utility, Avista does not impose requirements to serve a certain amount of electric- or natural gas-heated homes each year. Each CAP is provided with the flexibility to serve the needs of the qualified customer it identifies during a program year. As mentioned previously, the measures that appear on the approved and qualified list may fluctuate annually based on utility cost-effectiveness tests. The flexibility given to the health, safety, and repair allocation does allow for non-cost-effective measures identified on the qualified list to be fully funded. Except for the pandemic year, the agencies have demonstrated the ability to spend most of their utility allocation. With the increase to the percentages in the administration/program support category, the company will work with its advisory group on a periodic review of this allocation.

Avista has retained a consultant to conduct a research study on non-energy impacts (NEIs) in 2021. Based on the outcome of this study, low-income energy-efficiency measures may see an increase in cost-effectiveness, as NEIs are quantified and verified, and included in future cost-effectiveness calculations.

Avista will continue to revisit savings assumptions for UES measures as part of its annual business planning process. The company also continues to re-evaluate the units used to set program participation goals for the year. Finally, Avista will ensure that the TRM is updated to reflect any UES adjustments.

Community Energy Efficiency Program

TABLE 39 – COMMUNITY ENERGY EFFICIENCY PROGRAM METRICS

Community Energy Efficiency Program Summary – Electric		2020
Participation, Savings, and Costs		
Conservation projects		21
Overall kWh savings		130,805
Incentive spend	$	590,299
Non-incentive utility costs	$	513,303
Washington energy-efficiency rider spend	$	1,103,602

Note: CEEP accomplishments have been included within the Low-Income program.

In addition to the company's Low-Income program delivered by community action agencies, Avista partners with the Community Energy Efficiency Program (CEEP) to deliver energy-efficiency programs for hard-to-reach markets such as rental properties, homes with alternative heat, low- to moderate-income households, and small businesses. Created by the Washington State Legislature in 2009, CEEP was initially funded by the American Recovery and Reinvestment Act. Since then CEEP has developed into a mature program with support from the Washington State Capital Budget. Washington State University Energy Program executes and manages the program in conjunction with CEEP partners to provide support to homeowners and small businesses across the state that may not benefit from traditional energy-efficiency programs.

Avista's current CEEP contract is for $750,000 and is matched with energy efficiency tariff rider funds. The contract is set to end June 2021 and includes three components. The primary component includes improvements for multifamily housing that may include but are not limited to HVAC systems and controls, building envelope, weatherization measures, and lighting. To date, three properties totaling 68 units in two rural communities have received the benefit of this program; measures included ductless heat pumps, windows, insulation, lighting, and other health and safety installations.

A secondary CEEP program component converts income-qualified, single-family homes that use alternative heat (e.g. oil or wood) to high-efficiency heat pump systems. Once the home has been converted, it becomes eligible for utility program consideration since it now uses company-provided electricity for heat. The home will then be weatherized with either CEEP funds or other weatherization funding sources. Three of the company's community action agency partners are assisting with delivering these two program components spanning three counties in Avista's service territory. At the time of this writing, two homes have been served under this initiative. Identification and installation of projects slowed down considerably with COVID-19 protocols in place since March 2020.

A third component encourages energy-efficiency improvements for businesses in rural communities by providing a financial match if the project is eligible for utility rebates. Avista has made a concerted effort to reach all 63 communities who receive service in Washington to offer a comprehensive approach in the identification of – and estimating costs for – these potential projects. At the time of this writing, over a dozen properties have or will receive a CEEP match for a variety of improvements including lighting, HVAC, and insulation. The CEEP match, along with the utility incentive, has resulted in a low out-of-pocket expense for these customers, many of whom provide services that are relevant to the community. Keeping these businesses operating with lower energy costs allows the businesses to continue to grow and develop in their communities.

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Columbia River, Kettle Falls, Washington

CLEAN ENERGY TRANSFORMATION ACT IMPLEMENTATION

Senate Bill (SB) 5116, otherwise known as the Clean Energy Transformation Act (CETA), was approved by the Washington State Legislature in 2019. Avista, in collaboration with commission staff and consumer advocacy groups, participated in various rule-making workshops relating to CETA in 2020. One key subsection within SB 5116 introduces the Clean Energy Implementation Plan (CEIP). A CEIP must describe the utility's plan for making progress toward meeting the clean energy transformation standards while the utility continues to pursue all cost-effective, reliable, and feasible conservation and efficiency resources. The utility must also provide equitable distribution of energy and non-energy benefits, as well as help vulnerable populations and highly impacted communities. During 2020, Avista's focus was on the establishment of internal workgroups, participation in rulemaking workshops, and providing comments on the development of CETA language.

In 2021, Avista will focus on the creation of the equity advisory group that will provide guidance on best avenues to provide equitable benefits to highly impacted communities and vulnerable populations within Avista's Washington service territory. The company will also create a plan to mitigate risks for these populations. Much of the work in 2021 will focus on enlisting community partners such as community action agencies, stakeholders, and other groups that focus on serving customers from a health, safety, and security perspective. Avista will also pilot approaches to identify data gaps and other barriers to ensure an equitable distribution of energy and non-energy impacts.

Gateway Bridge, Spokane, Washington

Program-by-Program Summaries

Active Energy Management

Description

Consistent with the goals to be carbon-neutral by 2030 and carbon-free by 2045 – and also aligning efficiency requirements on commercial buildings – the Active Energy Management (AEM) pilot focuses on the exploration of clean energy transformation for commercial buildings. As an example of Avista's commitment to leadership in innovation and clean energy, the company is using its resources to design, own, and operate an eco-district development in Spokane's University District. The development, which is funded by shareholder investment, illustrates how net-zero and carbon-free developments can be economically sustainable. In addition, the Catalyst building, located in the eco-district, will house the best and brightest from private industry and academia to test and certify new technologies and create jobs that enable a clean energy future.

The AEM pilot will procure a technology platform license as well as services to deploy and operate the program. It will use eco-district communication networks, cloud services, and data-mining algorithms to capture, process, and disseminate actionable information to participants in the program – including buildings outside of the eco-district. The technology platform will provide a framework to evaluate building performance with or without the deployment of AEM.

The HUB building, located in the South Landing Eco-District, contains the central plant that consists of heat pumps, boilers, chillers, solar generation, and electric and thermal storage. In addition to the central plant, the HUB building will house the operations center for the central plant, the energy-efficiency demonstration area, and other tenants. Avista will occupy a portion of a HUB building floor and operate an energy-efficiency lab and staff to evaluate, demonstrate, and train customers in the latest energy-efficiency appliances and tools. The vision is to use this building and its HVAC systems as a learning center for customers to understand and optimize their own energy consumption.

Program Activities

Although AEM implementation activities were put on hold in 2020 due to COVID-19, the AEM initiative achieved a number of milestones.

The HUB building was completed in summer 2020. A virtual grand opening was held on September 17, featuring talks by executives from Avista, McKinstry, Katerra, Michael Green Architecture, and Eastern Washington University explaining how the South Landing area is changing the use of energy, the design of buildings, and collaboration across multiple businesses and institutions in the Inland Northwest. In October 2020, Edo was selected as the consultant to assist Avista in developing the AEM pilot plan. Edo, a joint investment between Avista Development and McKinstry, is a building efficiency and grid optimization business.

The pilot design process launched in October with a series of kickoff workshops that identified key pilot elements and determined the most appropriate pilot design concept. The final product of these workshops will be a pilot charter.

Plans for 2021

The design process will continue in 2021. As it advances and COVID-19 restrictions ease, the pilot program team will determine whether a launch in 2021 is feasible.

Residential Home Energy Audit Pilot Program

Description

Taking advantage of previous experience and aligning with industry best practices, Avista launched a pilot Home Energy Audit program in 2019. Eligible participants included residential customers who use Avista energy as their primary heating source and are located in Kootenai County, Idaho or in Spokane County, Washington. The program was implemented by Avista using a contract auditor.

The contract auditor conducted in-person energy audits in customer homes. Audit findings and energy-efficiency recommendations were discussed with the customer and documented in an audit report, which was later sent by both email and postal mail to customers. Customers were also given low-cost efficiency items if needed. Where applicable/feasible, items were directly installed by the auditor at the time of the audit. Energy savings were captured for LED lamps, power strips, low-flow showerheads, and low-flow faucet aerators. Other low-cost efficiency items were left behind for the customer to self-install if warranted. These items included rope caulk, plastic window film kits, foam outlet and switch-plate gaskets, door sweeps, and weather-stripping. Customers were then interviewed for feedback on the program.

Program Activities

In early 2020, Avista gained support from the energy-efficiency advisory group and commission staff for both Washington and Idaho to move the program from pilot to full program status. Modifications to program marketing materials and agreement forms were underway prior to the COVID-19 pandemic. COVID-19 restrictions effectively suspended the Home Energy Audit program. As a result, no audits were conducted in 2020.

Plans for 2021

The program will resume as planned when COVID-19 restrictions are eased. The home energy audit pilot program will be scaled up and offered across the utility's entire Idaho and Washington service territory. Based on pilot program participation, Avista estimates that 200 audits will be conducted between the two states per year. Customer education about energy efficiency and cross-program awareness will be key focus areas. Avista will also continue to work closely with community agency partners to serve vulnerable populations with this program offering.

Qualifying customers are residential customers using an Avista fuel for space heating. Single-family homes, multifamily homes up to a four-plex, and condominium homes are eligible to participate. Multifamily homes with five or more units will be considered on a case-by-case basis.

Residential Always-On Behavioral Program

Description

Avista has identified a new opportunity to provide additional customer-facing value from the Washington Advanced Metering Infrastructure (AMI) deployment. The targeted load behavioral program will use AMI-based non-intrusive load monitoring to identify the electricity loads that are present within a residence. Load information will be shared with customers to better inform them of tailored energy-efficiency solutions.

The initial target of the program will be reductions in always-on load. This target was selected because, on average, 23 percent of a customer's bill can be attributed to always-on loads, and because calculations related to determining always-on loads are accurate. An additional benefit of targeting always-on loads is that significant improvements can be achieved with low- or no-cost behavioral interventions, such as turning off computers when not in use. The pilot program will target customers with the highest third of residential always-on loads. An initial communication to customers will include their personalized information regarding always-on usage, associated costs, tips to reduce the load, and anticipated cost savings. Subsequent communications, sent monthly, will update customers on their progress toward reducing always-on usage. Avista will track and report on observed energy savings as a result of the program.

Avista is developing this program in collaboration with Bidgely, WUTC energy-efficiency staff, and E2e, a joint venture between UC Berkeley, the University of Chicago, and MIT.

Program Activities

The program was in design phase in 2020.

Plans for 2021

Design activities will continue into 2021, with program delivery planned for the fourth quarter of 2021.

Pilot Programs On Hold

The following pilot programs were put on hold in 2020 due to COVID-19:

Small Business Lighting Direct Install Pilot – The Small Business Lighting Direct Install pilot is designed to service hard-to-reach small business customers within Avista's service territory. The criteria for participation is still in development; it will, however, have similar criteria to the company's MFDI program for area lighting. Initially, the pilot will select 25 customers to participate and its cost-effectiveness will be evaluated.

Luminaire Level Lighting Control (LLLC)/Networked Lighting Pilot – Avista will pilot LLLC for 20 customers in order to determine whether additional efficiencies can be gained by fine-tuning lighting within a commercial/industrial building. Avista will work with the customers to add LLLC or networked lighting in a space in the customer's building prior to a lighting upgrade of 50 percent or greater. The goal of the pilot is to show the additional energy savings derived from the additional network controls.

Energy Use Index (EUI) Retrofit Pilot – The EUI pilot will encourage customers toward a more efficient use of their energy. The pilot will use a pay-for-performance approach with the goal of achieving 50 percent of the customer's previous energy use. Facilities must do at least 25 percent of their buildings' square footage, and there must be a way to accurately measure at a sub-panel for performance. The pilot will be limited to five customers.

Tool-Lending Pilot – The Tool-Lending pilot will be a two-year program allowing tool lending to Avista customers from a public space in the eco-district. The library of tools will include the current stock of energy efficiency-related equipment, but will also include some newer technologies that provide more insight into energy use. In addition to training, the program will include shipping the tools and training materials to customers who are not in the immediate area.

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Pullman, Washington

REGIONAL MARKET TRANSFORMATION

Avista's local energy-efficiency portfolio consists of programs and supporting infrastructure designed to enhance and accelerate the saturation of energy-efficiency measures throughout its service territory through a combination of financial incentives, technical assistance, program outreach, and education.

It is not feasible for Avista to independently have a meaningful impact on regional or national markets. Consequently, utilities within the Northwest have worked together through NEEA to address opportunities that are beyond the ability or reach of individual utilities. Avista has been participating in and funding NEEA since it was founded in 1997.

Table 40 shows the 2020 NEEA forecast savings versus actual savings and the associated costs for Washington. The costs exclude internal administrative costs associated with participation in the various NEEA surveys ($15,397 in Washington for 2020).

TABLE 40 – NEEA ENERGY SAVINGS AND PARTICIPATION COSTS

Fuel Type	2020 NEEA Energy Savings	2020 NEEA Participation Costs	Avista 2020-2024 Funding Share
Electric	8,406.8 MWh (0.96 aMW)	$ 1,204,129	3.95%
Natural Gas	13,490 therms	$ 229,648	15.63%

Electric Energy Savings Share

Values provided in NEEA's 2020 annual report represent the amounts allocated to Avista's service territory, which is a combination of site-based energy savings data (where available) or an allocation of savings based on funding share. Using the latter approach, the funding share for Avista is split between 30 percent for Avista Idaho and 70 percent for Avista Washington (see Table 40). The funding share for Avista varies by funding cycle and within each cycle if the funding composition changes.

Natural Gas Energy Savings Share

NEEA's costs include all expenditures for operations and value delivery; energy savings initiatives; investments in market training and infrastructure; stock assessments, evaluations, data collection, and other regional and program research; emerging technology research and development; and all administrative costs.

Avista's criteria for funding NEEA's market transformation portfolio calls for the portfolio to deliver incrementally cost-effective resources beyond what could be acquired through Avista's local portfolio alone. Avista has historically communicated with NEEA the importance of delivering cost-effective resources to the company's service territory. Avista remains confident that NEEA will continue to offer cost-effective electric market transformation in the foreseeable future. The company will continue to be active in the organizational oversight of NEEA, a critical step in ensuring that geographic equity, cost-effectiveness, and resource acquisition goals of market transformation are met.

Spokane River, Tumtum, Washington

GLOSSARY OF TERMS

advisory group: Avista's group of external stakeholders who comment about the company's energy efficiency activities.

Active Energy Management (AEM): The implementation of continuous building monitoring to improve building performance in real time.

Adjusted Market Baseline (AMB): Based on the RTF guidelines, represents a measurement between the energy-efficient measure and the standard efficiency case that is characterized by current market practice or the minimum requirements of applicable codes or standards, whichever is more efficient. When applying an Adjusted Market Baseline, no net-to-gross factor would be applied since the resultant unit energy savings amount would represent the applicable savings to the grid.

Advanced Metering Infrastructure (AMI): Systems that measure, collect and analyze energy usage, from advanced devices such as electricity meters, natural gas meters and/or water meters through various communication media on request or on a predetermined schedule.

Air-Conditioning, Heating, and Refrigeration Institute (AHRI): The trade association representing manufacturers of HVACR and water heating equipment within the global industry.

aMW: The amount of energy that would be generated by one megawatt of capacity operating continuously for one full year. Equals 8,760 MWhs of energy.

American National Standards Institute (ANSI): A source for information on national, regional, and international standards and conformity assessment issues.

American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE): Devoted to the advancement of indoor-environment-control technology in the heating, ventilation, and air conditioning (HVAC) industry, ASHRAE's mission is "to advance technology to serve humanity and promote a sustainable world."

Annual Conservation Plan (ACP): An Avista-prepared resource document that outlines Avista's conservation offerings, its approach to energy efficiency, and details on verifying and reporting savings.

Annual Conservation Report (ACR): An Avista-prepared resource document that summarizes its annual energy efficiency achievements.

Annual Fuel Utilization Efficiency (AFUE): A measurement on how efficiently a furnace or boiler uses its fuel.

Applied Energy Group (AEG): A consulting service that provides a wide range of energy efficiency and demand response-related management services to assist clients in designing and implementing programs for their customers.

avoided cost: An investment guideline, describing the value of conservation and generation resource investments in terms of the cost of more expensive resources that would otherwise have to be acquired.

baseline: Conditions, including energy consumption, which would have occurred without implementation of the subject energy efficiency activity. Baseline conditions are sometimes referred to as "business-as-usual" conditions.

baseline efficiency: The energy use of the baseline equipment, process, or practice that is being replaced by a more efficient approach to providing the same energy service. It is used to determine the energy savings obtained by the more efficient approach.

baseline period: The period of time selected as representative of facility operations before the energy efficiency activity takes place.

Biennial Conservation Plan (BCP): An Avista-prepared resource document that outlines Avista's conservation offerings, its approach to energy efficiency, and details on verifying and reporting savings for a two-year period.

Building Owners & Managers Association (BOMA): An international federation of U.S. local associations and global affiliates that represents the owners, managers, service providers, and other property professionals of all commercial building types.

Business Partner Program (BPP): An outreach effort designed to raise awareness of utility programs and services that can assist rural small business customers in managing their energy bills.

British Thermal Unit (Btu): The amount of heat energy necessary to raise the temperature of one pound of water one degree Fahrenheit (3,413 BTUs are equal to one kilowatt-hour).

busbar: The physical electrical connection between the generator and transmission system. Typically load on the system is measured at busbar.

capacity: The maximum power that a machine or system can produce or carry under specified conditions. The capacity of generating equipment is generally expressed in kilowatts or megawatts. In terms of transmission lines, capacity refers to the maximum load a line is capable of carrying under specified conditions.

Clean Energy Implementation Plan (CEIP): Introduced within a subsection of the Clean Energy Transformation Act, a CEIP must describe the utility's plan for making progress toward meeting the clean energy transformation standards while it continues to pursue all cost-effective, reliable, and feasible conservation and efficiency resources.

Clean Energy Transformation Act (CETA): Signed into law in 2019, the Clean Energy Transformation Act requires electric utilities to supply their Washington customers with 100 percent renewable or non-emitting electricity with no provision for offsets.

Coefficient of Performance (COP): A ratio of useful heating or cooling provided to work (energy) required for heat pumps, refrigerators or air conditioning systems. Higher COPs equate to more efficient systems and lower operating costs.

Community Action Partnership (CAP): General term for Community Action Programs, Community Action Agencies, and Community Action Centers that provide services such as low-income weatherization through federal and state and other funding sources (e.g. utility constitutions).

Community Energy Efficiency Program (CEEP): Created by the Washington State Legislature in 2009, CEEP encourages homeowners and small businesses across the state to make energy-efficiency retrofits and upgrades.

conservation: According to the Northwest Power Act, any reduction in electric power consumption as a result of increases in the efficiency of energy use, production or distribution.

Conservation Potential Assessment (CPA): An analysis of the amount of conservation available in a defined area. Provides savings amounts associated with energy efficiency measures to input into the Company's Integrated Resource Planning (IRP) process.

cooling degree days: A measure of how hot the temperature was on a given day or during a period of days. A day with a mean temperature of 80°F has 15 cooling degree days. If the next day has a mean temperature of 83°F, it has 18 cooling degree days.

cost-effective: According to the Northwest Power Act, a cost-effective measure or resource must be forecast to be reliable and available within the time it is needed, and to meet or reduce electrical power demand of consumers at an estimated incremental system cost no greater than that of the least-costly, similarly reliable and available alternative or combination of alternatives.

curtailment: An externally imposed reduction of energy consumption due to a shortage of resources.

customer/customer classes: A category(ies) of customer(s) defined by provisions found in tariff(s) published by the entity providing service, approved by the PUC. Examples of customer classes are residential, commercial, industrial, agricultural, local distribution company, core and non-core.

decoupling: In conventional utility regulation, utilities make money based on how much energy they sell. A utility's rates are set based largely on an estimation of costs of providing service over a certain set time period, with an allowed profit margin, divided by a forecasted amount of unit sales over the same time period. If the actual sales turn out to be as forecasted, the utility will recover all of its fixed costs and its set profit margin. If the actual sales exceed the forecast, the utility will earn extra profit.

deemed savings: Primarily referenced as unit energy savings, an estimate of an energy savings for a single unit of an installed energy efficiency measure that (a) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and (b) is applicable to the situation being evaluated.

demand: The load that is drawn from the source of supply over a specified interval of time (in kilowatts, kilovolt-amperes, or amperes). Also, the rate at which natural gas is delivered to or by a system, part of a system or piece of equipment, expressed in cubic feet, therms, BTUs or multiples thereof, for a designated period of time such as during a 24-hour day.

Demand Response (DR): A voluntary and temporary change in consumers' use of electricity when the power system is stressed.

Demand Side Management (DSM): The process of helping customers use energy more efficiently. Used interchangeably with Energy Efficiency and Conservation although conservation technically means using less while DSM and energy efficiency means using less while still having the same useful output of function.

Direct Load Control (DLC): The means by which a utility can signal a customer's appliance to stop operations in order to reduce the demand for electricity. Such rationing generally involves a financial incentive for the affected customer.

discount rate: The rate used in a formula to convert future costs or benefits to their present value.

distribution: The transfer of electricity from the transmission network to the consumer. Distribution systems generally include the equipment to transfer power from the substation to the customer's meter.

Distributed Generation (DG): An approach that employs a variety of small-scale technologies to both produce and store electricity close to the end users of power.

Effective Useful Life (EUL): Sometimes referred to as measure life and often used to describe persistence. EUL is an estimate of the duration of savings from a measure.

Emergency Operating Plan (EOP): A plan that assigns responsibility to organizations and individuals for carrying out specific actions to respond to an emergency. An EOP sets forth lines of authority, lays out organizational roles and responsibilities during an emergency, and illustrates how actions will be coordinated. An EOP also describes how people and property will be be protected in emergencies and natural disasters, and identifies personnel, equipment, facilities and supplies to use during recovery operations.

end-use: A term referring to the final use of energy; it often refers to the specific energy services (for example, space heating), or the type of energy-consuming equipment (for example, motors).

energy assistance advisory group: An ongoing energy assistance program advisory group to monitor and explore ways to improve Avista's Low-Income Rate Assistance Program (LIRAP).

Energy Efficiency Advisory Group (EEAG): A group which advises investor-owned utilities on the development of integrated resource plans and conservation programs.

energy-efficiency measure: Refers to either an individual project conducted or technology implemented to reduce the consumption of energy at the same or an improved level of service. Often referred to as simply a "measure."

Energy Independence Act (EIA): Requires electric utilities serving at least 25,000 retail customers to use renewable energy and energy conservation.

Energy Use Intensity (EUI): A metric – energy per square foot per year – that expresses a building's energy use as a function of its size or other characteristics.

evaluation: The performance of a wide range of assessment studies and activities aimed at determining the effects of a program (and/or portfolio) and understanding or documenting program performance, program or program-related markets and market operations, program-induced changes in energy efficiency markets, levels of demand or energy savings, or program cost-effectiveness. Market assessment, monitoring and evaluation, and verification are aspects of evaluation.

Evaluation, Measurement and Verification (EM&V): Catch-all term for evaluation activities at the measure, project, program and/or portfolio level; can include impact, process, market and/or planning activities. EM&V is distinguishable from Measurement and Verification (M&V) defined below.

ex-ante savings estimate: Forecasted savings value used for program planning or savings estimates for a measure; Latin for "beforehand."

ex-post evaluated estimated savings: Savings estimates reported by an independent, third-party evaluator after the energy impact evaluation has been completed. If only the term "ex-post savings" is used, it will be assumed that it is referring to the ex-post evaluation estimate, the most common usage; from Latin for "from something done afterward."

external evaluators (AKA third party evaluators): Independent professional efficiency person or entity retained to conduct EM&V activities. Consideration will be made for those who are Certified Measurement and Verification Professionals (CMVPs) through the Association of Energy Engineers (AEE) and the Efficiency Evaluation Organization (EVO).

free rider: A common term in the energy efficiency industry meaning a program participant who would have installed the efficient product or changed a behavior regardless of any program incentive or education received. Free riders can be total, partial, or deferred.

generation: The act or process of producing electricity from other forms of energy.

Green Motors Practices Group (GMPG): A nonprofit corporation governed by electric motor service center executives and advisors whose goal is the continual improvement of the electric motor repair industry.

gross savings: The change in energy consumption and/or demand that results from energy efficiency programs, codes and standards, and naturally-occurring adoption which have a long-lasting savings effect, regardless of why they were enacted.

heating degree days: A measure of the amount of heat needed in a building over a fixed period of time, usually a year. Heating degree days per day are calculated by subtracting from a fixed temperature the average temperature over the day. Historically, the fixed temperature has been set at 65 degrees Fahrenheit, the outdoor temperature below which heat was typically needed. As an example, a day with an average temperature of 45 degrees Fahrenheit would have 20 heating degree days, assuming a base of 65 degrees Fahrenheit.

Heating Seasonal Performance Factor (HSPF): Defined as the ratio of heat output over the heating season to the amount of electricity used in air source or ductless heat pump equipment.

Heating, Ventilation, and Air Conditioning (HVAC): Sometimes referred to as climate control, the HVAC is particularly important in the design of medium to large industrial and office buildings where humidity and temperature must all be closely regulated whilst maintaining safe and healthy conditions within.

impact evaluation: Determination of the program-specific, directly or indirectly induced changes (e.g., energy and/or demand usage) attributable to an energy efficiency program.

implementer: Avista employees whose responsibilities are directly related to operations and administration of energy efficiency programs and activities, and who may have energy savings targets as part of their employee goals or incentives.

incremental cost: The difference between the cost of baseline equipment or services and the cost of alternative energy-efficient equipment or services.

Integrated Resource Plan (IRP): An IRP is a comprehensive evaluation of future electric or natural gas resource plans. The IRP must evaluate the full range of resource alternatives to provide adequate and reliable service to a customer's needs at the lowest possible risk-adjusted system cost. These plans are filed with the state public utility commissions on a periodic basis.

Integrated Resource Plan Technical Advisory Committee (IRP TAC): Advisory committee for the IRP process that includes internal and external stakeholders.

International Performance Measurement and Verification Protocol (IPMVP): A guidance document with a framework and definitions describing the four M&V approaches; a product of the Energy Valuation Organization (www.evo-world.org).

Investor-owned utility (IOU): A utility that is organized under state law as a corporation to provide electric power service and earn a profit for its stockholders.

Kilowatt (kW): The electrical unit of power that equals 1,000 watts.

Kilowatt-hour (kWh): A basic unit of electrical energy that equals one kilowatt of power applied for one hour.

Kilo British Thermal Unit (kBTU): BTU, which stands for British thermal units, measures heat energy. Each BTU equals the amount of heat needed to raise one pound of water one degree Fahrenheit; the prefix kilo- stands for 1,000, which means that a kBTU equals 1,000 BTU.

Levelized Cost of Energy (LCOE): The present value of a resource's cost (including capital, financing, and operating costs) converted into a stream of equal annual payments. This stream of payments can be converted to a unit cost of energy by dividing them by the number of kilowatt-hours produced or saved by the resource in associated years. By levelizing costs, resources with different lifetimes and generating capabilities can be compared.

line losses: The amount of electricity lost or assumed lost when transmitting over transmission or distribution lines. This is the difference between the quantity of electricity generated and the quantity delivered at some point in the electric system.

Low-Income Home Energy Assistance Program (LIHEAP): Federal energy assistance program, available to qualifying households based on income, usually distributed by community action agencies or partnerships.

Low-Income Rate Assistance Program (LIRAP): LIRAP provides funding (collected from Avista's tariff rider) to CAP agencies for distribution to Avista customers who are least able to afford their utility bill.

market effect evaluation: An evaluation of the change in the structure or functioning of a market, or the behavior of participants in a market, that results from one or more program efforts. Typically, the resultant market or behavior change leads to an increase in the adoption of energy-efficient products, services, or practices.

measure (also Energy Efficiency Measure or "EEM"): Installation of a single piece of equipment, subsystem or system, or single modification of equipment, subsystem, system, or operation at an end-use energy consumer facility, for the purpose of reducing energy and/or demand (and, hence, energy and/or demand costs) at a comparable level of service.

measure life: See Effective Useful Life (EUL).

Measurement and Verification (M&V): A subset of program impact evaluation that is associated with the documentation of energy savings at individual sites or projects, using one or more methods that can involve measurements, engineering calculations, statistical analyses, and/or computer simulation modeling. M&V approaches are defined in the International Performance Measurement and Verification Protocol (IPMVP available at www.evo-world.org).

Megawatt (MW): The electrical unit of power that equals one million watts or one thousand kilowatts.

Megawatt-hour (MWh): A basic unit of electrical energy that equals one megawatt of power applied for one hour.

net savings: The change in energy consumption and/or demand that is attributable to an energy efficiency program. This change in energy use and/or demand may include, implicitly or explicitly, consideration of factors such as free drivers, non-net participants (free riders), participant and non-participant spillover, and induced market effects. These factors may be considered in how a baseline is defined and/or in adjustments to gross savings values.

Non-Energy Benefit/Non-Energy Impact (NEB/NEI): The quantifiable non-energy impacts associated with program implementation or participation; also referred to as non-energy benefits (NEBs) or co-benefits. Examples of NEIs include water savings, non-energy consumables and other quantifiable effects. The value is most often positive, but may also be negative (e.g., the cost of additional maintenance associated with a sophisticated, energy-efficient control system).

Northwest Energy Efficiency Alliance (NEEA): A nonprofit organization that works to accelerate energy efficiency in the Pacific Northwest through the adoption of energy-efficient products, services, and practices.

Northwest Power and Conservation Council (NWPCC): An organization that develops and maintains both a regional power plan and a fish and wildlife program to balance the environmental and energy needs of the Pacific Northwest.

Outside Air Temperature (OAT): Refers to the temperature of the air around an object, but unaffected by the object.

On-Bill Repayment/Financing (OBR): A financing option in which a utility or private lender supplies capital to a customer to fund energy efficiency, renewable energy, or other generation projects. It's repaid through regular payments on an existing utility bill.

portfolio: Collection of all programs conducted by an organization. In the case of Avista, portfolio includes electric and natural gas programs in all customer segments. Portfolio can also be used to refer to a collection of similar programs addressing the market. In this sense of the definition, Avista has an electric portfolio and a natural gas portfolio with programs addressing the various customer segments.

prescriptive: A prescriptive program is a standard offer for incentives for the installation of an energy efficiency measure. Prescriptive programs are generally applied when the measures are employed in relatively similar applications.

process evaluation: A systematic assessment of an energy efficiency program or program component for the purposes of documenting operations at the time of the examination, and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources while maintaining high levels of participant satisfaction.

program: An activity, strategy or course of action undertaken by an implementer. Each program is defined by a unique combination of program strategy, market segment, marketing approach and energy efficiency measure(s) included. Examples are a program to install energy-efficient lighting in commercial buildings and residential weatherization programs.

project: An activity or course of action involving one or multiple energy efficiency measures at a single facility or site.

Regional Technical Forum of the Northwest Power and Conservation Council (RTF): A technical advisory committee to the Northwest Power and Conservation Council established in 1999 to develop standards to verify and evaluate energy efficiency savings.

Realization Rate (RR): Ratio of ex-ante reported savings to ex-post evaluated estimated savings. When realization rates are reported, they are labeled to indicate whether they refer to comparisons of 1) ex-ante gross reported savings to ex-post gross evaluated savings, or 2) ex-ante net reported savings to ex-post net evaluated savings.

reliability: When used in energy efficiency evaluation, the quality of a measurement process that would produce similar results on (a) repeated observations of the same condition or event, or (b) multiple observations of the same condition or event by different observers. Reliability refers to the likelihood that the observations can be replicated.

reported savings: Savings estimates reported by Avista for an annual (calendar) period. These savings will be based on best available information.

Request for Proposal (RFP): Business document that announces and provides details about a project, as well as solicits bids from potential contractors.

retrofit: To modify an existing generating plant, structure, or process. The modifications are done to improve energy efficiency, reduce environmental impacts, or to otherwise improve the facility.

rigor: The level of expected confidence and precision. The higher the level of rigor, the more confident one is that the results of the evaluation are both accurate and precise, i.e., reliable.

R-value or R-factor (resistance transfer factor): Measures how well a barrier, such as insulation, resists the conductive flow of heat.

schedules 90 and 190: Rate schedules that show energy efficiency programs.

schedules 91 and 191: Rate schedules that are used to fund energy efficiency programs.

sector(s): The economy is divided into four sectors for energy planning. These are the residential, commercial (e.g., retail stores, office and institutional buildings), industrial, and agriculture (e.g. dairy farms, irrigation) sectors.

site-specific: A non-residential program offering individualized calculations for incentives upon any electric or natural gas efficiency measure not incorporated into a prescriptive program.

simple payback: The time required before savings from a particular investment offset costs, calculated by investment cost divided by value of savings (in dollars). For example, an investment costing $100 and resulting in a savings of $25 each year would be said to have a simple payback of four years. Simple paybacks do not account for future cost escalation, nor other investment opportunities.

spillover: Reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without direct financial or technical assistance from the program. There can be participant and/or nonparticipant spillover (sometimes referred to as "Free Drivers"). Participant spillover is the additional energy savings that occur as a result of the program's influence when a program participant independently installs incremental energy efficiency measures or applies energy-saving practices after having participated in the energy efficiency program. Non-participant spillover refers to energy savings that occur when a program non-participant installs energy efficiency measures or applies energy savings practices as a result of a program's influence.

technical reference manual (TRM): An Avista-prepared resource document that contains Avista's (ex-ante) savings estimates, assumptions, sources for those assumptions, guidelines, and relevant supporting documentation for its natural gas and electricity energy efficiency prescriptive measures. This document is populated and vetted by the RTF and 3rd party evaluators.

Total Resource Cost (TRC) test: A cost-effectiveness test that assesses the impacts of a portfolio of energy-efficiency initiatives regardless of who pays the costs or who receives the benefits. The test compares the present value of costs of efficiency for all members of society (including all costs to participants and program administrators) compared to the present value of all quantifiable benefits, including avoided energy supply and demand costs and non-energy impacts.

transmission: The act or process of long-distance transport of electric energy, generally accomplished by elevating the electric current to high voltages. In the Pacific Northwest, Bonneville operates a majority of the high-voltage, long-distance transmission lines.

Uniform Energy Factor (UEF): A measurement on how efficiently a water heater utilizes its fuel.

Unit Estimated Savings (UES): Defines the first year kWh savings value for an energy efficiency measure.

U-value or U-factor: The measure of a material's ability to conduct heat, numerically equal to 1 divided by the value of the material. Used to measure the rate of heat transfer in windows. The lower the u-factor, the better the window insulates

uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall within some degree of confidence.

Utility Cost Test (UCT): One of the four standard practice tests commonly used to evaluate the cost-effectiveness of DSM programs. The UCT evaluates the cost-effectiveness based upon a program's ability to minimize overall utility costs. The primary benefits are the avoided cost of energy in comparison to the incentive and non-incentive utility costs.

Variable Frequency Drive (VFD): A type of motor drive used in electro-mechanical drive systems to control AC motor speed and torque by varying motor input frequency and voltage.

verification: An assessment that the program or project has been implemented per the program design. For example, the objectives of measure installation verification are to confirm (a) the installation rate, (b) that the installation meets reasonable quality standards, and (c) that the measures are operating correctly and have the potential to generate the predicted savings. Verification activities are generally conducted during on-site surveys of a sample of projects. Project site inspections, participant phone and mail surveys, and/or implementer and consumer documentation review are typical activities association with verification. Verification may include one-time or multiple activities over the estimated life of the measures. It may include review of commissioning or retro-commissioning documentation. Verification can also include review and confirmation of evaluation methods used, samples drawn, and calculations used to estimate program savings. Project verification may be performed by the implementation team, but program verification is a function of the 3rd party evaluator.

Washington Utilities and Transportation Commission (WUTC): A three-member commission appointed by the governor and confirmed by the state senate, whose mission is to protect the people of Washington by ensuring that investor-owned utility and transportation services are safe, available, reliable, and fairly priced.

weather normalized: This is an adjustment that is made to actual energy usage, stream-flows, etc., which would have happened if "normal" weather conditions would have taken place.

Weighted Average Cost of Capital (WACC): A calculation of a firm's cost of capital in which each category of capital is proportionately weighted. All sources of capital, including common stock, preferred stock, bonds, and any other long-term debt, are included in a WACC calculation.

8760: Total number of hours in a year.

APPENDICES AND SUPPLEMENTS

Highway 231, Springdale, Washington

APPENDIX A – 2020 WASHINGTON ELECTRIC IMPACT EVALUATION REPORT – COMMERCIAL/INDUSTRIAL

CADMUS

Washington 2020 Electric Impact Evaluation Report

April 9, 2021

Prepared for:

Avista Corporation
1411 East Mission Avenue
Spokane, WA 99202

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Portfolio Executive Summary

For several decades, Avista Corporation (Avista) has administered demand-side management (DSM) programs to reduce electricity and natural gas energy use by its customer portfolio. While Avista has implemented most of these programs in-house, external vendors have fulfilled some of them.

Avista contracted with Cadmus to complete process and impact evaluations of its program year (PY) 2020 electric DSM Nonresidential and Multifamily Residential programs in Washington. This report presents the electric impact evaluation findings for PY 2020. Cadmus did not apply net-to-gross (NTG) adjustments to savings values, except where deemed energy savings values already incorporated NTG as a function of the market baseline.

Evaluation Methodology and Activities

Table 1 shows the variety of methods and activities Cadmus completed for the Washington electric portfolio evaluation.

Table 1. Electric Program Evaluation Activities

Sector	Program	Document/ Database Review	Verification/ Virtual Site Visit
Nonresidential	Prescriptive (multiple)	✓	✓
	Site Specific	✓	✓
Multifamily	Multifamily Direct install	✓	--
	Supplemental Lighting	✓	--

Summary of Impact Evaluation Results

The Nonresidential and Multifamily Washington electric energy efficiency programs achieved a 91% realization rate and acquired 22,324,517 kWh in evaluated savings, as shown in Table 2. Cadmus collected Avista-reported savings through database extracts, drawn from Avista's iEnergy database (Nonresidential) and from data provided by the third-party implementor (MFDI).

Despite the COVID-19 pandemic reducing participation in both the Nonresidential and Multifamily sectors, most programs Cadmus evaluated performed strongly relative to reported savings in PY 2020.

Table 2. Reported and Evaluated Energy Efficiency Electric Savings

Sector	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Nonresidential	22,723,395	20,584,356	91%
Multifamily	1,715,647	1,740,162	101%
Total	**24,439,042**	**22,324,517**	**91%**

Conclusions and Recommendations

During the PY 2020 evaluation, Cadmus identified the areas discussed below for improvements by sector.

Nonresidential Conclusions and Recommendations

The Nonresidential sector achieved total evaluated electric energy savings of 20,584 MWh with a 91% combined realization rate. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' electric savings goal of 36,070 MWh, achieving 57% of its goal.

Although some individual project results varied, particularly within the Prescriptive exterior lighting program and the Site Specific lighting program, the overall Nonresidential sector performed strongly in PY 2020 relative to reported savings. Most projects that Cadmus sampled for the evaluation were well documented and matched findings from the remote project verifications.

Avista completed a transition from its previous InforCRM system to the new iEnergy system to track Nonresidential energy efficiency applications and measures prior to the start of PY 2020. Cadmus found that the additional detail provided by the iEnergy system facilitated conducting a detailed and comprehensive evaluation. The team encountered some challenges with inconsistent data in report extracts from iEnergy (i.e., reports with duplicated records) and developed additional quality control processes to identify such issues, working with Avista's technical staff to resolve them. Avista continues to work with the iEnergy vendor to improve the system and integrate feedback.

Cadmus notified Avista in January 2021 of systematic savings discrepancies in sign lighting measures within the Prescriptive exterior lighting program. The team observed a significant increase in sign lighting measures in PY 2020 and found consistently low realization rates on the sign lighting measures evaluated. Avista plans to implement changes to the sign lighting measure effective April 15, 2021, to address these concerns.

Cadmus offers the following conclusions and recommendations to improve the Nonresidential sector's energy savings:

- Cadmus found that savings for some Site Specific projects could have been measured more accurately using control system trends or equipment-level logging, but that trends had not been configured during the baseline period or were overwritten during the project. Trend data are typically higher resolution and more targeted to the upgraded equipment than monthly whole-building utility data but requires engagement with the customer before any changes are made.
    - **Recommendation:** Review M&V plans for Site Specific projects early in the process to ensure that sufficiently detailed baseline data will be available, and work with site contacts to establish trend logs for relevant building management system or industrial control system data points during the baseline period.
- Cadmus evaluated a Site Specific HVAC project where the Y intercept of the HDD regression model was forced to zero. Linear regression models should not have a fixed intercept at zero if there is any non-heating electricity consumption on the meter.
    - **Recommendation:** Ensure that weather regression models account for base load energy consumption that is present even during low heating or cooling demand.
- Cadmus evaluated a Site Specific HVAC project that used whole-building electric billing data to estimate savings, but where multiple unrelated changes in building equipment and operations

occurred during the same period and there was no significant correlation between weather data and electricity consumption.

- **Recommendation:** Be cautious when using whole-building billing data to evaluate electric energy savings for Site Specific projects to ensure that there are sufficient savings to distinguish changes in energy consumption related to the efficiency measure from other changes to building operations or equipment, or from noise in the data. In general, energy savings should be greater than 10% of total consumption for the specific fuel to ensure a reliable savings estimate through billing analysis. Cadmus recommends Avista staff review historical billing data when developing an M&V plan to see if there is a strong correlation between monthly electricity consumption and weather data or other appropriate independent variables. Consider options to use submetering or building control system trend data for larger projects affecting many separate building systems, or consider installing temporary power meters on individual equipment for projects involving systems that can be isolated.

- Cadmus found that Avista's new iEnergy system records additional detailed inputs on some prescriptive measures that were not previously tracked in InforCRM and are not currently used in the savings calculations.
  - **Recommendation:** Review deemed savings values for prescriptive measures and consider opportunities to leverage the additional data now collected in iEnergy to calculate more accurate savings for each participant project. For example, food service measures can use the reported pounds of food cooked per day and cooking hours per day values collected in iEnergy to automatically calculate more precise savings.
- Cadmus found that verified lighting HOU varied from reported HOU in some interior and exterior lighting projects evaluated. Several projects reported correct weekly HOU but did not operate the lights every week of the year. Other projects had different weekly or daily operating hours than had been reported.
  - **Recommendation:** Review HOU estimates when processing applications and conducting installation verifications. When entering average weekly HOU, confirm how many weeks per year that schedule applies. In particular, scrutinize applications claiming 8,760 hours per year.
- Cadmus found that reported fixture quantities for Site Specific lighting projects often did not match invoice quantities, and applications often lack detailed notes explaining these differences. It is often impractical for Avista staff conducting IV inspections or evaluators conducting verification visits to count every fixture for large lighting projects to resolve such discrepancies.
  - **Recommendation:** Include more detailed documentation for Site Specific lighting projects. Lighting drawings should be provided whenever possible, and if any other notes, spreadsheets, or other documentation are used to determine eligible quantities, these should be included with the application records. Any difference between invoice quantities and rebated quantities should be clearly explained.

- Cadmus found variation of up to 3% between reported and evaluated savings on Prescriptive lighting projects due to iEnergy rounding an intermediate value in kilowatt units to two decimal places, which is equivalent to rounding the lighting wattage to the nearest 10 watts.
  - **Recommendation:** Review iEnergy calculations to ensure that rounding is only applied on final displayed values and not to any intermediate values.
- Cadmus found that site contacts at larger facilities often did not know where program equipment was installed or could not recall which equipment was installed during which project if they had completed multiple applications over the course of the year.
  - **Recommendation:** Update all application forms to include space for location notes for each installed measure.
- Cadmus staff found that the detail level in IV reports varied. Many IV reports only mention that "equipment and quantities were verified," and photos sometimes only show the equipment from a distance.
  - **Recommendation:** Provide more consistent documentation with Avista IV reports. Cadmus recommends that all IV reports include basic information explicitly stating the quantity and type of equipment found. For lighting projects, this would include confirmed fixture types, quantities, installation locations, controls, and estimated HOU. For most other equipment, this would include nameplates, model numbers, and quantities.
- Cadmus observed that several Site Specific analyses used historical data from up to four years prior to the completion of the final report. Due to the necessary use of historical data for billing analyses, Cadmus expects that recent changes in business operation due to the COVID-19 pandemic may affect future billing data analysis for several years, even after most business return to normal operations.
  - **Recommendation:** Carefully scrutinize any Site Specific project using utility meter data, equipment trend data, or other timeseries data that may include periods of atypical business operation due to the COVID-19 pandemic. Any such analysis for the next few years should include discussion of potential COVID-19 impacts, whether they affect the proposed analysis methodology, and what steps were taken to adjust the analysis accordingly. If it is determined that the equipment in question was operating normally during the COVID-19 period, this should be noted explicitly in the report so that evaluators are aware that these effects were considered.

Multifamily Direct Install Conclusions and Recommendations

Evaluated electricity savings show a 101% realization rate on evaluated savings of 1,740,162 kWh for MFDI programs, representing 45% of the savings goal for the year.

Cadmus offers the following conclusions and recommendations to improve Avista's MFDI electric programs:

- Cadmus found the MFDI program to be an efficient, effective mechanism for installing high-efficiency lighting and aerators in multifamily units.
  - **Recommendation:** Continue to focus on replacing high-use, low-efficiency lamps where practical to maximize program cost-effectiveness and maintain high savings.
- Cadmus observed the reported savings for the PY 2020 showerhead measure were not calculated using the most current RTF UES values. More specifically, the reported savings for the PY 2020 showerhead measure was based on RTF UES values found in the RTF measure workbook "Showerheads_v3.0" when the RTF measure workbook "Showerheads_v4_3" was available.
  - **Recommendation:** Use the most current RTF UES values to calculate reported savings, and ensure that the TRM provides values for all measures.
- Cadmus observed the reported savings for PY 2020 aerator measures were not calculated using the RTF UES values most appropriate for the MFDI program's building stock. More specifically, reported savings for aerators used a conservative weighted average UES value that would allow for some heat pump water heaters when a UES value for aerators with electric resistance water heaters is more appropriate.
  - **Recommendation:** Use the current RTF UES value for measures that is most appropriate for the MFDI program's building stock.
- Cadmus did not find large-scale problems with the MFDI programs' measure tracking data, but did note numerous occasions where electric HVAC interactive effects were not accounted for in the reported savings calculation for lighting measures in interior common areas with documented electric heating and cooling, or a combination of the two.
  - **Recommendation:** Have the implementer clearly identify the types of spaces that should include HVAC interactive effects and those that should not.
- Cadmus observed several occasions in the MFDI supplemental lighting site data where the reported savings calculations appeared to use custom HOU that were different from deemed HOU values for interior and exterior spaces. Cadmus could not confirm some custom HOU because some spaces did not have an assigned site identification.
  - **Recommendation:** Ensure methodology documentation and reported savings inputs are accurate and provided for all site data.

Nonresidential Impact Evaluation

Through its Nonresidential portfolio of programs, Avista promotes the purchase of high-efficiency equipment to commercial and industrial utility customers. Avista provides rebates to partially offset the difference in cost between high-efficiency equipment and standard equipment. Cadmus conducted Nonresidential impact evaluation activities to determine evaluated savings for all programs with participation; the team conducted measurement and verification (M&V) of Prescriptive and Site Specific projects across the full sample.

Program Summary

Avista completed and provided incentives for 1,827 Nonresidential electric measures in Washington during PY 2020 and reported total electric energy savings of 22,723,395 kWh. Through the Nonresidential sector, Avista offers incentives for high-efficiency equipment and controls through two program paths: Prescriptive and Site Specific.

The Prescriptive program path applies to smaller, straightforward equipment installations that generally have similar operating characteristics (such as lighting, simple HVAC systems, food service equipment, and variable-frequency drives [VFD]). The Site Specific program path applies to more unique projects that require custom savings calculations and technical assistance from Avista's account executives (such as compressed air, process equipment and controls, and comprehensive lighting retrofits).

Program Participation Summary

This section summarizes Nonresidential sector participation and progress toward the PY 2020 goals through the Prescriptive and Site Specific program paths.

Nonresidential Prescriptive Programs

Table 3 shows electric energy savings goals assigned to Avista's Nonresidential Prescriptive programs for PY 2020 as well as reported savings and a comparison between reported savings and goals. Avista's Nonresidential Prescriptive programs achieved 77% of their collective savings goal in PY 2020. The lower participation is likely due to effects from the COVID-19 pandemic, which forced many businesses to reduce their operations or close entirely. For those businesses that remained open, facility and maintenance staff had to prioritize planning for health and safety impacts above energy efficiency concerns.

Table 3. Nonresidential Prescriptive Electric Savings

Program Type	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Interior Lighting	7,796,000	7,639,244	98%
Exterior Lighting	9,078,000	7,151,313	79%
Shell Measure	535,000	38,949	7%
Green Motors	52,000	11,978	23%
Motor Control (VFD)	967,000	166,470	17%
Fleet Heat	400,000	0	0%
Food Service Equipment	158,000	54,257	34%
AirGuardian	42,000	0	0%
Energy Smart Grocer	442,000	0	0%
Total	**19,470,000**	**15,062,211**	**77%**

Table 4 summarizes actual program participation.

Table 4. Nonresidential Prescriptive Participation by Project

Program Type	Number of Applications	Number of Measures
Interior Lighting	418	624
Exterior Lighting	512	855
Shell Measure	10	11
Green Motors	6	6
Motor Control (VFD)	2	2
Fleet Heat	0	0
Food Service Equipment	13	13
AirGuardian	0	0
Energy Smart Grocer	0	0
Total[a]	**961**	**1,511**

[a] Total participants. A single application may contain measures from multiple programs.

Nonresidential Site Specific Program

Table 5 shows electric savings goals assigned to the Site Specific program path in Avista's Nonresidential sector for PY 2020, reported savings, and the percent of goal achieved. The Site Specific program achieved 46% of its PY 2020 savings goal, with participation reduced likely due to effects of the COVID-19 pandemic.

Table 5. Nonresidential Site Specific Electric Savings

Program	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Site Specific	16,600,000	7,661,184	46%

Table 6 summarizes actual program participation for the Site Specific program.

Table 6. Nonresidential Site Specific Participation by Project

Program	Number of Applications	Number of Measures
Site Specific Lighting	60	287
Site Specific Other	26	29
Total	**86**	**316**

Nonresidential Impact Evaluation Methodology

As the first step in evaluating savings for the Nonresidential sector, Cadmus reviewed the following documents and data records to gain an understanding of the programs and measures slated for evaluation:

- Avista's annual business plans, processes, and energy savings justifications
- Project documents from external sources (such as customers, program consultants, or implementation contractors)
- Avista's iEnergy tracking system for Nonresidential programs

Based on the initial review, Cadmus checked the distribution of program contributions with the overall program portfolio. The review provided insight into the sources for unit energy savings (UES) claimed for each measure offered in the programs, along with sources for energy-savings algorithms, internal quality assurance, and quality control processes for large Nonresidential sector projects.

Following this review, Cadmus designed a sample strategy for impact evaluation activities and performed the following evaluation activities in two waves:

- Selected evaluation sample and requested project documentation from Avista
- Reviewed project documentation
- Prepared virtual site visit M&V plans
- Performed virtual site visits using the Streem platform and collected on-site data (e.g., trend data, photos, and operating schedules) [1]
- Used virtual site visit findings to calculate evaluated savings by measure
- Applied realization rates to the total reported savings population to determine overall evaluated savings

[1] For more information on Streem: https://www.streem.com/platform-streem#platform-remote-video

Sample Design

Cadmus conducted sampling in two waves for PY 2020:

- Sample 1 included program data from January 2020 through June 2020.
- Sample 2 included program data from July 2020 through December 2020.

Cadmus initially estimated the total annual population size by reviewing the wave 1 population data and comparing it to 2018-2019 population data. The team developed initial sample size targets to achieve 90% confidence at ±10% precision (90/10) for the estimated annual population across the 2020-2021 biennium, with a target of 90/20 by program. The team selected the first sample wave to meet one-quarter of the total target for each program. After receiving the wave 2 population data, Cadmus revised the annual sample size targets and selected the wave 2 sample to make up half of the revised target within each program.

For each activity wave, Cadmus developed a stratified random sample of applications by program (such as Site Specific other, Site Specific lighting, Prescriptive interior lighting, or Prescriptive motor controls). In programs where individual projects represented a significant portion of the total savings in the program, the team selected the highest-savings applications with certainty. Within programs with a wide variance in savings, Cadmus further stratified non-certainty applications by reported savings magnitude into small and medium strata, each with approximately 50% of the total non-certainty program savings. The team assigned random numbers within each stratum to select a random sample of non-certainty sites. In some cases, Cadmus selected additional applications at the same location as a previously selected application to evaluate as a convenience selection if the team could assess both applications in a single virtual visit.

Cadmus encountered some challenges contacting customers to evaluate the wave 1 sample, primarily due to changes in business operations as a result of the COVID-19 pandemic. The team pulled an additional backup sample for the wave 2 sample using random sampling and recruited participants from the backup sample when participants from the initial random sample were unreachable.

The team pooled results from the randomly selected projects to calculate a realization rate by stratum and applied that realization rate to projects in the population in that stratum. Cadmus applied the project-specific evaluated savings for every project that was in the sample, regardless of whether it was a random, certainty, or convenience selection.

Table 7 summarizes the Washington Nonresidential Prescriptive program path evaluation sample. Cadmus sampled 43 Prescriptive applications at 33 unique sites. Of the sampled applications, the team selected 4 for certainty review based on scale of savings, selected 29 randomly, and selected 11 additional convenience projects based on location. There was no participation in the AirGuardian, Fleet Heat, and EnergySmart Grocer programs in PY 2020 as shown in Table 4. Table 7 shows the total number of unique application IDs sampled in each program, including one application containing measures from more than one program.

Table 7. Washington Nonresidential Prescriptive Electric Evaluation Sample

Program Type	Applications Sampled[a]	Sampled Savings (kWh)	Percentage of Reported Savings
Interior Lighting	16	1,447,503	19%
Exterior Lighting	15	774,093	11%
Shell Measure	6	20,143	52%
Green Motors	3	6,584	55%
Motor Control (VFD)	2	166,470	100%
Fleet Heat	0	0	N/A
Food Service Equipment	2	9,638	70%
AirGuardian	0	0	N/A
Energy Smart Grocer	0	0	N/A
Nonresidential Prescriptive	**43**	**2,424,430**	**32%**

[a] One application included measures in both the interior lighting and exterior lighting programs but is only counted once in the total.

Table 8 summarizes the Washington Nonresidential Site Specific program's path evaluation sample, where Cadmus sampled 22 Site Specific applications at 15 unique sites overall. Of the sampled applications, the team selected one for certainty review based on the savings scale, selected 16 randomly, and selected an additional five by convenience.

Table 8. Washington Nonresidential Site Specific Electric Evaluation Sample

Program	Applications Sampled	Sampled Savings (kWh)	Percentage of Reported Savings
Site Specific	22	3,473,091	45%

Document Review

Cadmus requested and reviewed project documentation for each sampled application and prepared M&V plans to guide its site visits. Typically, project documentation included data entered into the iEnergy system, incentive application forms, calculation workbooks, invoices, equipment specification sheets, and Avista installation verification reports.

Remote Verification

Cadmus performed virtual site visits and verification calls at 43 unique Nonresidential locations to assess electric savings for 110 unique Prescriptive and Site Specific measures from 60 different applications. Cadmus evaluated the remaining five applications through desk reviews that did not require participant outreach. Cadmus typically conducted virtual site visits using the Streem platform that records video and audio. The visits involved a detailed walkthrough to verify installed equipment types, make and model numbers, operating schedules, and set points, as applicable. Cadmus conducted some virtual visits using Microsoft Teams meetings if customers were unable to access Streem or preferred using Teams due to prior familiarity. Verification calls involved a brief phone or video call to confirm key details and any information missing from the project documentation. Cadmus used the project documentation review and on-site findings to adjust reported savings calculations, where necessary.

Nonresidential Impact Evaluation Results

This section summarizes electric impact evaluation results for the Nonresidential sector's Prescriptive and Site Specific program paths in PY 2020.

Nonresidential Prescriptive Programs

Table 9 shows the reported and evaluated electric energy savings for Avista's Nonresidential Prescriptive program path as well as the realization rates between the evaluated and reported savings for PY 2020. The overall Nonresidential Prescriptive program path achieved a 90% electric realization rate.

Table 9. Nonresidential Prescriptive Electric Impact Findings

Program Type	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Interior Lighting	7,639,244	7,731,720	101%
Exterior Lighting	7,151,313	5,482,211	77%
Shell Measure	38,949	35,587	91%
Green Motors	11,978	11,978	100%
Motor Control (VFD)	166,470	166,470	100%
Fleet Heat	0	0	N/A
Food Service Equipment	54,257	54,257	100%
AirGuardian	0	0	N/A
Energy Smart Grocer	0	0	N/A
Nonresidential Prescriptive	**15,062,211**	**13,482,224**	**90%**

Of 43 evaluated applications, Cadmus identified discrepancies for 26, based on virtual site visits, verification calls, and project documentation reviews. Table 10 summarizes the reasons for discrepancies between reported and evaluated savings.

Table 10. Nonresidential Prescriptive Evaluation Summary of Discrepancies

<table>
<tr><th>Project Type</th><th>Number of Occurrences</th><th>Savings Impact</th><th>Reason(s) for Discrepancy</th></tr>
<tr><td rowspan="2">Interior Lighting</td><td>7</td><td>↓</td><td>Cadmus reduced the hours of use (HOU) for three projects at an indoor agriculture facility after determining that the lights operate 26 weeks out of the year rather than 52 weeks as reported.
Cadmus found that the installed fixtures for three projects had a higher wattage than reported on the application.
Cadmus found that the baseline fixtures for one project were CFL rather than incandescent, disqualifying them from the program.</td></tr>
<tr><td>2</td><td>↑</td><td>Cadmus found that the installed fixtures for one project had a lower wattage than reported on the application.
Cadmus determined that the HOU for one project was higher than reported on the application.</td></tr>
</table>

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
Exterior Lighting	10	↓	• Cadmus found that the installed fixtures for two projects had a higher wattage than reported on the application. • Cadmus found that the baseline fixtures for one project had a lower wattage than reported on the application. • Cadmus evaluated seven sign lighting projects by calculating the difference in energy use between the baseline and installed lamps, rather than applying a deemed value per square footage of the sign. Cadmus determined the deemed values overestimated savings.
	6	↓↑	• Cadmus found that some projects had discrepancies up to 3% due to rounding differences. iEnergy rounds the kilowatt savings to two decimal places in the middle of the calculation, causing a loss of accuracy in the final savings. This correction resulted in a decrease in savings for two projects and an increase in savings for four.
Shell	1	↓	• Cadmus found that the primary heat source for one project was natural gas rather than electricity as reported, lowering the electric savings and adding natural gas savings that were not previously reported.

Sign lighting measures in particular resulted in low realization rates. Avista applied deemed savings of 107.2 kWh per square footage of signage replaced, based on a 2014 internal engineering review which assumed 8-foot T12 HO fluorescent lamps as the baseline for all sign lighting. Cadmus evaluated sign lighting projects by verifying the quantity, wattages, and HOU for the baseline and installed lamps in each sign by visual confirmation through video or by reviewing invoices and installation verification (IV) report photos. In cases where documentation was insufficient and customers were unable to access the sign, Cadmus estimated lamp quantities and lengths based on the shape and size of the sign. Cadmus calculated savings as the difference in energy use between the actual baseline and installed lighting equipment that the team verified. In every case, this evaluation methodology resulted in a lower evaluated savings and Cadmus found an average realization rate of 30% across the evaluated sign lighting measures. The team did not find any systematic discrepancies with other exterior lighting measures. The realization rate for non-sign lighting exterior lighting measures was 95%.

Nonresidential Site Specific Program

Table 11 shows reported and evaluated electric energy savings for Avista's Nonresidential sector Site Specific program path for the program year. The overall Site Specific program path had a 93% electric realization rate.

Table 11. Nonresidential Site Specific Electric Impact Findings

Program	Reported Savings (kWh)	Evaluated Savings (kWh)	Realization Rate
Site Specific	7,661,184	7,102,132	93%

Of 22 evaluated applications, Cadmus identified discrepancies in 17, based on virtual site visits and project documentation. Table 12 summarizes the discrepancies between reported and evaluated savings.

Table 12. Nonresidential Site Specific Evaluation Summary of Discrepancies

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
Interior Lighting	4	↑	• Cadmus found increased savings across four applications for in an indoor agriculture lighting project that added new lighting controls, which had not been accounted for in the reported savings, had a higher fixture quantity than reported. The team also found an electric heating penalty that should not have been included because the building had cooling only.
	8	↓	• Cadmus verified that the baseline fixture wattage was lower than reported for one project. • Cadmus found the verified lighting HOU to be lower than reported for two projects. • Cadmus reviewed a lighting retrofit project that was part of a full interior remodel and the updated code baseline applied. Cadmus revised the analysis to compare the installed lighting power density against the state code baseline and adjusted HOU based on information from the occupant. • Cadmus found that four projects had discrepancies totaling 2,056 kWh due to rounding differences. iEnergy rounds the kilowatt savings to two decimal places in the middle of the calculation, causing a loss of accuracy in the final savings. This correction resulted in a decrease in savings.
HVAC Combined	2	↓	• The original weather normalized utility billing analysis for a web-enabled thermostat project with electric heat pumps did not account for outlier months with atypical usage and assumed zero electricity usage in months with no heating degree days (HDDs) in the regression model (intercept forced to zero). Cadmus revised the regression analysis to account for the heating and cooling season separately and to exclude outlier months from the model. • The original analysis for a comprehensive building controls retrofit project reported electricity savings as the exact difference between the total annual electricity consumption in the year before and after implementation. Cadmus updated the analysis to use a calibrated energy model and to account for efficient lighting that was installed during the same period.
New Construction	1	↑	• Cadmus adjusted the estimated HOU for a new construction lighting project where the building was currently unoccupied as the owner sought a tenant to match the Regional Technical Forum (RTF) typical HOU for a warehouse space and adjusted the electric waste heat factor to match the building and HVAC system type.
	1	↓	• Cadmus updated the efficient window calculator after determining that the surface area of an energy-efficient window was lower than reported and the cooling system capacity was lower than reported.
Compressed Air	1	↑	• Air compressor VFD power data was rounded or truncated in the original analysis files. Cadmus did not round any intermediate numbers, which resulted in slightly higher evaluated savings.

Cadmus noted that many M&V plans, pre-installation verifications, and installation verification reports relied on customer-provided photos and data because Avista staff could not safely visit the site due to the COVID-19 pandemic. It is likely that some of the discrepancies identified above may have been avoided had Avista been able to conduct thorough in-person inspections before and after the project to verify the baseline and installed equipment.

Cadmus evaluated two HVAC controls projects where electric savings were estimated from whole-building metering (International Performance Measurement and Verification Protocol [IPMVP] Option C). This is often an appropriate option for gas measures where most gas consumption in the building goes to HVAC end uses and can be easily correlated to HDDs, but requires caution for electric measures where HVAC is typically a smaller portion of the total energy consumption.

For one evaluated project, savings were reported as the simple difference in total metered electricity consumption between the year before and after the project implementation, despite other unrelated equipment changes made during the same period. IPMVP Option C is not recommended when expected savings are less than 10% of the total utility billing consumption, or when other changes in building operations or equipment occur during the measurement period. Cadmus revised this analysis to use IPMVP Option D, a calibrated simulation model. In another project, a weather regression model was used, but the model only accounted for HDDs and assumed zero electricity consumption when HDDs were zero despite the presence of electric cooling, lighting, and other loads. Regression models should not force a zero intercept unless there is evidence of no energy consumption when the independent variable is zero. Cadmus updated this analysis to consider the heating and cooling season separately, and adjusted the model to include base load electricity consumption.

Nonresidential Conclusions and Recommendations

The Nonresidential sector achieved total evaluated electric energy savings of 20,584 MWh with a 91% combined realization rate. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' electric savings goal of 36,070 MWh, achieving 57% of its goal.

Although some individual project results varied, particularly within the Prescriptive exterior lighting program and the Site Specific lighting program, the overall Nonresidential sector performed strongly in PY 2020 relative to reported savings. Most projects that Cadmus sampled for the evaluation were well documented and matched findings from the remote project verifications.

Avista completed a transition from its previous InforCRM system to the new iEnergy system to track Nonresidential energy efficiency applications and measures prior to the start of PY 2020. Cadmus found that the additional detail provided by the iEnergy system facilitated conducting a detailed and comprehensive evaluation. The team encountered some challenges with inconsistent data in report extracts from iEnergy (i.e., reports with duplicated records) and developed additional quality control processes to identify such issues, working with Avista's technical staff to resolve them. Avista continues to work with the iEnergy vendor to improve the system and integrate feedback.

Cadmus notified Avista in January 2021 of systematic savings discrepancies in sign lighting measures within the Prescriptive exterior lighting program. The team observed a significant increase in sign lighting measures in PY 2020 and found consistently low realization rates on the sign lighting measures evaluated. Avista plans to implement changes to the sign lighting measure effective April 15, 2021, to address these concerns.

Cadmus offers the following conclusions and recommendations to improve the Nonresidential sector's energy savings:

- Cadmus found that savings for some Site Specific projects could have been measured more accurately using control system trends or equipment-level logging, but that trends had not been configured during the baseline period or were overwritten during the project. Trend data are typically higher resolution and more targeted to the upgraded equipment than monthly whole-building utility data but requires engagement with the customer before any changes are made.
  - **Recommendation:** Review M&V plans for Site Specific projects early in the process to ensure that sufficiently detailed baseline data will be available, and work with site contacts to establish trend logs for relevant building management system or industrial control system data points during the baseline period.
- Cadmus evaluated a Site Specific HVAC project where the Y intercept of the HDD regression model was forced to zero. Linear regression models should not have a fixed intercept at zero if there is any non-heating electricity consumption on the meter.
  - **Recommendation:** Ensure that weather regression models account for base load energy consumption that is present even during low heating or cooling demand.
- Cadmus evaluated a Site Specific HVAC project that used whole-building electric billing data to estimate savings, but where multiple unrelated changes in building equipment and operations occurred during the same period and there was no significant correlation between weather data and electricity consumption.
  - **Recommendation:** Be cautious when using whole-building billing data to evaluate electric energy savings for Site Specific projects to ensure that there are sufficient savings to distinguish changes in energy consumption related to the efficiency measure from other changes to building operations or equipment, or from noise in the data. In general, energy savings should be greater than 10% of total consumption for the specific fuel to ensure a reliable savings estimate through billing analysis. Cadmus recommends Avista staff review historical billing data when developing an M&V plan to see if there is a strong correlation between monthly electricity consumption and weather data or other appropriate independent variables. Consider options to use submetering or building control system trend data for larger projects affecting many separate building systems, or consider installing temporary power meters on individual equipment for projects involving systems that can be isolated.

- Cadmus found that Avista's new iEnergy system records additional detailed inputs on some prescriptive measures that were not previously tracked in InforCRM and are not currently used in the savings calculations.
  - **Recommendation:** Review deemed savings values for prescriptive measures and consider opportunities to leverage the additional data now collected in iEnergy to calculate more accurate savings for each participant project. For example, food service measures can use the reported pounds of food cooked per day and cooking hours per day values collected in iEnergy to automatically calculate more precise savings.
- Cadmus found that verified lighting HOU varied from reported HOU in some interior and exterior lighting projects evaluated. Several projects reported correct weekly HOU but did not operate the lights every week of the year. Other projects had different weekly or daily operating hours than had been reported.
  - **Recommendation:** Review HOU estimates when processing applications and conducting installation verifications. When entering average weekly HOU, confirm how many weeks per year that schedule applies. In particular, scrutinize applications claiming 8,760 hours per year.
- Cadmus found that reported fixture quantities for Site Specific lighting projects often did not match invoice quantities, and applications often lack detailed notes explaining these differences. It is often impractical for Avista staff conducting IV inspections or evaluators conducting verification visits to count every fixture for large lighting projects to resolve such discrepancies.
  - **Recommendation:** Include more detailed documentation for Site Specific lighting projects. Lighting drawings should be provided whenever possible, and if any other notes, spreadsheets, or other documentation are used to determine eligible quantities, these should be included with the application records. Any difference between invoice quantities and rebated quantities should be clearly explained.
- Cadmus found variation of up to 3% between reported and evaluated savings on Prescriptive lighting projects due to iEnergy rounding an intermediate value in kilowatt units to two decimal places, which is equivalent to rounding the lighting wattage to the nearest 10 watts.
  - **Recommendation:** Review iEnergy calculations to ensure that rounding is only applied on final displayed values and not to any intermediate values.
- Cadmus found that site contacts at larger facilities often did not know where program equipment was installed or could not recall which equipment was installed during which project if they had completed multiple applications over the course of the year.
  - **Recommendation:** Update all application forms to include space for location notes for each installed measure.

- Cadmus staff found that the detail level in IV reports varied. Many IV reports only mention that "equipment and quantities were verified," and photos sometimes only show the equipment from a distance.
  - **Recommendation:** Provide more consistent documentation with Avista IV reports. Cadmus recommends that all IV reports include basic information explicitly stating the quantity and type of equipment found. For lighting projects, this would include confirmed fixture types, quantities, installation locations, controls, and estimated HOU. For most other equipment, this would include nameplates, model numbers, and quantities.
- Cadmus observed that several Site Specific analyses used historical data from up to four years prior to the completion of the final report. Due to the necessary use of historical data for billing analyses, Cadmus expects that recent changes in business operation due to the COVID-19 pandemic may affect future billing data analysis for several years, even after most business return to normal operations.
  - **Recommendation:** Carefully scrutinize any Site Specific project using utility meter data, equipment trend data, or other timeseries data that may include periods of atypical business operation due to the COVID-19 pandemic. Any such analysis for the next few years should include discussion of potential COVID-19 impacts, whether they affect the proposed analysis methodology, and what steps were taken to adjust the analysis accordingly. If it is determined that the equipment in question was operating normally during the COVID-19 period, this should be noted explicitly in the report so that evaluators are aware that these effects were considered.

Multifamily Direct Install (MFDI) Impact Evaluation

Cadmus designed the MFDI program's impact evaluation to verify reported program participation and energy savings. Since the 2018-2019 evaluation showed that billing analysis did not provide meaningful evaluation results and a document review was out of scope for this evaluation, Cadmus found that a database review was the most appropriate evaluation approach. The team used data collected and reported in the tracking database, online application forms, and Avista Technical Reference Manual (TRM) and RTF values to evaluate savings. This approach provided a reasonable estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, and number of participants.

Program Summary

In PY 2020, Avista completed and provided incentives for 3,295 living units, common areas, or installed lighting fixtures in Washington and reported total electric energy savings of 1,715,647 kWh. Participation is defined as installed lighting fixtures for the MFDI supplemental lighting program and common areas or living units served for the MFDI program.

The MFDI program includes two delivery channels:

- MFDI, which provides free direct-install measures to multifamily residences (five units or more) and common areas.
- MFDI supplemental lighting, which revisits multifamily properties participating in the MFDI program to install additional common area lighting.

Program Participation Summary

Table 13 shows savings goals assigned to Avista's MFDI programs for PY 2020, in addition to reported savings. During PY 2020, the response to the COVID-19 pandemic caused disruption to the MFDI program's direct-install design, forcing Avista to temporarily halt program processes and implement changes that adapt to pandemic restrictions. As a result, the MFDI and MFDI supplemental lighting programs did not meet savings goals, with reported savings achieving 44% of the savings goal for MFDI programs.

Table 13. MFDI Programs Reported Electric Savings

Program	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Multifamily Direct Install	1,784,000	1,206,443	68%
Multifamily Direct Install Supplemental Lighting	2,081,000	509,204	24%
MFDI Programs Total	**3,865,000**	**1,715,647**	**44%**

Table 14 summarizes reported participation in the MFDI programs for PY 2020.

Table 14. MFDI Programs Participation

Program	Participation Reported
Multifamily Direct Install[a]	2,046
Multifamily Direct Install Supplemental Lighting[b]	1,249
MFDI Programs Total	**3,295**

[a] Participation is defined as the number of living units and common areas served.

[b] Participation is defined as the number of installed units.

Lighting measures accounted for 80.2% of the total MFDI programs' savings. The following shows the percentage of MFDI reported savings provided by each program:

- MFDI lighting measures provided 50.5% of reported savings.
- MFDI non-lighting measures provided 19.8% of reported savings.
- MFDI supplemental lighting program provided 29.7% of reported savings.

Multifamily Direct Install Impact Evaluation Methodology

To determine the MFDI program's evaluated savings for PY 2020, Cadmus employed a database review. For the impact evaluation database review, Cadmus applied UES values provided in the TRM and by the RTF to calculate savings for measures reported in the measure tracking database. Such impact activity may help identify incorrect UES values used to calculate reported savings. For this evaluation, Cadmus applied 2020 Avista TRM values to PY 2020 measures.

Multifamily Direct Install Impact Evaluation Results

Cadmus used the results of the database review to evaluate savings for each measure. The analysis then rolled up measure-level evaluated savings to calculate evaluated savings and a realization rate for each program. Table 15 shows the resulting evaluated savings and realization rates.

Table 15. MFDI Programs Electric Impact Findings

Program	Reported Electric Savings (kWh)	Evaluated Electric Savings (kWh)	Realization Rates
Multifamily Direct Install	1,206,443	1,242,058	103%
Multifamily Direct Install Supplemental Lighting	509,204	498,103	98%
MFDI Programs Total	**1,715,647**	**1,740,162**	**101%**

The discrepancies between evaluated and reported savings for the MFDI program were a result of reported savings calculations using UES values for non-lighting measures (aerators and showerheads) that were lower than the appropriate UES values provided by the most recent RTF. Specifically, reported savings for showerheads used UES values from Avista's most recent TRM that did not reflect the most recent RTF UES values. The implementer confirmed that the UES values used to calculate reported savings for showerheads reflected the most recent TRM but had not been updated to match the most recent RTF revision. Cadmus evaluated reported savings using the most recent 2019 RTF UES value for showerheads. Reported savings for aerators used a conservative weighted average UES value that would allow for some aerators with heat pump water heaters. However, Cadmus determined that the aerator UES value for electric resistance water heater types is more appropriate for the building stock served by the MFDI program. The implementer accepted this recommendation and Cadmus evaluated savings using the 2019 RTF UES value for aerators with electric resistance water heater types.

Cadmus also identified instances where evaluated realization rates were low for lighting measures because the implementer did not properly account for electric heating interactive effects in common area spaces. In addition, Cadmus found reported savings calculations for lighting measures that did not account for the savings that come from cooling interaction effects in interior spaces. However, the evaluated savings that resulted in fully realized or higher realization rates for lighting and non-lighting measures in the MFDI program outweighed those with low realization rates.

The discrepancies between evaluated and reported savings for the MFDI supplemental lighting program resulted from two general issues: (1) a combination of cases where the implementer did not account for electric HVAC interactive effects and (2) contractors used undefined annual HOU in the reported savings calculations instead of those hours consistent with the savings calculations methodology and site data provided. Cases with undefined HOU either exceeded 100% realization when these hours were lower than those documented in the calculation methodology and site data provided or resulted in low realization rates when the reported hours of use were much greater than what was documented. All cases that did not account for HVAC interactive effects resulted in realization rates below 100%.

Multifamily Direct Install Conclusions and Recommendations

Evaluated electricity savings show a 101% realization rate on evaluated savings of 1,740,162 kWh for MFDI programs, representing 45% of the savings goal for the year.

Cadmus offers the following conclusions and recommendations to improve Avista's MFDI electric programs:

- Cadmus found the MFDI program to be an efficient, effective mechanism for installing high-efficiency lighting and aerators in multifamily units.
  - **Recommendation:** Continue to focus on replacing high-use, low-efficiency lamps where practical to maximize program cost-effectiveness and maintain high savings.
- Cadmus observed the reported savings for the PY 2020 showerhead measure were not calculated using the most current RTF UES values. More specifically, the reported savings for the PY 2020 showerhead measure was based on RTF UES values found in the RTF measure workbook "Showerheads_v3.0" when the RTF measure workbook "Showerheads_v4_3" was available.
  - **Recommendation:** Use the most current RTF UES values to calculate reported savings, and ensure that the TRM provides values for all measures.
- Cadmus observed the reported savings for PY 2020 aerator measures were not calculated using the RTF UES values most appropriate for the MFDI program's building stock. More specifically, reported savings for aerators used a conservative weighted average UES value that would allow for some heat pump water heaters when a UES value for aerators with electric resistance water heaters is more appropriate.

  - **Recommendation:** Use the current RTF UES value for measures that is most appropriate for the MFDI program's building stock.
- Cadmus did not find large-scale problems with the MFDI programs' measure tracking data, but did note numerous occasions where electric HVAC interactive effects were not accounted for in the reported savings calculation for lighting measures in interior common areas with documented electric heating and cooling, or a combination of the two.
  - **Recommendation:** Have the implementer clearly identify the types of spaces that should include HVAC interactive effects and those that should not.
- Cadmus observed several occasions in the MFDI supplemental lighting site data where the reported savings calculations appeared to use custom HOU that were different from deemed HOU values for interior and exterior spaces. Cadmus could not confirm some custom HOU because some spaces did not have an assigned site identification.
  - **Recommendation:** Ensure methodology documentation and reported savings inputs are accurate and provided for all site data.

APPENDIX B – 2020 WASHINGTON NATURAL GAS IMPACT EVALUATION REPORT – COMMERCIAL/INDUSTRIAL

CADMUS

Washington 2020 Natural Gas Impact Evaluation Report

April 9, 2021

Prepared for:

Avista Corporation
1411 East Mission Avenue
Spokane, WA 99202

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Tables

Portfolio Executive Summary

For several decades, Avista Corporation (Avista) has administered demand-side management (DSM) programs to reduce electricity and natural gas energy use by its customer portfolio. While Avista has implemented most of these programs in-house, external vendors have fulfilled some of them.

Avista contracted with Cadmus to complete process and impact evaluations of its program year (PY) 2020 natural gas DSM Nonresidential and Multifamily Residential programs in Washington. This report presents the natural gas impact evaluation findings for PY 2020. Cadmus did not apply net-to-gross (NTG) adjustments to savings values, except where deemed energy savings values already incorporated NTG as a function of the market baseline.

Evaluation Methodology and Activities

Table 1 shows the variety of methods and activities Cadmus completed in conducting the Washington natural gas portfolio evaluation.

Table 1. Annual Natural Gas Program Evaluation Activities

Sector	Program	Document/ Database Review	Verification/ Virtual Site Visit
Nonresidential	Prescriptive (multiple)	✓	✓
	Site Specific	✓	✓
Multifamily	Multifamily Direct Install	✓	--

Summary of Impact Evaluation Results

Overall, the Washington portfolio achieved a 92% realization rate on savings from natural gas measures, acquiring 172,733 therms in annual gross savings, as shown in Table 2. Cadmus collected Avista-reported savings through database extracts, drawn from Avista's iEnergy database (Nonresidential) and from data provided by the third-party implementor (MFDI).

Table 2. Reported and Evaluated Energy Efficiency Natural Gas Savings

Sector	Reported Savings (therms)	Evaluated Savings (therms)	Realization Rate
Nonresidential	187,787	172,357	92%
Multifamily	409	376	92%
Total	**188,195**	**172,733**	**92%**

Conclusions and Recommendations

During the course of the annual evaluation, Cadmus identified the areas addressed below for improvements by sector.

Nonresidential Conclusions and Recommendations

In PY 2020, the Nonresidential sector achieved total evaluated natural gas energy savings of 172,357 therms, with a combined realization rate of 92%. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' natural gas savings goal of 268,727 therms, achieving 64% of its goal.

Although some individual project results varied, particularly within the Site Specific program, the overall Nonresidential gas sector performed strongly in PY 2020 relative to reported savings. Most projects that Cadmus sampled for the evaluation were well documented and matched findings from the remote project verifications.

Avista completed a transition from its previous InforCRM system to the new iEnergy system to track Nonresidential energy efficiency applications and measures prior to the start of PY 2020. Cadmus found that the additional detail provided by the iEnergy system facilitated conducting a detailed and comprehensive evaluation. The team encountered some challenges with inconsistent data in report extracts from iEnergy (i.e., reports with duplicated records) and developed additional QC processes to identify such issues, working with Avista's technical staff to resolve them. Avista continues to work with the iEnergy vendor to improve the system and integrate feedback.

Cadmus offers the following conclusions and recommendations to improve the Nonresidential sector's natural gas savings:

- Cadmus found two Site Specific HVAC analyses with a HDD utility bill analysis where the Y intercept of the regression model was forced to zero. Linear regression models typically should not have a fixed intercept at zero unless there is clear evidence of no gas consumption outside of the heating season.
  - **Recommendation:** Ensure that weather regression models account for base load energy consumption that is present even during low heating demand.
- Cadmus found slight discrepancies in the billing analyses because the billing date was used to group HDD and gas consumption instead of the meter-read date. While this did not substantially affect the realization rate in these cases, it could cause a larger variance in future projects.
  - **Recommendation:** Ensure that utility billing analyses use the meter-read date, not the customer bill date.
- Cadmus noted that Avista used first-year actual weather data for all utility billing regression analyses reviewed. Year-to-year variations in weather data can cause significant differences in reported savings. For example, from 2015 to 2019, the total annual HDD recorded at the Spokane International Airport weather station ranged from 5,800 to 7,000, a difference of over 16%. Typical meteorological year weather normalization is an accepted practice for addressing this variation.
  - **Recommendation:** Consider normalizing utility billing regression analysis to typical weather data rather than normalizing it to actual weather for the post-installation year.
- Cadmus found that Avista's new iEnergy system records additional detailed inputs on some prescriptive measures that were not previously tracked in InforCRM and are not currently used in the savings calculations.

  - **Recommendation:** Review deemed savings values for prescriptive measures and consider opportunities to leverage the additional data now collected in iEnergy to calculate more accurate savings for each incentivized project. For example, HVAC furnace measures can use the exact AHRI efficiency rating collected in iEnergy instead of a typical average to automatically calculate more precise savings.
- Cadmus found that most Avista Installation Verification (IV) reports only mention that "equipment and quantities were verified," and that photos sometimes only show the equipment from a distance.
  - **Recommendation:** Provide more consistent documentation with IV reports. Cadmus recommends that all IV reports include basic information explicitly stating the actual quantity and type of equipment found and include clear photos of equipment nameplates.
- Cadmus evaluated one Site Specific project that relied on gas billing data that overlapped with a period when the building's operations had been significantly altered due to the COVID-19 pandemic. Cadmus also observed that several other Site Specific analyses used historical data from up to four years prior to the completion of the final report. Due to the necessary use of historical data for billing analyses, Cadmus expects that COVID-19 impacts may affect future such projects for several years, even after most business return to normal operations.
  - **Recommendation:** Carefully scrutinize any Site Specific project using utility meter data, equipment trend data, or other timeseries data that may include periods of atypical business operation related to COVID-19. Any such analysis for the next few years should include discussion of potential COVID-19 impacts, whether they affect the proposed analysis methodology, and what steps were taken to adjust the analysis accordingly. If it is determined that the equipment in question was operating normally during the COVID-19 pandemic, explicitly note it in the report so that evaluators are aware that these effects were considered.

Multifamily Direct Install (MFDI) Conclusions and Recommendations

Cadmus evaluated 376 therms for MFDI natural gas savings, resulting in a 92% realization rate and representing 35% of the savings goal for the year.

Cadmus offers the following conclusion and recommendation to improve Avista's MFDI natural gas programs:

- Cadmus observed that the reported savings for the PY 2020 showerhead measure were not calculated using the most current RTF UES values. More specifically, the reported savings for the PY 2020 showerhead measure was based on RTF UES values found in the RTF measure workbook "Showerheads_v3.0" when the RTF measure workbook "Showerheads_v4_3" was available. Showerheads had a realization rate of 62% resulting from the discrepancy between these UES values.

  - **Recommendation:** Use the most current RTF UES values to calculate reported savings, and ensure that the TRM provides values for all measures.

Nonresidential Impact Evaluation

Through its Nonresidential program portfolio, Avista promotes purchases of high-efficiency equipment to commercial and industrial utility customers. By providing rebates, Avista partially offsets cost differences between high-efficiency and standard equipment. Cadmus conducted Nonresidential impact evaluation activities to determine evaluated savings for all programs that reported participation; the team also conducted measurement and verification (M&V) of Prescriptive and Site Specific projects across the full sample.

Program Summary

In PY 2020, Avista completed and provided incentives for 109 Nonresidential natural gas measures in Washington, reporting total natural gas energy savings of 187,787 therms. Through the Nonresidential sector, Avista offers incentives for high-efficiency equipment and controls via two program paths: Prescriptive and Site Specific.

The Prescriptive program path serves smaller, straightforward equipment installations that generally include similar operating characteristics (such as simple HVAC systems, food service equipment, and envelope upgrades). The Site Specific program path serves more unique projects, requiring custom savings calculations and technical assistance from Avista's account executives (such as process equipment, controls, and comprehensive HVAC retrofits).

Program Participation Summary

This section summarizes Nonresidential sector participation and progress toward PY 2020 goals through the Prescriptive and Site Specific program paths.

Nonresidential Prescriptive Programs

Table 3 shows natural gas energy savings goals assigned to Avista's Nonresidential Prescriptive programs for PY 2020 as well as reported savings and a comparison between reported savings and goals. Avista's Nonresidential Prescriptive programs achieved 46% of their collective savings goal in PY 2020. The lower participation is likely due to effects from the COVID-19 pandemic, which forced many businesses to reduce their operations or close entirely. For those businesses that remained open, facility and maintenance staff had to prioritize planning for health and safety impacts above energy efficiency concerns.

Table 3. Nonresidential Prescriptive Natural Gas Savings

Program Type	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
HVAC	34,620	18,126	52%
Shell	26,000	6,682	26%
Food Service Equipment	57,107	30,123	53%
Energy Smart Grocer	2,450	0	0%
Total	**120,177**	**54,931**	**46%**

Table 4 summarizes actual program participation by unique application numbers.

Table 4. Nonresidential Prescriptive Participation by Project

Program Type	Number of Applications	Number of Measures
HVAC	33	50
Shell	6	7
Food Service Equipment	38	41
Energy Smart Grocer	0	0
Total[a]	**77**	**98**

[a] Total participants. A single application may contain measures from multiple programs.

Nonresidential Site Specific Program

Table 5 shows natural gas savings goals assigned to the Site Specific program path for Avista's Nonresidential sector in PY 2020, reported savings, and the percent of goal achieved. The Site Specific program achieved 88% of the PY 2020 savings goal, with participation reduced likely due to effects of the COVID-19 pandemic.

Table 5. Nonresidential Site Specific Natural Gas Savings

Program	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Site Specific	151,000	132,856	88%

Table 6 summarizes actual program participation for the Site Specific program.

Table 6. Nonresidential Site Specific Participation by Project

Program Type	Number of Applications	Number of Measures
Site Specific Other	10	11
Total	**10**	**11**

Nonresidential Impact Evaluation Methodology

As the first step in evaluating annual savings for the Nonresidential sector, Cadmus reviewed the following documents and data records to gain an understanding of programs and measures slated for evaluation:

- Avista's annual business plans, detailing processes and energy savings justifications
- Project documents from external sources (such as customers, program consultants, or implementation contractors)
- Avista's iEnergy tracking system for Nonresidential programs

Based on the initial review, Cadmus checked the distribution of program contributions with the overall program portfolio. The review provided insight into the sources for unit energy savings (UES) claimed for each measure offered in the programs, along with sources for energy-savings algorithms, internal quality assurance, and quality control processes for large Nonresidential sector projects.

Following this review, Cadmus designed a sample strategy for impact evaluation activities and performed the following evaluation activities in each of the two waves:

- Selected evaluation sample and requested project documentation from Avista
- Reviewed project documentation
- Prepared virtual site visit M&V plans
- Performed virtual site visits using the Streem platform and collected on-site data (e.g. trend data, photos, and operating schedules) [1]
- Used virtual site visit findings to calculate evaluated savings by measure
- Applied realization rates to the total reported savings population to determine overall evaluated savings

Sample Design

Cadmus created two sample waves for PY 2020:

- Sample 1 included program data from January 2020 through June 2020.
- Sample 2 included program data from July 2020 through December 2020.

Cadmus initially estimated the total annual population size by reviewing the wave 1 population data and comparing it to 2018-2019 population data. Cadmus developed initial sample size targets to achieve 90% confidence at ±10% precision (90/10) for the estimated annual population across the 2020-2021 biennium, with a target of 90/20 by program. The team pulled the first sample wave to meet one-quarter of the total target for each program. After receiving the wave 2 population data, Cadmus revised the annual sample size targets and pulled the wave 2 sample to make up half of the revised target within each program.

For each activity wave, Cadmus developed a stratified random sample of application by program path (such as Site Specific other, shell measure, or Prescriptive HVAC). In the programs where individual projects represented a significant portion of the total savings in the program, the team selected the highest-savings applications with certainty. For non-certainty applications, Cadmus assigned random numbers and developed a random sample. In some cases, the team selected additional applications at the same location as a previously selected application to evaluated as a convenience selection if the team could assess both applications in a single virtual visit.

Cadmus encountered some challenges contacting customers to evaluate the wave 1 sample, primarily due to changes in business operations as a result of the COVID-19 pandemic. Cadmus pulled an additional backup sample for the wave 2 sample using random sampling and recruited participants from the backup sample when participants from the initial random sample were unreachable.

[1] For more information about Streem: https://www.streem.com/platform-streem#platform-remote-video

The team pooled results from the randomly selected sites to calculate a realization rate by stratum and applied that realization rate to projects in the population in that stratum. Cadmus applied the project-specific evaluated savings for every project that was in the sample, regardless of whether it was a random, certainty, or convenience selection.

Table 7 summarizes the Washington Nonresidential Prescriptive program path's natural gas evaluation sample. Overall, Cadmus sampled 15 Prescriptive applications at 13 unique sites. Of the sampled applications, the team selected two for certainty review based on the savings scale, measure type, or location; selected 11 applications randomly; and selected an additional two applications by convenience. There was no participation in the EnergySmart Grocer program in PY 2020 as shown in Table 4. Table 7 shows the total number of unique application IDs sampled in each program.

Table 7. Washington Nonresidential Prescriptive Natural Gas Evaluation Sample

Program Type	Applications Sampled	Sampled Savings (therms)	Percentage of Reported Savings
HVAC	7	5,729	3%
Shell	4	6,054	3%
Food Service Equipment	4	4,143	2%
Nonresidential Prescriptive	**15**	**15,926**	**8%**

Table 8 summarizes the Washington Nonresidential Site Specific program path's natural gas evaluation sample. Cadmus sampled five Site Specific applications at five unique sites. Of the sampled applications, the team selected one for certainty review based on the scale of savings and selected the remaining four applications randomly.

Table 8. Washington Nonresidential Site Specific Natural Gas Evaluation Sample

Program	Applications Sampled	Sampled Savings (therms)	Percentage of Reported Savings
Site Specific	5	92,298	51%

Document Review

Cadmus requested and reviewed project documentation for each sampled application and prepared M&V plans to guide the site visits. Typically, project documentation included data entered into the iEnergy system, incentive application forms, calculation workbooks, invoices, equipment specification sheets, and Avista installation verification reports.

Remote Verification

Cadmus performed virtual site visits and verification calls at 18 unique Nonresidential locations to assess natural gas energy savings for 31 unique Prescriptive and Site Specific measures. Cadmus typically conducted virtual site visits using the Streem platform that records video and audio. The visits involved a detailed walkthrough to verify installed equipment types, make and model numbers, operating schedules, and set points, as applicable. Cadmus conducted some virtual visits using Microsoft Teams meetings if customers were unable to access Streem or preferred using Teams due to prior familiarity. Verification calls involved a brief phone call or video call to confirm key details and any information that was missing in the project documentation. Cadmus used the project documentation review and on-site findings to adjust reported savings calculations, where necessary.

Nonresidential Evaluation Results

This section summarizes natural gas impact evaluation results for the Nonresidential sector's Prescriptive and Site Specific program paths in PY 2020.

Nonresidential Prescriptive Programs

Table 9 shows the reported and evaluated natural gas energy savings for Avista's Nonresidential Prescriptive program path as well as realization rates between the evaluated and reported savings for PY 2020. The overall Nonresidential Prescriptive program path achieved an 100% natural gas realization rate.

Table 9. Nonresidential Prescriptive Natural Gas Impact Findings

Program Type	Reported Savings (therms)	Evaluated Savings (therms)	Realization Rate
HVAC	18,126	18,126	100%
Shell	6,682	6,880	103%
Food Service Equipment	30,123	30,123	100%
Nonresidential Prescriptive	**54,931**	**55,129**	**100%**

Of 15 evaluated applications, Cadmus identified discrepancies for one based on verification calls and project documentation reviews. The team evaluated one Prescriptive shell measure from the electric sample that had natural gas savings, which contributed to the increased natural gas realization rate in the Prescriptive shell program. This amounted to less than 1% difference in the total realization rate for all Prescriptive natural gas programs. Table 10 summarizes reasons for discrepancies between reported and evaluated savings.

Table 10. Nonresidential Prescriptive Evaluation Summary of Discrepancies

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
Shell	1	↑	• Cadmus found that the primary heat source for an electric shell measure was natural gas rather than electricity as reported, lowering the electric savings and adding natural gas savings that were not previously reported.

Nonresidential Site Specific Program

Table 11 shows reported and evaluated natural gas energy savings for Avista's Nonresidential sector Site Specific program path for the program year. The overall Site Specific program path achieved an 88% natural gas realization rate.

Table 11. Nonresidential Site Specific Natural Gas Impact Findings

Program	Reported Savings (therms)	Evaluated Savings (therms)	Realization Rate
Site Specific	132,856	117,228	88%

Of the five evaluated applications, Cadmus identified discrepancies for three based on virtual site visits and on the project documentation review. Table 12 summarizes reasons for discrepancies between reported and evaluated savings. Cadmus evaluated two separate gas measures in a single new construction application, resulting in lower evaluated savings for one measure and higher evaluated savings in the other.

Table 12. Nonresidential Site Specific Evaluation Summary of Discrepancies

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
HVAC	2	↓	• Cadmus updated the heating degree days weather regression analysis for two projects to better fit the available data. Both analyses had initially forced the intercept to zero in the regression model, which underestimated gas consumption for domestic hot water or other uses outside of the heating season. • One of the two projects had also included months in the regression model that were affected by changes in operation due to the COVID-19 pandemic. Cadmus updated the model to exclude these months so the model would accurately represent typical operations.
New Construction	1	↓	• Cadmus updated the efficient window calculator after determining that the surface area of an energy-efficient window was lower than reported.
		↑	• Cadmus verified that the installed boilers had a lower efficiency than reported. However, the hot water supply temperature was found to be lower than proposed and the original analysis modeled the boiler as a natural draft type. Cadmus updated the provided simulation model to reflect the verified hot water supply temperature and model the boiler as a condensing type. These updates resulted in a net increase in evaluated savings.

Cadmus noted that some M&V plans, pre-installation verifications, and installation verification reports relied on customer-provided photos and data because Avista staff could not safely visit the site due to the COVID-19 pandemic. It is likely that some of the discrepancies identified above may have been avoided had Avista been able to conduct thorough in-person inspections before and after the project to verify the baseline and installed equipment.

Nonresidential Conclusions and Recommendations

In PY 2020, the Nonresidential sector achieved total evaluated natural gas energy savings of 172,357 therms, with a combined realization rate of 92%. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' natural gas savings goal of 268,727 therms, achieving 64% of its goal.

Although some individual project results varied, particularly within the Site Specific program, the overall Nonresidential gas sector performed strongly in PY 2020 relative to reported savings. Most projects that Cadmus sampled for the evaluation were well documented and matched findings from the remote project verifications.

Avista completed a transition from its previous InforCRM system to the new iEnergy system to track Nonresidential energy efficiency applications and measures prior to the start of PY 2020. Cadmus found that the additional detail provided by the iEnergy system facilitated conducting a detailed and comprehensive evaluation. The team encountered some challenges with inconsistent data in report extracts from iEnergy (i.e., reports with duplicated records) and developed additional QC processes to identify such issues, working with Avista's technical staff to resolve them. Avista continues to work with the iEnergy vendor to improve the system and integrate feedback.

Cadmus offers the following conclusions and recommendations to improve the Nonresidential sector's natural gas savings:

- Cadmus found two Site Specific HVAC analyses with a HDD utility bill analysis where the Y intercept of the regression model was forced to zero. Linear regression models typically should not have a fixed intercept at zero unless there is clear evidence of no gas consumption outside of the heating season.
  - **Recommendation:** Ensure that weather regression models account for base load energy consumption that is present even during low heating demand.
- Cadmus found slight discrepancies in the billing analyses because the billing date was used to group HDD and gas consumption instead of the meter-read date. While this did not substantially affect the realization rate in these cases, it could cause a larger variance in future projects.
  - **Recommendation:** Ensure that utility billing analyses use the meter-read date, not the customer bill date.
- Cadmus noted that Avista used first-year actual weather data for all utility billing regression analyses reviewed. Year-to-year variations in weather data can cause significant differences in reported savings. For example, from 2015 to 2019, the total annual HDD recorded at the Spokane International Airport weather station ranged from 5,800 to 7,000, a difference of over 16%. Typical meteorological year weather normalization is an accepted practice for addressing this variation.
  - **Recommendation:** Consider normalizing utility billing regression analysis to typical weather data rather than normalizing it to actual weather for the post-installation year.
- Cadmus found that Avista's new iEnergy system records additional detailed inputs on some prescriptive measures that were not previously tracked in InforCRM and are not currently used in the savings calculations.
  - **Recommendation:** Review deemed savings values for prescriptive measures and consider opportunities to leverage the additional data now collected in iEnergy to calculate more accurate savings for each incentivized project. For example, HVAC furnace measures can use the exact AHRI efficiency rating collected in iEnergy instead of a typical average to automatically calculate more precise savings.
- Cadmus found that most Avista Installation Verification (IV) reports only mention that "equipment and quantities were verified," and that photos sometimes only show the equipment from a distance.
  - **Recommendation:** Provide more consistent documentation with IV reports. Cadmus recommends that all IV reports include basic information explicitly stating the actual quantity and type of equipment found and include clear photos of equipment nameplates.

- Cadmus evaluated one Site Specific project that relied on gas billing data that overlapped with a period when the building's operations had been significantly altered due to the COVID-19 pandemic. Cadmus also observed that several other Site Specific analyses used historical data from up to four years prior to the completion of the final report. Due to the necessary use of historical data for billing analyses, Cadmus expects that COVID-19 impacts may affect future such projects for several years, even after most business return to normal operations.
    - **Recommendation:** Carefully scrutinize any Site Specific project using utility meter data, equipment trend data, or other timeseries data that may include periods of atypical business operation related to COVID-19. Any such analysis for the next few years should include discussion of potential COVID-19 impacts, whether they affect the proposed analysis methodology, and what steps were taken to adjust the analysis accordingly. If it is determined that the equipment in question was operating normally during the COVID-19 pandemic, explicitly note it in the report so that evaluators are aware that these effects were considered.

Multifamily Direct Install (MFDI) Impact Evaluation

Cadmus designed the MFDI program's impact evaluation to verify reported program participation and energy savings. Since the 2018-2019 evaluation showed that billing analysis did not provide meaningful evaluation results and a document review was out of scope for this evaluation, Cadmus found that a database review was the most appropriate evaluation approach. The team used data collected and reported in the tracking database, online application forms, and Avista Technical Reference Manual (TRM) and RTF values to evaluate savings. This approach provided a reasonable estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, and number of participants.

Program Summary

In PY 2020, Avista reported participation of 105 for the MFDI natural gas program in Washington, resulting in reported natural gas energy savings of 409 therms. Participation is defined as common areas or living units served for the MFDI program. The Multifamily Direct Install program provides free direct-install measures to multifamily residences (five units or more) and common areas.

Program Participation Summary

Table 13 shows savings goals assigned to Avista's MFDI program for PY 2020, in addition to reported savings. During PY 2020, the response to the COVID-19 pandemic caused disruption to the MFDI program's direct install design, forcing Avista to temporarily halt program processes and implement changes that adapt to pandemic restrictions. As a result, the MFDI program did not meet savings goals, based on reported savings, achieving 38% of the savings goal for the MFDI program.

Table 13. MFDI Programs Reported Natural Gas Savings

Program	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Multifamily Direct Install	1,074	409	38%

Table 14 summarizes participation goals and reported participation in Avista's MFDI program for PY 2020.

Table 14. MFDI Program Participation

Program	Participation Reported
Multifamily Direct Install[a]	105

[a] Participation is defined as the number of living units and common areas served.

The following shows the percentage of MFDI reported savings provided by each measure:

- Faucet aerators (1 gpm) provided 65% of reported savings.
- Kitchen aerators (1.5 gpm) provided 16% of reported savings.
- Showerheads provided 19% of reported savings.

Multifamily Direct Install Impact Evaluation Methodology

To determine the MFDI program's evaluated savings for PY 2020, Cadmus employed a database review. For the impact evaluation database review, Cadmus applied UES values provided in the TRM and by the RTF to calculate savings for measures reported in the measure tracking database. Such impact activity may help identify incorrect UES values used to calculate reported savings. For this evaluation, Cadmus applied 2020 Avista TRM values to PY 2020 measures.

Multifamily Direct Install Impact Evaluation Results

Cadmus applied the results of the database review to evaluate savings for each measure. The analysis then rolled up measure-level evaluated savings to calculate evaluated savings and a realization rate for each program.

Table 15 shows the resulting total evaluated savings and realization rate.

Table 15. MFDI Programs Natural Gas Impact Findings

Program	Reported Savings (therms)	Evaluated Savings (therms)	Realization Rate
Multifamily Direct Install	409	376	92%

The discrepancies between evaluated and reported savings for the MFDI program were a result of reported savings calculations using UES values for showerhead natural gas savings that were higher than the UES values provided by the most recent RTF. The implementer confirmed that the UES values used to calculate reported savings for showerheads reflected Avista's most recent TRM but had not been updated to match the most recent RTF revision. Cadmus evaluated reported savings using the most recent 2019 RTF UES value for showerheads.

Cadmus applied the results of the database review to evaluate savings for each measure. The analysis then rolled up measure-level evaluated savings to calculate evaluated savings and a realization rate for each program.

Multifamily Direct Install Conclusions and Recommendations

Cadmus evaluated 376 therms for MFDI natural gas savings, resulting in a 92% realization rate and representing 35% of the savings goal for the year.

Cadmus offers the following conclusion and recommendation to improve Avista's MFDI natural gas programs:

- Cadmus observed that the reported savings for the PY 2020 showerhead measure were not calculated using the most current RTF UES values. More specifically, the reported savings for the PY 2020 showerhead measure was based on RTF UES values found in the RTF measure workbook "Showerheads_v3.0" when the RTF measure workbook "Showerheads_v4_3" was available. Showerheads had a realization rate of 62% resulting from the discrepancy between these UES values.

- **Recommendation:** Use the most current RTF UES values to calculate reported savings, and ensure that the TRM provides values for all measures.

APPENDIX C – 2020 WASHINGTON ELECTRIC IMPACT EVALUATION REPORT – RESIDENTIAL AND LOW-INCOME

Evaluation, Measurement and Verification (EM&V) of Avista Washington Electric PY2020 Residential and Low-Income Energy Efficiency Programs

Prepared for:

Avista Corporation

Delivered on:

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1. Executive Summary

This report is a summary of the Residential and Low-Income Electric Evaluation, Measurement, and Verification (EM&V) effort of the 2020 program year (PY2020) portfolio of programs for Avista Corporation (Avista) in the Washington service territory. The evaluation was administered by ADM Associates, Inc. and Cadeo Group, LLC (herein referred to as the "Evaluators").

1.1 Savings & Cost-Effectiveness Results

The Evaluators conducted an impact evaluation for Avista's Residential and Low-Income programs for PY2020. The Residential portfolio savings amounted to 1,520,403 kWh with a 120.63% realization rate. The Low-Income portfolio savings amounted to 341,277 kWh with a 98.99% realization rate. The Evaluators summarize the Residential portfolio verified savings in Table 1-1 and the Low-Income portfolio verified savings in Table 1-2 below.

The Residential portfolio reflects a TRC value of 1.11 and a UCT value of 1.74. The Low-Income portfolio reflects a TRC value of 0.38 and a UCT value of 0.24, leading to a total Residential and Low-Income TRC of 0.80 and a UCT of 0.87. Table 1-3 summarizes the evaluated TRC and UCT values with each the Residential and Low-Income portfolios.

Table 1-1: Residential Verified Impact Savings by Program

Program	Expected Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate	Total Costs
Water Heat	136,422	148,557	108.89%	$60,644.87
HVAC	501,105	527,574	105.28%	$249,332.51
Shell	374,382	610,472	163.06%	$669,148.24
ENERGY STAR Homes	109,319	84,256	77.07%	$65,757.33
Simple Steps, Smart Savings	139,204	149,544	107.43%	$48,734.17
Total Res	**1,260,432**	**1,520,403**	**120.63%**	**$1,093,617.13**

Table 1-2: Low-Income Verified Impact Savings by Program

Program	Expected Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate	Total Costs
Low-Income	183,775	210,472	114.53%	$1,060,969.24
CEEP	160,970	130,805	81.26%	$764,546.62
Total Low-Income	**344,745**	**341,277**	**98.99%**	**$1,825,515.86**

Table 1-3: Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Residential	$2,266,648	$2,045,578	1.11	$2,044,124	$1,173,511	1.74
Low Income	$581,136	$1,530,941	0.38	$383,012	$1,614,270	0.24
Total	**$2,847,784**	**$3,576,519**	**0.80**	**$2,427,136**	**$2,787,781**	**0.87**

Table 1-4 summarizes the electric programs offered to residential and low-income customers in the Washington Avista service territory in PY2020 as well as the Evaluators' evaluation tasks and impact methodology for each program.

Table 1-4: Impact Evaluation Activities by Program and Sector

Sector	Program	Database Review	Survey Verification	Impact Methodology
Residential	Water Heat	✓	✓	RTF UES
Residential	HVAC	✓	✓	RTF UES/Billing analysis with comparison group
Residential	Shell	✓	✓	RTF UES
Residential	ENERGY STAR® Homes	✓		RTF UES
Residential	Simple Steps, Smart Savings	✓		RTF UES
Low-Income	Low-Income	✓		Avista TRM
Low-Income	Community Energy Efficiency Program (CEEP)	✓		RTF UES

*This program was not deployed for the 2020 program year. Evaluation of this program will commence in 2021.

1.2 Conclusions and Recommendations

The following section details the Evaluators' conclusions and recommendations for each the Residential Portfolio and Low-Income Portfolio program evaluations.

1.2.1 Conclusions

The following section details the Evaluator's findings resulting from the program evaluations for each the Residential Portfolio and Low-Income Portfolio.

1.2.1.1 Residential Programs

The Evaluators provide the following conclusions regarding Avista's Residential electric programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 1,520,403 kWh with a realization rate of 121%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 1.11 while the UCT value is 1.74. Further details on cost-effectiveness methodology can be found in Appendix C.

- The Residential Portfolio impact evaluation resulted in a realization rate of 121% due to slight differences between the Avista TRM categories and the appropriately assigned RTF UES categories for each measure. The Evaluators note several instances in which the Avista TRM value reflects an average of a range of RTF UES values for the electric measures offered in the Washington electric service territory. The values had been averaged across heating zones, water heater storage tank sizes, equipment efficiency values, and fuel types. The Evaluators, instead of applying these averages, verified the appropriate RTF UES values for each rebate for a sample of rebates in each program and applied the resulting realization rates to the population of rebates for each program. This led to a higher realization rate, as some rebates reflected RTF savings values higher than the average for that measure.
- The Shell Program, which contributes 30% of the expected savings, resulted in a realization rate of 163% whereas each of the other programs resulted in a combined 103% realization rate. The Shell Program contributed to a 18% increase in the overall residential sector, which displayed a realization rate of 121%.
- The Simple Steps, Smart Savings Program was implemented in Washington during the month of January 2020 and was discontinued for the remainder of the year. The program therefore reflects a small percentage of savings for the residential electric savings (4%).
- The Evaluators conducted a billing analysis to estimate observed, verified savings for the E Variable Speed Motor measure. The Evaluators found the resulting savings to be 513 kWh per year, roughly 124% of the current Avista TRM value for the measure. This savings value was applied to all rebates completed in PY2020.
- In the HVAC Program, the E Smart Thermostat DIY with Electric Heat realization rate is low because the Avista TRM uses an average of retail and direct install savings values as well as an average across heating types, while the Evaluators assigned the appropriate RTF UES value for each installation type and heating zone. The appropriate categories in the RTF led to a lower-than-expected savings for the retail rebates and a higher than expected savings for the direct install rebates for this measure.
- The Evaluators note that the RTF version used to evaluate the Simple Steps, Smart Savings Program represents the residential lighting workbook active at the time the Bonneville Power Administration (BPA) planning for this program was established (October 1, 2019). The values present in this version of the RTF workbook do not reflect the current savings values present in the Avista TRM. Therefore, the adjusted savings displayed is significantly lower than the verified savings. This is because the savings for the lighting measures decreased as the baseline efficiencies have been updated and increased.

1.2.1.2 Low-Income Programs

The Evaluators provide the following conclusions regarding Avista's Residential electric programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 341,277 kWh with a realization rate of 99%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 0.38 while the UCT value is 0.24. These values are expected, as the Low-Income portfolio is not expected to meet cost-effectiveness but are implemented in order to provide energy efficiency benefits to low-income customers. Further details on cost-effectiveness methodology can be found in Appendix C.

- The Low-Income Portfolio impact evaluation resulted in a nearly 100% realization rate. The Low-Income Program and CEEP individually resulted in a 115% and 81% realization, respectively. The realization rates for each program deviate from 100% due to differences between the Avista TRM values and the appropriately assigned RTF UES values. The Evaluators note several instances in which the Avista TRM value reflects an average of a range of RTF UES values for the electric measures offered in the Washington electric service territory. The values had been averaged across heating zones, equipment efficiency values, and fuel types. The Evaluators, instead of applying these averages, verified the appropriate RTF UES values for CEEP. For the Low-Income Program, the Evaluators applied a realization rate from a sample of rebates after verifying documentation for quantity and efficiency of measures.
- The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolate each unique measure. However, participation for the Low-Income program resulted in a small number of customers with isolated measures and therefore the Evaluators conducted a whole-home billing analysis for all the electric measures combined in the Low-Income in order to estimate savings for the average household participating in the program, across all measures. The Evaluators found a realization rate of 130% for all electric measures in the program, which supported the realization rate of 115% from the desk review.
- CEEP contained 21 unique customers across all measures. Due to the requirement of a sufficient number of pre/post billing month and the requirement that customers do not participate in more than one program, the Evaluators determined that a billing analysis was not feasible.
- Some rebates included in the Low-Income Program and CEEP indicate that savings had been capped at 20% of consumption. The provided project data do not include adequate information to determine when savings values are being appropriately capped. The Evaluators recommend that annual consumption be provided for each measure in the tracking data, if practical, so that evaluation can include verifying that savings are being capped at 20% consumption for application measures.

1.2.2 Recommendations

The following section details the Evaluator's recommendations resulting from the program evaluations for each the Residential Portfolio and Low-Income Portfolio.

1.2.2.1 Residential Programs

The Evaluators offer the following recommendations regarding Avista's Residential electric programs:

- The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. The values found in the project documentation should accurately reflect the values represented in the CC&B database.
- A number of rebates were not accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and

submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.

- The realization rate for the electric savings in the Water Heat Program deviate from 100% due to the methodology in which the Avista TRM prescriptive savings value was applied. The Avista TRM assigns a combination of the values the RTF assigns for Tier 2 and Tier 3 heat pump water heaters. However, among document verification, the Evaluators found a majority of water heaters to be Tier 3 or Tier 4, which the RTF UES assigns a higher savings value. The Evaluators recommend splitting the Avista TRM value for Tier 2, Tier 3, and Tier 4 water heaters into separate values in order to accurately reflect expected savings for the electric water heater measure.
- The Avista TRM assigns the savings values for water heaters of any size. During document review, the Evaluators found most of the water heaters to have a storage tank under 55 gallons, which has a higher savings value in the RTF than water heaters with unknown tank sizes (larger systems have a more stringent code baseline). The Evaluators applied the RTF UES value for the associated tank size and tier found for each model number in the sampled rebates. These changes led to the high realization rate for the E Heat Pump Water Heater measure in the Water Heat Program. The Evaluators recommend updating the Avista TRM value for this measure based on actual tank size, in addition to collecting information on the tank size of the measure in the rebate applications.
- The Evaluators note that some of the model numbers for the rebated equipment were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.
- The Evaluators note that a number of rebate applications did not contain values associated with whether the home is existing or was a new construction home. This field is an input to apply correct RTF UES values. The Evaluators recommend requiring this field be completed in rebate applications, both mail-in and web-based.
- The Evaluators cross-referenced the billing data to verify if customers demonstrated the required heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually. In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.
- The Evaluators conducted a billing analysis for the E Variable Speed Motor measure in the HVAC Program. The estimated savings value from the billing analysis was roughly 124% of the value reflected in the Avista TRM. The Evaluators recommend updating the savings value for this measure in the Avista TRM to reflect observed savings more closely in the territory.
- For the Shell Program, the Evaluators found rebates in which the R-values did not align with TRM or RTF values (R38 and R64). The Evaluators recommend collecting information in a standardized manner.
- The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows in order to correctly assign RTF UES values.

- The Evaluators also recommend collecting information on single-family/multi-family/manufactured in the web rebate form. This allows the Evaluators to accurately assign RTF values. The mail-in rebates collect this information; however, it does not seem to be currently required to complete the rebate. Therefore many rebates are missing this information.
- The Evaluators note several instances in which the web-based rebate data indicates the household has electric space heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend updating data collection standards in order for all sources of information to reflect the same values as the project documentation.
- The Evaluators note that the realization for the E ENERGY STAR® Home – Manufactured, Gas & Electric measure is low because the Avista TRM savings was employed using an additive methodology between a gas-heated home and an electric-heated home for the electric savings. However, the Evaluators reviewed the RTF and determined manufactured home electric savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. The Evaluators recommend adjusting Avista TRM electric savings for this measure to reflect the RTF values associated with a fully natural gas-heated home at 43 kWh saved per year.
- The Evaluators recommend the Avista TRM reflect the savings values in effect for the Simple Steps, Smart Savings Program. The Avista TRM currently uses RTF values in effect on November 1, 2019 for the Simple Steps, Smart Savings whereas the expected savings for this program are calculated using the RTF-approved BPA workbook in effect on October 1, 2019.

1.2.2.2 Low-Income Programs

The Evaluators offer the following recommendations regarding Avista's Low-Income electric programs:

- The Evaluators note that most deviations from 100% realization rate is due to differences between the limited measure category options Avista TRM values and the more detailed categories referencing heating zone, cooling zone, heating type, and bulb types present in the RTF. The Evaluators recommend that Avista reference the more detailed RTF measures when calculating expected savings for the programs.
- The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. In addition, the unit type, in terms of square footage or number of measures (windows, doors, etc) was not documented consistently and therefore savings values were applied inaccurately. The Evaluators recommend updating CC&B documentation standards to more accurately reflect values present on the rebate applications.
- The Evaluators identified two duplicated rebates. The Evaluators recommend conducting cleaning and data quality practices in order to avoid duplicated rebates and therefore unexpectedly low verified savings.
- The Evaluators found discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

2. General Methodology

The Evaluators performed an impact evaluation on each of the programs summarized in Table 1-4. The Evaluators used the following approaches to calculate energy impact defined by the International Performance Measurement and Verification Protocols (IPMVP)[1] and the Uniform Methods Project (UMP)[2]:

- Simple verification (web-based surveys supplemented with phone surveys)
- Document verification (review project documentation)
- Deemed savings (RTF UES and Avista TRM values)
- Whole facility billing analysis (IPMVP Option C)

The Evaluators completed the above impact tasks for each the electric impacts and the natural gas impacts for projects completed in the Washington Avista service territory.

The M&V methodologies are program-specific and determined by previous Avista evaluation methodologies as well as the relative contribution of a given program to the overall energy efficiency impacts. Besides drawing on IPMVP, the Evaluators also reviewed relevant information on infrastructure, framework, and guidelines set out for EM&V work in several guidebook documents that have been published over the past several years. These include the following:

- Northwest Regional Technical Forum (RTF)[3]
- National Renewable Energy Laboratory (NREL), United States Department of Energy (DOE) The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures, April 2013[4]
- International Performance Measurement and Verification Protocol (IPMVP) maintained by the Efficiency Valuation Organization (EVO) with sponsorship by the U.S. Department of Energy (DOE)[5]

The Evaluators kept data collection instruments, calculation spreadsheets, and monitored/survey data available for Avista records.

2.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators have provided a glossary of terms to follow:

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[1] https://www.nrel.gov/docs/fy02osti/31505.pdf

[2] https://www.nrel.gov/docs/fy18osti/70472.pdf

[3] https://rtf.nwcouncil.org/measures

[4] Notably, The Uniform Methods Project (UMP) includes the following chapters authored by ADM. Chapter 9 (Metering Cross-Cutting Protocols) was authored by Dan Mort and Chapter 15 (Commercial New Construction Protocol) was Authored by Steven Keates.

[5] Core Concepts: International Measurement and Verification Protocol. EVO 100000 – 1:2016, October 2016.

- **Deemed Savings** – An estimate of an energy savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) are applicable to the situation being evaluated.
- **Expected Savings** – Calculated savings used for program and portfolio planning purposes.
- **Adjusted Savings** – Savings estimates after database review and document verification has been completed using deemed unit-level savings provided in the Avista TRM. It adjusts for such factors as data errors and installation rates.
- **Verified Savings** – Savings estimates after the unit-level savings values have been updated and energy impact evaluation has been completed, integrating results from billing analyses and appropriate RTF UES and Avista TRM values.
- **Gross Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, regardless of why they participated.
- **Free Rider** – A program participant who would have implemented the program measure or practice in absence of the program.
- **Net-To-Gross** – A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.
- **Net Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, with adjustments to remove savings due to free ridership.
- **Non-Energy Benefits** – Quantifiable impacts produced by program measures outside of energy savings (comfort, health and safety, reduced alternative fuel, etc).
- **Non-Energy Impacts** – Quantifiable impacts in energy efficiency beyond the energy savings gained from installing energy efficient measures (reduced cost for operation and maintenance of equipment, reduced environmental and safety costs, etc).

2.2 Summary of Approach

This section presents our general cross-cutting approach to accomplishing the impact evaluation of Avista's Residential and Low-Income programs listed in Table 1-4. The Evaluators start by presenting our general evaluation approach. This chapter is organized by general task due to several overlap across programs. Section 3.3 describes the Evaluators' program-specific residential impact evaluation methods and results in further detail and Section 4.1 describes the Evaluator's program-specific low-income impact evaluation methods and results.

The Evaluators outline the approach to verifying, measuring, and reporting the residential portfolio impacts as well as cost-effectiveness and summarizing potential program and portfolio improvements. The primary objective of the impact evaluation is to determine ex-post verified net energy savings. On-site verification and equipment monitoring was not conducted during this impact evaluation due to stay-at-home orders due to the COVID19 pandemic.

Our general approach for this evaluation considers the cyclical feedback loop among program design, implementation, and impact evaluation. Our activities during the evaluation estimate and verify annual energy savings and identify whether a program is meeting its goals. These activities are aimed to provide guidance for continuous program improvement and increased cost effectiveness for the 2020 and 2021 program years.

The Evaluators employed the following approach to complete impact evaluation activities for the programs. The Evaluators define two major approaches to determining net savings for Avista's programs:

- A *Deemed Savings* approach involves using stipulated savings for energy conservation measures for which savings values are well-known and documented. These prescriptive savings may also include an adjustment for certain measures, such as lighting measures in which site operating hours may differ from RTF values.
- A *Billing Analysis* approach involves estimating energy savings by applying a linear regression to measured participant energy consumption utility meter billing data. Billing analyses included billing data from nonparticipant customers. This approach does not require on-site data collection for model calibration. This approach aligns with the IPMVP Option C.

The Evaluators accomplished the following quantitative goals as part of the impact evaluation:

- Verify savings with 10% precision at the 90% confidence level;
- Where appropriate, apply the RTF to verify measure impacts; and
- Where available data exists, conduct billing analysis with a suitable comparison group to estimate measure savings.

For each program, the Evaluators calculated adjusted savings for each measure based on the Avista TRM and results from the database review. The Evaluators calculated verified savings for each measure based on the RTF UES, Avista TRM, or billing analysis in combination with the results from document review. For the HVAC, Water Heat, and Fuel Efficiency programs, the Evaluators also applied in-service rates (ISRs) from verification surveys.

The Evaluators assigned methodological rigor level for each measure and program based on its contribution to the portfolio savings and availability of data.

The Evaluators analyzed billing data for all electric measure participants in the HVAC and Low-Income programs. The Evaluators applied billing analysis results to determine evaluated savings only for measures where savings could be isolated (that is, where a sufficient number of participants could be identified who installed only that measure). Program-level realization rates for the HVAC, Water Heat, and Fuel Efficiency programs incorporate billing analysis results for some measures.

2.2.1 Database Review

At the outset of the evaluation, the Evaluators reviewed the databases to ensure that each program tracking database conforms to industry standards and adequately tracks key data required for evaluation.

Measure-level net savings were evaluated primarily by reviewing measure algorithms and values in the tracking system to assure that they are appropriately applied using the Avista TRM. The Evaluators then aggregated and cross-check program and measure totals.

The Evaluators reviewed program application documents for a sample of incented measures to verify the tracking data accurately represents the program documents. The Evaluators ensured the home installed measures that meet or exceed program efficiency standards.

2.2.2 Verification Methodology

The Evaluators verified a sample of participating households for detailed review of the installed measure documentation and development of verified savings. The Evaluators verified tracking data by reviewing invoices and surveying a sample of participant customer households. The Evaluators also conducted a verification survey for program participants.

The Evaluators used the following equations to estimate sample size requirements for each program and fuel type. Required sample sizes were estimated as follows:

Equation 2-1: Sample Size for Infinite Sample Size

$$n = \left(\frac{Z \times CV}{d}\right)^2$$

Equation 2-2: Sample Size for Finite Population Size

$$n_0 = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

Where,

- n = Sample size
- Z = Z-value for a two-tailed distribution at the assigned confidence level.
- CV = Coefficient of variation
- d = Precision level
- N = Population

For a sample that provides 90/10 precision, *Z* = 1.645 (the critical value for 90% confidence) and *d* = 0.10 (or 10% precision). The remaining parameter is *CV*, or the expected coefficient of variation of measures for which the claimed savings may be accepted. A *CV* of .5 was assumed for residential programs due to the homogeneity of participation[6], which yields a sample size of 68 for an infinite population. Sample sizes were adjusted for smaller populations via the method detailed in Equation 2-2.

The following sections describe the Evaluator's methodology for conducting document-based verification and survey-based verification.

2.2.2.1 Document-Based Verification

The Evaluators requested rebate documentation for a subset of participating customers. These documents included invoices, rebate applications, pictures, and AHRI certifications for the following programs.

- Water Heat Program
- HVAC Program
- Shell Program
- ENERGY STAR® Homes
- Simple Steps, Smart Savings
- Low-Income Program
- Community Energy Efficiency Program

This sample of documents was used to cross-verify tracking data inputs. In the case the Evaluators found any deviations between the tracking data and application values, the Evaluators reported and summarized those differences in the Database Review sections presented for each program in Section 3.3 and Section 4.1.

The Evaluators developed a sampling plan that achieves a sampling precision of ±10% at 90% statistical confidence – or "90/10 precision" – to estimate the percentage of projects for which the claimed savings are verified or require some adjustment.

The Evaluators developed the following samples for each program's document review using Equation 2-1 and Equation 2-2. The Evaluators ensured representation in each state and fuel type for each measure.

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[6] Assumption based off California Evaluation Framework:

https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/CAEvaluationFramework.pdf

Table 2-1: Document-based Verification Samples and Precision by Program

Sector	Program	Electric Population	Sample (With Finite Population Adjustment)*	Precision at 90% CI
Residential	Water Heat	127	45	±10.0%
Residential	HVAC	419	62	±9.7%
Residential	Shell	379	63	±9.5%
Residential	ENERGY STAR® Homes	44	28	±9.8%
Residential	Simple Steps, Smart Savings	N/A	N/A	N/A
Low-Income	Low-Income	386	65	±9.4%
Low-Income	CEEP	21	21	±0.0%

*Assumes sample size of 68 for an infinite population, based on *CV* (coefficient of variation) = 0.5, *d* (precision) = 10%, *Z* (critical value for 90% confidence) = 1.645.

The table above represents the number of rebates in both Washington and Idaho territories. The Evaluators ensured representation of state and fuel type in the sampled rebates for document verification.

2.2.2.2 Survey-Based Verification

The Evaluators conducted survey-based verification for the Water Heat Program and HVAC Program. The primary purpose of conducting a verification survey is to confirm that the measure was installed and is still currently operational and whether the measure was early retirement or replace-on-burnout.

The Evaluators summarize the final sample sizes shown in Table 2-2 for the Water Heat and HVAC for the Washington Electric Avista projects. The Evaluators developed a sampling plan that achieved a sampling precision of ±6.50% at 90% statistical confidence for ISRs estimates at the measure-level during web-based survey verification.

Table 2-2: Survey-Based Verification Sample and Precision by Program

Sector	Program	Population	Respondents	Precision at 90% CI
Residential	Water Heat	127	32	±9.8%
Residential	HVAC	419	88	±7.9%
Total		**546**	**120**	**±6.5%**

The Evaluators implemented a web-based survey to complete the verification surveys. The Evaluators supplemented with phone interviews to reach the 90/10 precision goal. The findings from these activities served to estimate ISRs for each measure surveyed. These ISRs were applied to verification sample desk review rebates towards verified savings, which were then applied to the population of rebates. The measure-level ISRs resulting from the survey-based verification are summarized in Section 3.1.

2.2.3 Impact Evaluation Methodology

The Evaluators employed the following approach to complete impact evaluation activities for the programs. The Evaluators define two major approaches to determining net savings for Avista's programs:

- Deemed Savings
- Billing Analysis (IPMVP Option C)

In the following sections, the Evaluators summarize the general guidelines and activities followed to conduct each of the above analyses.

2.2.3.1 Deemed Savings

This section summarizes the deemed savings analysis method the Evaluators employed for the evaluation of a subset of measures for each program. The Evaluators completed the validation for specific measures across each program using the RTF unit energy savings (UES) values, where available. The Evaluators ensured the proper measure unit savings were recorded and used in the calculation of Avista's ex-ante measure savings. The Evaluators requested and used the technical reference manual Avista employed during calculation of ex-ante measure savings (Avista TRM). The Evaluators documented any cases where recommend values differed from the specific unit energy savings workbooks used by Avista.

In cases where the RTF has existing unit energy savings (UES) applicable to Avista's measures, the Evaluators verified the quantity and quality of installations and apply the RTF's UES to determine verified savings.

2.2.3.2 Billing Analysis

This section describes the billing analysis methodology employed by the Evaluators as part of the impact evaluation and measurement of energy savings for measures with sufficient participation. The Evaluators performed billing analyses with a matched control group and utilized a quasi-experimental method of producing a post-hoc control group. In program designs where treatment and control customers are not randomly selected at the outset, such as for downstream rebate programs, quasi-experimental designs are required.

For the purposes of this analysis, a household is considered a treatment household if it has received a program incentive. Additionally, a household is considered a control household if the household has not received a program incentive. To isolate measure impacts, treatment households are eligible to be included in the billing analysis if they installed only one measure during the 2019 and 2020 program years. Isolation of individual measures are necessary to provide valid measure-level savings. Households that installed more than one measure may display interactive energy savings effects across multiple measures that are not feasibly identifiable. Therefore, instances where households installed isolated measures are used in the billing analyses. In addition, the pre-period identifies the period prior to measure installation while the post-period refers to the period following measure installation.

The Evaluators utilized propensity score matching (PSM) to match nonparticipants to similar participants using pre-period billing data. PSM allows the evaluators to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing.

After matching based on these variables, the billing data for treatment and control groups are compared, as detailed in IPMVP Option C. The Evaluators fit regression models to estimate weather-dependent daily consumption differences between participating customer and nonparticipating customer households.

Cohort Creation

The PSM approach estimates a propensity score for treatment and control customers using a logistic regression model. A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households. The Evaluators created a post-hoc control group by compiling billing data from a subset of nonparticipants in the Avista territory to compare against treatment households using quasi-experimental methods. This allowed the Evaluators to select from a large group of similar households that have not installed an incented measure. With this information, the Evaluators created statistically valid matched control groups for each measure via seasonal pre-period usage. The Evaluators matched customers in the control group to customers in the treatment group based on nearest seasonal pre-period usage (e.g., summer, spring, fall, and winter) and exact 3-digit zip code matching (the first three digits of the five-digit zip code). After matching, the Evaluators conducted a *t*-test for each month in the pre-period to help determine the success of PSM.

While it is not possible to guarantee the creation of a sufficiently matched control group, this method is preferred because it is likely to have more meaningful results than a treatment-only analysis. Some examples of outside variables that a control group can sufficiently control for are changes in economies and markets, large-scale social changes, or impacts from weather-related anomalies such as flooding or hurricanes. This is particularly relevant in 2020 due to COVID-19 related lockdowns and restrictions.

After PSM, the Evaluators ran the following regression models for each measure:

- Fixed effect Difference-in-Difference (D-n-D) regression model (recommended in UMP protocols)[7]
- Random effects post-program regression model (PPR) (recommended in UMP protocols)
- Gross billing analysis (treatment only)

The second model listed above (PPR) was selected because it had the best fit for the data, identified using the adjusted R-squared. Further details on regression model specifications can be found below.

Data Collected

The following lists the data collected for the billing analysis:

1. Monthly billing data for program participants (treatment customers)
2. Monthly billing data for a group of non-program participants (control customers)
3. Program tracking data, including customer identifiers, address, and date of measure installation
4. National Oceanic and Atmospheric Administration (NOAA) weather data between January 1, 2018 and December 31, 2020)
5. Typical Meteorological Year (TMY3) data

[7] National Renewable Energy Laboratory (NREL) Uniform Methods Project (UMP) Chapter 17 Section 4.4.7.

Billing and weather data were obtained for program years 2019 and 2020 and for one year prior to measure install dates (2018).

Weather data was obtained from the nearest weather station with complete data during the analysis years for each customer by mapping the weather station location with the customer zip code.

TMY weather stations were assigned to NOAA weather stations by geocoding the minimum distance between each set of latitude and longitude points. This data is used for extrapolating savings to long-run, 30-year average weather.

Data Preparation

The following steps were taken to prepare the billing data:

1. Gathered billing data for homes that participated in the program.
2. Excluded participant homes that also participated in the other programs, if either program disqualifies the combination of any other rebate or participation.
3. Gathered billing data for similar customers that did not participate in the program in evaluation.
4. Excluded bills missing address information (0.1% of bills).
5. Removed bills missing fuel type/Unit of Measure (UOM) (0.1% of bills).
6. Removed bills missing usage, billing start date, or billing end date (0.17% of bills).
7. Remove bills with outlier durations (<9 days or >60 days).
8. Excluded bills with consumption indicated to be outliers.
9. Calendarized bills (recalculates bills, usage, and total billed such that bills begin and end at the start and end of each month).
10. Obtained weather data from nearest NOAA weather station using 5-digit zip code per household.
11. Computed Heating Degree Days (HDD) and Cooling Degree Days (CDD) for a range of setpoints. The Evaluators assigned a setpoint of 65°F for both HDD and CDD. The Evaluators tested and selected the optimal temperature base for HDDs and CDDs based on model R-squared values.
12. Selected treatment customers with only one type of measure installation during the analysis years and combined customer min/max install dates with billing data (to define pre- and post-periods).
13. Restricted to treatment customers with install dates in specified range (typically January 1, 2019 through June 30, 2020) to allow for sufficient post-period billing data.
14. Restricted to control customers with usage less than or equal to two times the maximum observed treatment group usage. This has the effect of removing control customers with incomparable usage relative to the treatment group.
15. Removed customers with incomplete post-period bills (<4 months).
16. Removed customers with incomplete pre-period bills.

17. Restricted control customers to those with usage that was comparable with the treatment group usage.
18. Created a matched control group using PSM and matching on pre-period seasonal usage and zip code.

Regression Models

The Evaluators ran the following models for matched treatment and control customers for each measure with sufficient participation. For net savings, the Evaluators selected either Model 1 or Model 2. The model with the best fit (highest adjusted R-squared) was selected. The Evaluators utilized Model 3 to estimate gross energy savings.

Model 1: Fixed Effects Difference-in-Difference Regression Model

The following equation displays the first model specification to estimate the average daily savings due to the measure.

Equation 2-3: Fixed Effects Difference-in-Difference (D-n-D) Model Specification

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(Post \times Treatment)_{it} + \beta_3(HDD)_{it} + \beta_4(CDD)_{it} \\ &+ \beta_5(Post \times HDD)_{it} + \beta_6(Post \times CDD)_{it} + \beta_7(Post \times HDD \times Treatment)_{it} \\ &+ \beta_8(Post \times CDD \times Treatment)_{it} + \beta_9(Month)_t + \beta_{10}(Customer\ Dummy)_i + \varepsilon_{it} \end{aligned}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage reading *t* for household *i* during the post-treatment period
- $Post_{it}$ = A dummy variable indicating pre- or post-period designation during period *t* at home *i*
- $Treatment_i$ = A dummy variable indicating treatment status of home *i*
- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*
- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home i *(if electric usage)*
- $Month_t$= A set of dummy variables indicating the month during period *t*
- $Customer\ Dummy_i$ = a customer-specific dummy variable isolating individual household effects
- ε_{it} = The error term
- α_0= The model intercept
- β_{1-10} = Coefficients determined via regression

The Average Daily Consumption (ADC) is calculated as the total monthly billed usage divided by the duration of the bill month. β_2 represents the average change in daily baseload in the post-period between the treatment and control group and β_7 and β_8 represent the change in weather-related daily consumption in the post-period between the groups. Typical monthly and annual savings were estimated by extrapolating the β_7 and β_8 coefficients with Typical Meteorological Year (TMY) HDD and

CDD data. However, in the case of gas usage, only the coefficient for HDD is utilized because CDDs were not included in the regression model.

The equation below displays how savings were extrapolated for a full year utilizing the coefficients in the regression model and TMY data. TMY data is weighted by the number of households assigned to each weather station.

Equation 2-4: Savings Extrapolation

$$Annual\ Savings = \beta_2 * 365.25 + \beta_7 * TMY\ HDD + \beta_8 * TMY\ CDD$$

Model 2: Random Effects Post-Program Regression Model

The following equation displays the second model specification to estimate the average daily savings due to the measure. The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the treatment and control customers; in particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between treatment and control customers will be reflected in the differences in their past energy use, which is highly correlated with their current energy use. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

Equation 2-5: Post-Program Regression (PPR) Model Specification

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Treatment)_i + \beta_2\ (PreUsage)_i + \beta_3\ (PreUsageSummer)_i \\ &+ \beta_4(PreUsageWinter)_i + \beta_5(Month)_t + \beta_6(Month \times PreUsage)_{it} \\ &+ \beta_7(Month \times PreUsageSummer)_{it} + \beta_8(Month \times PreUsageWinter)_{it} \\ &+ \beta_9(HDD)_{it} + \beta_{10}(CDD)_{it} + \beta_{11}(Treatment \times HDD)_{it} + \beta_{12}(Treatment \times CDD)_{it} \\ &+ \varepsilon_{it} \end{aligned}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period
- $Treatment_i$ = A dummy variable indicating treatment status of home *i*
- $Month_t$ = Dummy variable indicating month of month *t*
- $PreUsage_i$ = Average daily usage across household *i*'s available pre-treatment billing reads
- $PreUsageSummer_i$ = Average daily usage in the summer months across household *i*'s available pretreatment billing reads
- $PreUsageWinter_i$ = Average daily usage in the winter months across household *i*'s available pre-treatment billing reads
- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*

- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home i *(if electric usage)*
- ε_{it} = Customer-level random error
- α_0= The model intercept for home *i*
- β_{1-12} = Coefficients determined via regression

The coefficient β_1 represents the average change in consumption between the pre-period and post-period for the treatment group and β_{11} and β_{12} represent the change in weather-related daily consumption in the post-period between the groups. Typical monthly and annual savings were estimated by extrapolating the β_{11} and β_{12} coefficients with Typical Meteorological Year (TMY) HDD and CDD data.

The equation below displays how savings were extrapolated for a full year utilizing the coefficients in the regression model and TMY data.

Equation 2-6: Savings Extrapolation

$$Annual\ Savings = \beta_1 * 365.25 + \beta_{11} * TMY\ HDD + \beta_{12} * TMY\ CDD$$

Model 3: Gross Billing Analysis, Treatment-Only Regression Model

The sections above detail the Evaluator's methodology for estimating net energy savings for each measure. The results from the above methodology report net savings due to the inclusion of the counterfactual comparison group. However, for planning purposes, it is useful to estimate gross savings for each measure. To estimate gross savings, the Evaluators employed a similar regression model; however, only including participant customer billing data. This analysis does not include control group billing data and therefore models energy reductions between the pre-period and post-period for the measure participants (treatment customers).

To calculate the impacts of each measure, the Evaluators applied linear fixed effects regression using participant billing data with weather controls in the form of Heating Degree Days (HDD) and Cooling Degree Days (CDD). The following equation displays the model specification to estimate the average daily savings due to the measure.

Equation 2-7: Treatment-Only Fixed Effects Weather Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(HDD)_{it} + \beta_3(CDD)_{it} + \beta_4(Post \times HDD)_{it} + \beta_5(Post \times CDD)_{it} + \beta_6(Customer\ Dummy)_i + \beta_7(Month)_t + \varepsilon_{it}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period
- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*
- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home i *(if electric usage)*

- $Post_{it}$ = A dummy variable indicating pre- or post-period designation during period t at home *i*
- $Customer\ Dummy_i$ = a customer-specific dummy variable isolating individual household effects
- ε_{it} = Customer-level random error
- α_0= The model intercept for home *i*
- β_{1-6} = Coefficients determined via regression

The results of the treatment-only regression models are gross savings estimates. The gross savings estimates are useful to compare against the net savings estimates. However, the treatment-only models are unable to separate the effects of the COVID19 pandemic. The post-period for PY2020 and perhaps also PY2021 are affected by the stay-at-home orders that had taken effect starting March 2020 in Washington. The stay-at-home orders most likely affect the post-period household usage. Because there is insufficient post-period data before the shelter-in-place orders, the Evaluators were unable to separate the effects on consumption due to the orders and the effects on consumption due to the measure installation. Therefore, the results from this additional gross savings analysis are unable to reflect actual typical year savings. However, for planning purposes, these estimates may be useful.

2.2.4 Net-To-Gross

The Northwest RTF UES measures do not require NTG adjustments as they are built into the deemed savings estimates. In addition, billing analyses with counterfactual control groups, as proposed in our impact methodology, does not require a NTG adjustment, as the counterfactual represents the efficiency level at current market (i.e. the efficiency level the customer would have installed had they not participated in the program).

2.2.5 Cost-Effectiveness Tests

The Evaluators calculated each program’s cost-effectiveness, avoided energy costs, and implementation costs. The Evaluators used our company-developed cost-effectiveness tool to provide cost-effectiveness assessments for the Residential Portfolio by program, fuel type, program year, and measure, for each state.

As specified in this solicitation, the Evaluators determined the economic performance with the following cost-effectiveness tests:

- Total Resource Cost (TRC) test;
- Utility Cost Test (UCT);
- Participant Cost Test (PCT); and
- Rate Impact Measure (RIM).

2.2.6 Non-Energy Benefits

The Evaluators used the Regional Technical Forum (RTF) to quantify non-energy benefits (NEBs) for residential measures with established RTF values where available. Measures with quantified NEBs include residential insulation, high efficiency windows, air source heat pumps, and ductless heat pumps.

In addition to the residential NEBs, the Evaluators applied the end-use non-energy benefit and health and human safety non-energy benefit to the Low-Income Program. The Evaluators understand that the two major non-energy benefits referenced above are uniquely applicable to the Low-Income Program. The Evaluators applied those benefits to the program impacts as well as additional non-energy benefits associated with individual measures included in the program. The Evaluators incorporated additional NEBs to the impact evaluation, as applicable. Additional details on the non-energy benefits applied can be found in Section 7.2.

3. Residential Impact Evaluation Results

The Evaluators completed an impact evaluation on Avista's Residential portfolio to verify program-level and measure-level energy savings for PY2020. The following sections summarize findings for each electric impact evaluation in the Residential Portfolio in the Washington service territory. The Evaluators used data collected and reported in the tracking database, online application forms, Avista TRM, RTF, and billing analysis of participants and nonparticipants to evaluate savings. This approach provided the strongest estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, number of participants, and availability of data. Table 3-1 summarizes the Residential verified impact savings by program. Table 3-2 summarizes the Residential portfolio's cost-effectiveness.

Table 3-1: Residential Verified Impact Savings by Program

Program	Expected Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate
Water Heat	136,422	148,557	108.89%
HVAC	501,105	527,574	105.28%
Shell	374,382	610,472	163.06%
ENERGY STAR Homes	109,319	84,256	77.07%
Simple Steps, Smart Savings	139,204	149,544	107.43%
Total Res	**1,260,432**	**1,520,403**	**120.63%**

Table 3-2: Residential Portfolio Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Residential	$2,266,648	$2,045,578	1.11	$2,044,124	$1,173,511	1.74

In PY2020, Avista completed and provided incentives for residential electric measures in Washington and reported total electric energy savings of 1,520,403 kWh. All programs except the ENERGY STAR® Homes Program exceeded savings goals based on reported savings, leading to an overall achievement of 120.63% of the expected savings for the residential programs. The Evaluators estimated the TRC value for the Residential portfolio is 1.11 while the UCT value is 1.74. Further details of the impact evaluation results by program are provided in the sections following.

3.1 Simple Verification Results

The Evaluators surveyed 261 unique customers that participated in Avista's residential energy efficiency program in February and March 2021 using a mixed mode approach (phone/email). Customers with a valid email were sent the survey via an email invitation. Fifty-three did not have email addresses in program records and were invited to take the survey by the Evaluators' in-house survey administration team. The Evaluators also conducted targeted follow-up outreach to customers for certain measures.

The Evaluators surveyed customers that received rebates for HVAC, Water Heater, and Fuel Efficiency Programs.

Table 3-3: Summary of Survey Response Rate

Population	Respondents
Initial email contact list	959
Invalid email addresses	3
Bounced email	43
Undeliverable email	27
Invalid email (%)	*8%*
Email invitations sent (unique valid)	886
Email completions	208
Email response rate (%)	23%
Initial phone list	190
Phone numbers w/ email addresses	138
Phone numbers w/ no email address	52
Disconnected/wrong number	20
Invalid phone (%)	*11%*
Phone calls (unique valid)	170
Phone completions	54
Phone response rate (%)	32%
Total invites (unique)	938
Total completions	262
Response rate (%)	28%
Initial email contact list	959
Invalid email addresses	3

3.1.1 In-Service Rates

The Evaluators calculated in-service rates of installed measures from simple verification surveys deployed to program participants for the Water Heat and HVAC Programs. The Evaluators asked participants if the rebated equipment is currently installed and working, in addition to questions about the new equipment fuel type. The Evaluators achieved 6.50% precision across the programs surveyed for the electric measures in Avista's service territory, summarized in Table 3-4.

Table 3-4: Simple Verification Precision by Program

Sector	Program	Population	Respondents	Precision at 90% CI
Residential	Water Heat	59	32	9.84%
Residential	HVAC	419	88	7.90%
Total		**478**	**120**	**6.50%**

The measure-level ISRs determined from the verification survey for each program in which simple verification was conducted is presented in Table 3-5 and Table 3-6.

Table 3-5: Water Heat Program ISRs by Measure

Measure	Respondents	ISR
E Heat Pump Water Heater	32	100%

Table 3-6: HVAC Program ISRs by Measure

Measure	Respondents	ISR
E Electric To Air Source Heat Pump	21	100.00%
E Electric to Ductless Heat Pump	21	100.00%
E Smart Thermostat DIY with Electric Heat	15	93.33%
E Smart Thermostat Paid Install with Electric Heat	27	100.00%
E Variable Speed Motor	4	100.00%

These ISR values were utilized in the desk reviews for the Water Heat and HVAC Programs in order to calculate verified savings. Additional insights from the survey responses are summarized in Appendix B.

3.2 Impacts of COVID-19 Pandemic

On average, about three people lived at the residence that had the rebated equipment installed and about 60% of respondents said that two or fewer lived at the residence that had the rebated equipment installed.

About two-thirds of respondents (66%) observed that the pandemic had not changed the number of people in their household that worked or went to school remotely.[8] Twenty-two percent of respondents said that more members of their household were attending school remotely or working from home since the COVID-19 pandemic began. Twelve percent of respondents indicated that more members of their household had gone to work or school remotely before the COVID-19 pandemic.

Three-quarters of respondents said that the amount of time they spend at home has increased since the COVID-19 pandemic began. A much smaller portion of respondents indicated that other members of their household were spending more time at home, as displayed in Figure 3-1. About half of respondents indicated that their utility bill had increased, as displayed in Figure 3-2.

[8] n=257

Figure 3-1: Change in amount of time spent at home

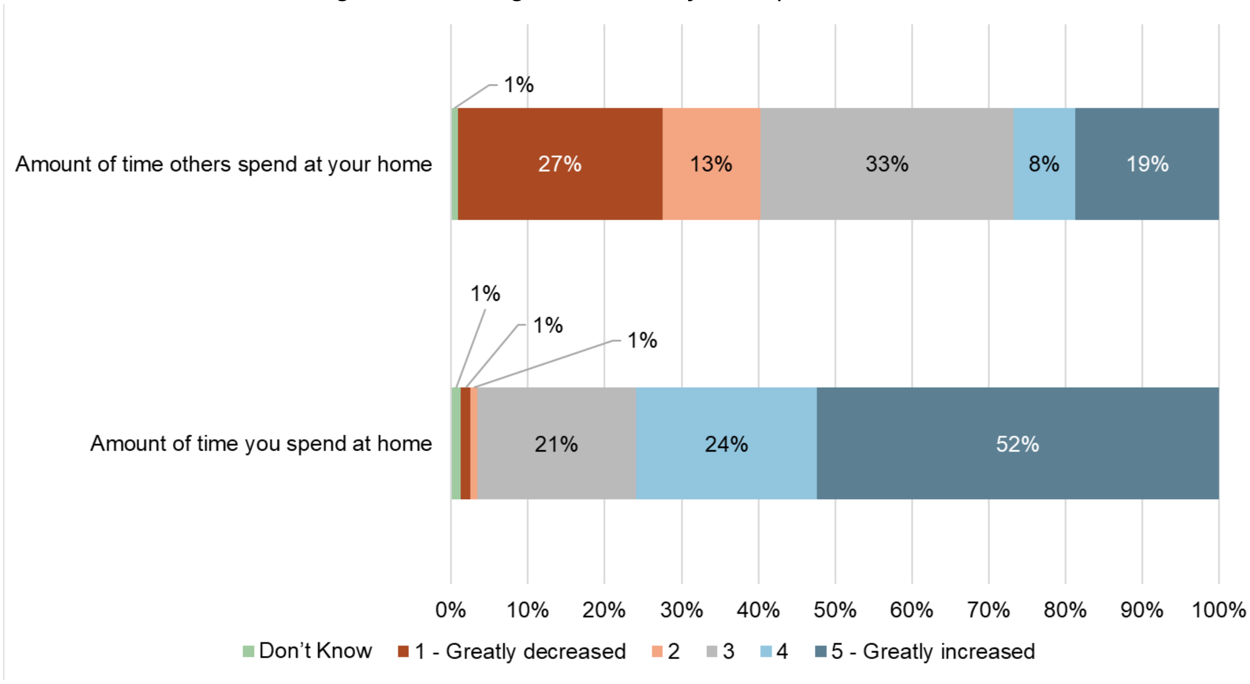
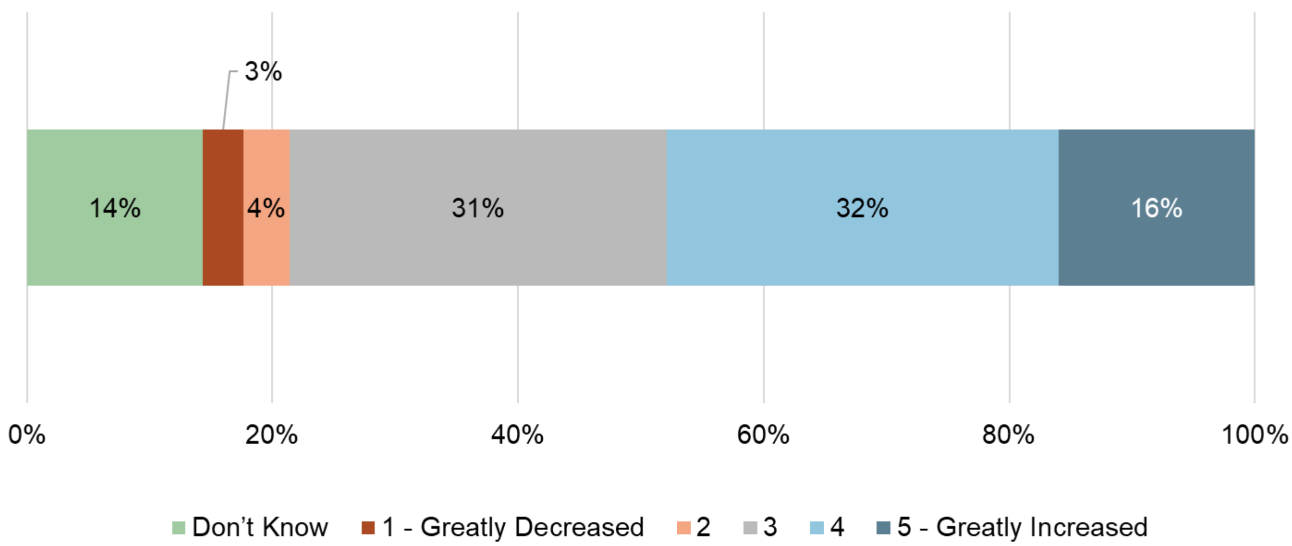


Figure 3-2: Change in electricity bill since COVID19 pandemic began



3.3 Program-Level Impact Evaluation Results

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Residential sector in the section below.

3.3.1 Water Heat Program

The Water Heat Program encourages customers to replace their existing electric or natural gas water heater with high efficiency equipment. Customers receive incentives after installation and after submitting a completed rebate form. Table 3-7 summarizes the measures offered under this program.

Table 3-7: Water Heat Program Measures

Measure	Description	Impact Analysis Methodology
E Heat Pump Water Heater	Electric water heater (0.94 EF or higher)	RTF UES

The following table summarizes the verified electric energy savings for the Water Heat Program impact evaluation.

Table 3-8: Water Heat Program Verified Electric Savings

Measure	PY2020 Participation	Expected Savings	Adjusted Savings	Verified Savings	Realization Rate
E Heat Pump Water Heater	117	136,422	137,588	148,557	108.89%
Total	**117**	**136,422**	**137,588**	**148,557**	**108.89%**

The Water Heat Program displayed verified savings of 148,557 kWh with a realization rate of 108.89% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-9: Water Heat Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
E Heat Pump Water Heater	$25,370.00	$35,274.87	$60,644.87
Total	**$25,370.00**	**$35,274.87**	**$60,644.87**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Water Heat Program in the section below.

3.3.1.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Water Heat Program.

3.3.1.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Water Heat Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators found all Water Heat Program rebates to have completed rebate applications with the associated water heater model number and efficiency values filled in either the Customer Care & Billing (CC&B) web rebate data or mail-in rebate applications.

However, the Evaluators note that the CC&B web rebate data does not reflect the same values found in the mail-in rebate applications and/or invoices or AHRI certification documents submitted with the rebate application. The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. For example, ten of the 111 sampled rebates were not found in the CC&B dataset. A number of the sampled rebates were found to have discrepancies in model numbers between the CC&B data and the mail-in rebate applications and/or invoices.

In addition, not all rebates were accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.

The Evaluators found all sampled rebate equipment met or exceeded the measure efficiency requirements for the Water Heat Program.

3.3.1.3 Verification Surveys

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measure. The Evaluators included questions such as:

- Was this water heater a new construction, or did it replace another water heater?
- Was the previous water heater functional?
- Is the newly installed water heater still properly functioning?

In addition, the Evaluators asked participants how the COVID19 pandemic stay-at-home orders have affected their household's energy consumption. The responses to this verification survey were used to calculate ISRs for the measures offered in the Water Heat Program.

Table 3-10 displays the ISRs for each of the Water Heat measures for Idaho and Washington territory combined.

Table 3-10: Water Heat Verification Survey ISR Results

Measure	Number of Rebates	Number of Survey Completes	Program-Level Precision at 90% Confidence	In-Service Rate
E Heat Pump Water Heater	117	32	9.84%*	100%

*Heat Pump Water Heater measure precision calculated at the participant-level, not the project-level, as most participants were builders.

All survey respondents for each water heater measure described equipment to be currently functioning, leading to a 100% ISR. The Evaluators applied these ISRs to each rebate to quantify verified savings for each measure.

3.3.1.4 Impact Analysis

This section summarizes the verified savings results for the Water Heat Program. The Evaluators calculated verified savings for the E Heat Pump Water Heater measure using the RTF workbook in place at the time the savings goals for the program was finalized The UES value associated with this measure was applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.1.5 Billing Analysis

The Evaluators did not conduct a billing analysis for the electric measures in the Water Heat Program.

3.3.1.6 Verified Savings

The Evaluators reviewed and applied the current RTF UES values for the E Heat Pump Water Heater measure along with verified tracking data to estimate net program savings for this measure. The verified savings for the program is 148,557 kWh with a realization rate of 108.89%, as displayed in Table 3-8.

The realization rate for the electric savings in the Water Heat Program deviate from 100% due to the Avista TRM prescriptive savings value. The Avista TRM assigns a combination of the values the RTF assigns for Tier 2 and Tier 3 heat pump water heaters. However, among document verification, the Evaluators found a majority of water heaters to be Tier 3 or higher, which the RTF UES assigns a higher savings value.

In addition, the Avista TRM assigns the savings values for water heaters of any size. During document review, the Evaluators found most of the water heaters to have a storage tank under 55 gallons, which has a higher savings value in the RTF than water heaters with unknown tank sizes. The Evaluators applied the RTF UES value for the associated tank size and tier found for each model number in the sampled rebates. These changes led to the high realization rate for the E Heat Pump Water Heater measure in the Water Heat Program. The ISRs for each of the measures in the Water Heat Program was 100% and therefore did not affect the verified savings realization rates.

3.3.2 HVAC Program

The HVAC program encourages installation of high efficiency HVAC equipment and smart thermostats through customer incentives. The program is available to residential electric or natural gas customers with a winter heating season usage of 4,000 or more kWh, or at least 160 Therms of space heating in the prior year. Existing or new construction homes are eligible to participate in the program. Table 3-7 summarizes the measures offered under this program.

Table 3-11: HVAC Program Measures

Measure	Description	Impact Analysis Methodology
E Electric To Air Source Heat Pump	Electric forced air furnace replacement with air source heat pump	RTF UES
E Electric to Ductless Heat Pump	Electric forced air furnace replacement with ductless heat pump	RTF UES
E Smart Thermostat DIY with Electric Heat	Self-installed connected thermostats in electrically heated home	RTF UES
E Smart Thermostat Paid Install with Electric Heat	Professionally installed connected thermostats in electrically heated home	RTF UES
E Variable Speed Motor	Variable speed motor in electrically heated home	Billing Analysis

The following table summarizes the verified electric energy savings for the HVAC Program impact evaluation.

Table 3-12: HVAC Program Verified Electric Savings

Measure	PY2020 Participation	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate
E Electric To Air Source Heat Pump	53	310,845	310,862	313,827	100.96%
E Electric to Ductless Heat Pump	41	94,828	96,268	122,555	129.24%
E Smart Thermostat DIY with Electric Heat	63	47,338	48,653	37,842	79.94%
E Smart Thermostat Paid Install with Electric Heat	61	46,438	46,407	51,299	110.47%
E Variable Speed Motor	3	1,656	1,656	2,052	123.92%
Total	**221**	**501,105**	**503,846**	**527,574**	**105.28%**

The HVAC Program displayed verified savings of 527,574 kWh with a realization rate of 105.28% against the expected savings for the program.

Table 3-13: HVAC Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
E Electric To Air Source Heat Pump	$37,100.00	$102,203.85	$139,303.85
E Electric to Ductless Heat Pump	$20,500.00	$48,458.44	$68,958.44
E Smart Thermostat DIY with Electric Heat	$4,849.56	$12,428.83	$17,278.39
E Smart Thermostat Paid Install with Electric Heat	$6,200.00	$16,848.70	$23,048.70
E Variable Speed Motor	$320.00	$423.13	$743.13
Total	**$68,969.56**	**$180,362.95**	**$249,332.51**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the HVAC Program in the section below.

3.3.2.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the HVAC Program.

3.3.2.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the HVAC Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in in Section 2.2.2.1.

The Evaluators found all HVAC Program rebates to have project documentation with the associated HVAC model number and efficiency values in either the CC&B web rebate data or mail-in rebate applications. However, the Evaluators note that some of the model numbers were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.

The Evaluators note that not all rebate applications contained existing/new construction field. This field is an input to apply correct RTF UES values. The Evaluators recommend requiring this field be completed in rebate applications, both mail-in and web-based.

The Evaluators cross-referenced the billing data to verify if customers that received a rebate for E Electric To Air Source Heat Pump or E Electric To Ductless Heat Pump demonstrate a heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually (not just heating months). In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.

The Evaluators found one E Electric to Air Source Heat Pump rebate was duplicated in the project data after confirming with Avista. The Evaluators removed this instance from the verified savings for the program. The Evaluators found all sampled rebate equipment met or exceeded the measure efficiency requirements for the HVAC Program.

3.3.2.3 Verification Surveys

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measure described in Section 2.2.2.2. The Evaluators included questions such as:

- What type of thermostat did this thermostat replace?
- Is your home heating with electricity, natural gas, or another fuel?
- Was the previous equipment functional?
  Is the newly installed equipment still properly functioning?

The responses to this verification survey were used to calculate ISRs for the measures offered in the HVAC Program. In addition, the Evaluators asked participants how the COVID19 pandemic stay-at-home orders have affected their household's energy consumption. The responses to these additional questions can be found in Appendix B.

Table 3-14 displays the ISRs for each of the HVAC measures for Idaho and Washington electric territory combined. The ISRs resulted in 7.90% precision at the 90% confidence interval for the program.

Table 3-14: HVAC Verification Survey ISR Results

Measure	Number of Rebates	Number of Survey Completes	Precision at 90% Confidence	In-Service Rate
E Electric To Air Source Heat Pump	53	21	7.90%	100.00%
E Electric to Ductless Heat Pump	41	21		100.00%
E Smart Thermostat DIY with Electric Heat	63	15		93.33%
E Smart Thermostat Paid Install with Electric Heat	61	27		100.00%
E Variable Speed Motor	3	4		100.00%

Survey respondents described equipment to be currently functioning, leading to a 100% ISR for all measures except the E Smart Thermostat DIY with Electric Heat. Although less than 100%, the ISR for the E Smart Thermostat DIY with Electric Heat measure still exceeded ISRs of 90%. The Evaluators applied the ISRs listed in Table 3-14 to each rebate to quantify verified savings for each measure.

3.3.2.4 Impact Analysis

This section summarizes the verified savings results for the HVAC Program. The Evaluators conducted a billing analysis for measures where participation allowed. The Evaluators calculated verified savings for the remaining measures using the RTF workbook in place at the time the savings goals for the program was finalized These UES values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.2.5 Billing Analysis

The results of the billing analysis for the HVAC program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2.

Table 3-15 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

Table 3-15: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
E Electric To Air Source Heat Pump		N/A	N/A
E Electric to Ductless Heat Pump		N/A	N/A
E Smart Thermostat DIY with Electric Heat		N/A	N/A
E Smart Thermostat Paid Install with Electric Heat		N/A	N/A
E Variable Speed Motor	✓	206	✓

The Evaluators were provided a considerable pool of control customers to draw upon. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. The final number of customers in each the treatment and control group are listed in Table 3-16.

The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure and the Evaluators conducted a linear regression using the matched participant and nonparticipant monthly billing data. Further details regarding the billing analysis methodology can be found in Appendix A.

Table 3-16 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the HVAC Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for E Variable Speed Motor The adjusted R-squared (0.88) shows the model provided an excellent fit for the data.

Table 3-16: Measure Savings, HVAC Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (kWh)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared	Model
E Variable Speed Motor	126	630	513	126	900	75.4%	0.88	Model 2: PPR

The Evaluators determined the savings estimate for E Variable Speed Motors in PY2020 to be 513 kWh, which represents a value 124% of that demonstrated in the Avista TRM. The Evaluators applied this value to all rebates in the PY2020 project data.

3.3.2.6 Verified Savings

The HVAC Program in total displays a realization rate of 105.28% with 527,574 kWh verified electric energy savings in the Washington service territory, as displayed in Table 3-12. The realization rate for the electric savings in the HVAC Program deviate from 100% due to the differences between the applied Avista TRM prescriptive savings value and the true Avista TRM or appropriate RTF UES value.

The Evaluators applied the results of the billing analysis to each E Variable Speed Motor measure. The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net program adjusted savings for measures not evaluated through billing analysis. In addition, the Evaluators reviewed and applied the current RTF UES values for the electric measures along with verified tracking data to estimate net program verified savings for this measure.

The E Smart Thermostat DIY with Electric Heat realization rate is low because the Avista TRM uses an average of retail and direct install savings values as well as an average across heating types, while the Evaluators assigned the appropriate RTF UES value for each installation type and heating zone. The appropriate categories in the RTF led to a lower-than-expected savings for the retail rebates and a higher-than-expected savings for the direct install rebates for this measure. In addition, the 93.33% ISR was applied to the E Smart Thermostat with Electric Heat measure, further decreasing the realization rate for the measure.

The E Electric to Ductless Heat Pump rebates have high realization rates because the expected savings value used a value differing from the RTF values. The value in the TRM for this measure most likely represents an average of the RTF savings values for a combination of heating zones. The E Variable Speed Motor has a high realization rate due to the relatively higher unit-level energy savings from the billing analysis as opposed to the Avista TRM.

3.3.3 Shell Program

The Shell Program provides incentives to customers for improving the integrity of the home's envelope with upgrades to windows and storm windows. Rebates are issued after the measure has been installed for insulation and window measures. Participating homes must have electric or natural gas heating and itemized invoices including measure details such as insulation levels, window values, and square footage. In order to be eligible for incentive, the single-family households, including fourplex or less, must demonstrate an annual electricity usage of at least 8,000 kWh or an annual gas usage of at least 340 Therms. Multifamily homes have no usage requirement. This program includes free manufactured home duct sealing implemented by UCONS. Table 3-7 summarizes the measures offered under this program.

Table 3-17: Shell Program Measures

Measure	Description	Impact Analysis Methodology
E Attic Insulation with Electric Heat	Attic insulation for homes heated with electricity	RTF UES
E Floor Insulation with Electric Heat	Floor insulation for homes heated with electricity	RTF UES
E Storm Window with Electric Heat	High-efficiency storm window replacement for homes heated with electricity	RTF UES
E Wall Insulation with Electric Heat	Wall insulation for homes heated with electricity	RTF UES
E Window Replc from Double Pane W Electric Heat	High-efficiency double pane window replacement for homes heated with electricity	RTF UES
E Window Replc from Single Pane W Electric Heat	High-efficiency single pane window replacement for homes heated with electricity	RTF UES

The following table summarizes the adjusted and verified electric energy savings for the Shell Program impact evaluation.

Table 3-18: Shell Program Verified Electric Savings

Measure	PY2020 Participation	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate
E Attic Insulation with Electric Heat	50	87,109	86,637	109,794	126.04%
E Floor Insulation with Electric Heat	3	3,777	5,579	4,328	114.58%
E Storm Window with Electric Heat	4	4,891	4,811	7,062	144.38%
E Wall Insulation with Electric Heat	11	19,060	17,126	23,069	121.03%

E Window Replc from Double Pane W Electric Heat	1	334	334	244	73.02%
E Window Replc from Single Pane W Electric Heat	191	259,211	249,871	465,976	179.77%
Total	**260**	**374,382**	**364,357**	**610,472**	**163.06%**

The Shell Program displayed verified savings of 610,472 kWh with a realization rate of 163.06% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-19: Shell Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
E Attic Insulation with Electric Heat	$37,332.00	$96,561.70	$133,893.70
E Floor Insulation with Electric Heat	$2,832.75	$3,806.08	$6,638.83
E Storm Window with Electric Heat	$1,254.00	$3,140.23	$4,394.23
E Wall Insulation with Electric Heat	$6,947.50	$20,289.01	$27,236.51
E Window Replc from Double Pane W Electric Heat	$116.00	$214.35	$330.35
E Window Replc from Single Pane W Electric Heat	$86,836.00	$409,818.62	$496,654.62
Total	**$135,318.25**	**$533,829.99**	**$669,148.24**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Shell Program in the section below.

3.3.3.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Shell Program.

3.3.3.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Shell Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators reviewed each measure number of units, square footage, and insulation where available. The Evaluators found one instance in which square footage quantity in the rebate application does not match the values presented in the project data attic insulation. Two rebates showed R-values that did not align with TRM or RTF values related to the measure (R38 and R64). The Evaluators recommend collecting information in a standardized manner. The Evaluators assumed insulation levels closest to those presented for those two instances.

The Evaluators found the square footage for the floor insulation, wall insulation, and storm windows to be equivalent between the project data and the rebate applications, where available. However, the Evaluators found one floor insulation rebate in which the new R-value did not match TRM or RTF values (R21). The Evaluators recommend collecting this information in a standardized manner in addition to the R-values, detailed above.

The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows in order to correctly assign RTF UES values.

The Evaluators also recommend collecting information on single-family/multi-family/manufactured in the web rebate form. This allows the Evaluators to accurately assign RTF values. The mail-in rebates collect this information; however, it does not seem to be required to complete the rebate and therefore many rebates are missing this information.

The Evaluators note several instances in which the web-based rebate data indicates the household has electric space heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend verifying the household space heating type prior to completing the rebate.

The Evaluators also note one instance in which the R-values for a window was assigned incorrectly. The Evaluators reassigned this window from an insulation of R0 to R49 to an insulation of R11 to R49.

The Evaluators cross-referenced the billing data to verify if customers demonstrate a heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually (not just heating months). In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.

The Evaluators found no duplicate rebates in the project data and therefore did not remove any rebates from verified savings.

3.3.3.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Shell Program. Weatherization measures historically have high verification rates.

3.3.3.4 Impact Analysis

This section summarizes the verified savings results for the Shell Program. The Evaluators calculated verified savings for the electric measures using the RTF workbook in place at the time the savings goals for the program was finalized. The Evaluators calculated adjusted savings for each measure using the active Avista TRM values and verified tracking data. These UES values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.3.5 Billing Analysis

The Evaluators did not conduct a billing analysis for the electric Shell measures, as the RTF provides valid UES savings for all measures incented through the program.

3.3.3.6 Verified Savings

The Shell Program in total displays a realization rate of 163.06% with 610,472 kWh verified electric energy savings in the Washington service territory, as displayed in Table 3-18. The realization rate for the electric savings in the Shell Program deviate from 100% due to the differences between the categories applied in the Avista TRM prescriptive savings values and the more detailed categories present with unique RTF UES values.

The Evaluators did not conduct a verification survey for the Shell Program and therefore did not adjust verified savings with an ISR.

3.3.4 ENERGY STAR® Homes Program

The ENERGY STAR® Homes Program provides rebates for homes within Avista's service territory that attain an ENERGY STAR® certification. This program incentivizes for ENERGY STAR® Eco-rated homes. Table 3-7 summarizes the measures offered under this program.

Table 3-20: ENERGY STAR® Homes Program Measures

Measure	Description	Impact Analysis Methodology
G ENERGY STAR Home - Manufactured, Gas & Electric	ENERGY STAR-rated manufactured home with gas and electric	RTF UES
E ENERGY STAR Home - Manufactured, Furnace	ENERGY STAR-rated manufactured home with electric furnace	RTF UES
E ENERGY STAR Home - Manufactured, Gas & Electric	ENERGY STAR-rated manufactured home with gas and electric	RTF UES

The following table summarizes the verified electric energy savings for the ENERGY STAR® Homes Program impact evaluation.

Table 3-21: ENERGY STAR® Homes Program Verified Electric Savings

Measure	PY2020 Participation	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate
G ENERGY STAR Home - Manufactured, Gas & Electric	3*	9,888	9,945	230	2.32%
E ENERGY STAR Home - Manufactured, Furnace	30**	96,135	96,135	83,984	87.36%
E ENERGY STAR Home - Manufactured, Gas & Electric	1	3,296	3,315	43	1.30%
Total	**34**	**109,319**	**109,395**	**84,256**	**77.07%**

*Verified number of rebates for this measure is 4. One rebate was recategorized from a Washington Gas to a Washington Electric measure due to heating type found in project documentation.

**Verified number of rebates for this measure is 29 due to the reassigned rebate.

The ENERGY STAR® Homes Program displayed verified savings of 84,256 kWh with a realization rate of 77.07% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program

Table 3-22: ENERGY STAR® Homes Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs

G ENERGY STAR Home - Manufactured, Gas & Electric*	N/A	N/A	$0.00
E ENERGY STAR Home - Manufactured, Furnace	$18,850.00	$46,235.66	$65,085.66
E ENERGY STAR Home - Manufactured, Gas & Electric	$650.00	$21.68	$671.68
Total	**$19,500.00**	**$46,257.33**	**$65,757.33**

*The costs associated with this measure are claimed in the Washington Gas Impact Evaluation Report

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the ENERGY STAR® Homes Program in the section below.

3.3.4.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the ENERGY STAR® Homes Program.

3.3.4.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the ENERGY STAR® Homes Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators found one duplicate rebate in the project data. The Evaluators confirmed this instance with Avista and removed the rebate from verified savings.

3.3.4.3 Verification Surveys

The Evaluators did not conduct verification surveys for the ENERGY STAR® Homes Program.

3.3.4.4 Impact Analysis

This section summarizes the verified savings results for the ENERGY STAR® Homes Program. The Evaluators calculated verified savings for the electric measures using the RTF workbook in place at the time the savings goals for the program was finalized. These RTF UES values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.4.5 Verified Savings

The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate adjusted program savings for each of the ENERGY STAR® Homes measures. In addition, the Evaluators reviewed and applied the current RTF UES values for each measure along with verified tracking data to estimate net program savings.

The ENERGY STAR® Homes Program in total displays a realization rate of 77.07% with 84,256 kWh verified electric energy savings in the Washington service territory, as displayed in Table 3-21. The realization rate for the electric savings in the ENERGY STAR® Homes Program deviate from 100% due to the categorical differences between the applied Avista TRM prescriptive savings value and the more detailed RTF UES categories.

The Avista TRM applies RTF savings values from heating zone 2 to all rebates. In addition, the Avista TRM does not take into account cooling zone, which also affects savings assigned in the RTF. The Evaluators applied the appropriate RTF savings values for the heating zone and cooling zone for each rebated household. This change led to low realization rates for some rebates and high realization rates for others within the same Avista E ENERGY STAR® Home – Manufactured Furnace measure category. The overall effect this change had on the measure is a downward adjustment on savings.

The realization for the E ENERGY STAR® Home – Manufactured, Furnace measure is also low because the Evaluators reassigned one rebate from E ENERGY STAR® Home – Manufactured, Furnace to G ENERGY STAR® Home – Manufactured, Gas & Electric measure after reviewing documentation and confirming space heating fuel type.

The realization for the E ENERGY STAR® Home – Manufactured, Gas & Electric measure is low because the expected savings employed an additive methodology between a gas-heated home and an electric-heated home for the electric savings. However, the Evaluators reviewed the RTF and determined manufactured home electric savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. Therefore, the Evaluators assigned electric savings from the RTF associated with a fully natural gas-heated home at 43 kWh saved per year.

The Evaluators did not conduct a verification survey for the ENERGY STAR® Homes Program and therefore did not adjust verified savings with an ISR.

3.3.5 Simple Steps, Smart Savings Program

The Simple Steps, Smart Savings Program is a midstream lighting and appliance program which encourages consumer to purchase and install high-quality LEDs, light fixtures, energy-efficient showerheads, and energy-efficient clothes washers by marking down retail prices in the Washington service territory. The Simple Steps, Smart Savings Program was implemented in Washington during the month of January 2020 and therefore reflect a small percentage of savings for the residential electric savings.

This section summarizes the impact results of the evaluation results for the Simple Steps, Smart Savings Program. Table 3-23 summarizes the measures offered under this program.

Table 3-23: Simple Steps, Smart Savings Program Measures

Measure	Description	Impact Analysis Methodology
Lighting	General purpose and specialty bulbs and fixtures	RTF UES
Showerhead	2.0 GPM showerheads	RTF UES
Appliance	High efficiency clothes washers	RTF UES

The following table summarizes the verified electric energy savings for the Simple Steps, Smart Savings Program impact evaluation.

Table 3-24: Simple Steps, Smart Savings Program Verified Electric Savings

Measure	PY2020 Units	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Realization Rate
Lighting	10,628	135,745	56,576	146,363	107.82%
Showerhead	8	97	160	51	52.60%
Appliances	22	3,362	2,389	3,130	93.12%
Total	**10,658**	**139,204**	**59,125**	**149,544**	**107.43%**

The Simple Steps, Smart Savings Program displayed verified savings of 149,544 kWh with a realization rate of 107.43% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-25: Simple Steps, Smart Savings Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
Lighting	$9,546.51	$37,989.77	$47,536.28
Showerhead	$16.00	$9.12	$25.12
Appliances	$550.00	$622.77	$1,172.77
Total	**$10,112.51**	**$38,621.67**	**$48,734.17**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for Simple Steps, Smart Savings Program in the section below.

3.3.5.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Simple Steps, Smart Savings Program.

3.3.5.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for Simple Steps, Smart Savings Program. The Evaluators requested the monthly invoices for each month in PY2020 for the Simple Steps, Smart Savings Program from Avista.

The Evaluators collected and reviewed product-level quantity and pricing on each invoice. The Evaluators found no discrepancies between the invoiced amounts and quantities and the project data provided by Avista.

3.3.5.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Simple Steps, Smart Savings Program. Ninety-eight percent of expected kWh savings were from retail markdown LEDs and these were discontinued in Washington as of January 2020.

3.3.5.4 Impact Analysis

This section summarizes the verified savings results for the Simple Steps, Smart Savings Program. The Evaluators calculated verified savings for the electric measures using the RTF workbook in place at the time the savings goals for the program was finalized

3.3.5.5 Verified Savings

The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net adjusted program savings for those measures. Final verified savings were estimated using the closest RTF UES lighting category value associated with each measure. Simple Steps, Smart Savings Program displayed 107.43% realization with 149,544 kWh saved, as displayed in Table 3-24.

The Evaluators note that the RTF version used to evaluate this program represents the residential lighting workbook active at the time the Bonneville Power Administration (BPA) planning for this program was established (October 1, 2019). The values present in this version of the RTF workbook do not reflect the current savings values present in the Avista TRM. Therefore, the adjusted savings displayed is significantly lower than the verified savings. This is because the savings for the lighting measures decreased as the baseline efficiencies have been updated and increased.

3.4 Conclusions and Recommendations

The Evaluators provide the following conclusions and recommendations for Avista's Residential Portfolio program implementation.

3.4.1 Conclusions

The Evaluators provide the following conclusions regarding Avista's Residential electric programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 1,520,403 kWh with a realization rate of 121%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 1.11 while the UCT value is 1.74. Further details on cost-effectiveness methodology can be found in Appendix C.
- The Residential Portfolio impact evaluation resulted in a realization rate of 121% due to slight differences between the Avista TRM categories and the appropriately assigned RTF UES categories for each measure. The Evaluators note several instances in which the Avista TRM value reflects an average of a range of RTF UES values for the electric measures offered in the Washington electric service territory. The values had been averaged across heating zones, water heater storage tank sizes, equipment efficiency values, and fuel types. The Evaluators, instead of applying these averages, verified the appropriate RTF UES values for each rebate for a sample of rebates in each program and applied the resulting realization rates to the population of rebates for each program. This led to a higher realization rate, as some rebates reflected RTF savings values higher than the average for that measure.
- The Shell Program, which contributes 30% of the expected savings, resulted in a realization rate of 163% whereas each of the other programs resulted in a combined 103% realization rate. The

Shell Program contributed to a 18% increase in the overall residential sector, which displayed a realization rate of 121%.

- The Simple Steps, Smart Savings Program was implemented in Washington during the month of January 2020 and was discontinued for the remainder of the year. The program therefore reflects a small percentage of savings for the residential electric savings (4%).
- The Evaluators conducted a billing analysis to estimate observed, verified savings for the E Variable Speed Motor measure. The Evaluators found the resulting savings to be 513 kWh per year, roughly 124% of the current Avista TRM value for the measure. This savings value was applied to all rebates completed in PY2020.
- In the HVAC Program, the E Smart Thermostat DIY with Electric Heat realization rate is low because the Avista TRM uses an average of retail and direct install savings values as well as an average across heating types, while the Evaluators assigned the appropriate RTF UES value for each installation type and heating zone. The appropriate categories in the RTF led to a lower than expected savings for the retail rebates and a higher than expected savings for the direct install rebates for this measure.
- The Evaluators note that the RTF version used to evaluate the Simple Steps, Smart Savings Program represents the residential lighting workbook active at the time the Bonneville Power Administration (BPA) planning for this program was established (October 1, 2019). The values present in this version of the RTF workbook do not reflect the current savings values present in the Avista TRM. Therefore, the adjusted savings displayed is significantly lower than the verified savings. This is because the savings for the lighting measures decreased as the baseline efficiencies have been updated and increased.

3.4.2 Recommendations

The Evaluators offer the following recommendations regarding Avista's Residential electric programs:

- The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. The values found in the project documentation should accurately reflect the values represented in the CC&B database.
- A number of rebates were not accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.
- The realization rate for the electric savings in the Water Heat Program deviate from 100% due to the methodology in which the Avista TRM prescriptive savings value was applied. The Avista TRM assigns a combination of the values the RTF assigns for Tier 2 and Tier 3 heat pump water heaters. However, among document verification, the Evaluators found a majority of water heaters to be Tier 3 or Tier 4, which the RTF UES assigns a higher savings value. The Evaluators recommend splitting the Avista TRM value for Tier 2, Tier 3, and Tier 4 water heaters into separate values in order to accurately reflect expected savings for the electric water heater measure.
- The Avista TRM assigns the savings values for water heaters of any size. During document review, the Evaluators found most of the water heaters to have a storage tank under 55 gallons,

which has a higher savings value in the RTF than water heaters with unknown tank sizes (larger systems have a more stringent code baseline). The Evaluators applied the RTF UES value for the associated tank size and tier found for each model number in the sampled rebates. These changes led to the high realization rate for the E Heat Pump Water Heater measure in the Water Heat Program. The Evaluators recommend updating the Avista TRM value for this measure based on actual tank size, in addition to collecting information on the tank size of the measure in the rebate applications.

- The Evaluators note that some of the model numbers for the rebated equipment were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.
- The Evaluators note that a number of rebate applications did not contain values associated with whether the home is existing or was a new construction home. This field is an input to apply correct RTF UES values. The Evaluators recommend requiring this field be completed in rebate applications, both mail-in and web-based.
- The Evaluators cross-referenced the billing data to verify if customers demonstrated the required heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually. In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.
- The Evaluators conducted a billing analysis for the E Variable Speed Motor measure in the HVAC Program. The estimated savings value from the billing analysis was roughly 124% of the value reflected in the Avista TRM. The Evaluators recommend updating the savings value for this measure in the Avista TRM to reflect observed savings more closely in the territory.
- For the Shell Program, the Evaluators found rebates in which the R-values did not align with TRM or RTF values (R38 and R64). The Evaluators recommend collecting information in a standardized manner.
- The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows in order to correctly assign RTF UES values.
- The Evaluators also recommend collecting information on single-family/multi-family/manufactured in the web rebate form. This allows the Evaluators to accurately assign RTF values. The mail-in rebates collect this information; however, it does not seem to be currently required to complete the rebate. Therefore many rebates are missing this information.
- The Evaluators note several instances in which the web-based rebate data indicates the household has electric space heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend updating data collection standards in order for all sources of information to reflect the same values as the project documentation.
- The Evaluators note that the realization for the E ENERGY STAR® Home – Manufactured, Gas & Electric measure is low because the Avista TRM savings was employed using an additive methodology between a gas-heated home and an electric-heated home for the electric savings.

However, the Evaluators reviewed the RTF and determined manufactured home electric savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. The Evaluators recommend adjusting Avista TRM electric savings for this measure to reflect the RTF values associated with a fully natural gas-heated home at 43 kWh saved per year.

- The Evaluators recommend the Avista TRM reflect the savings values in effect for the Simple Steps, Smart Savings Program. The Avista TRM currently uses RTF values in effect on November 1, 2019 for the Simple Steps, Smart Savings whereas the expected savings for this program are calculated using the RTF-approved BPA workbook in effect on October 1, 2019.

4. Low-Income Impact Evaluation Results

The Low-Income Program delivers energy efficiency measures to low-income residential customers in its Washington service territory with a partnership with five network Community Action Agencies ("Agencies") and one tribal weatherization organization. The Agencies qualify income to prioritize and treat households based on several characteristics. In-house or contract crews install approved program measures. In addition, the Agencies have access to other monetary resources which allow them to weatherize a home or install additional energy efficiency measures.

The Evaluators completed an impact evaluation on Avista's Low-Income portfolio to verify program-level and measure-level energy savings for PY2020. The following sections summarize findings for each electric impact evaluation in the Low-Income Portfolio in the Washington service territory. The Evaluators used data collected and reported in the tracking database, online application forms, Avista TRM, and RTF values to evaluate verified savings. This approach provided the strongest estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, number of participants, and availability of data. Table 4-1 summarizes the Low-Income verified impact savings by program. Table 4-2 summarizes the Low-Income portfolio cost-effectiveness results.

Table 4-1: Low-Income Verified Impact Savings by Program

Program	Expected Savings (kWh)	Verified Savings (kWh)	Verified Realization Rate
Low-Income	183,775	210,472	114.53%
CEEP	160,970	130,805	81.26%
Total Low-Income	**344,745**	**341,277**	**98.99%**

Table 4-2: Low-Income Portfolio Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Low Income	$581,136	$1,530,941	0.38	$383,012	$1,614,270	0.24

In PY2020, Avista completed and provided incentives for low-income electric measures in Washington and achieved total electric energy savings of 341,277 kWh. The Low-Income Program exceeded savings expectations based on reported savings while the Community Energy Efficiency Program (CEEP) did not meet savings expectations. However, the low-income sector had achieved 98.99% of the savings expectations. The Evaluators estimated the TRC value for the Low-Income portfolio is 0.38 while the UCT value is 0.24. Further details of the impact evaluation results by program are provided in the sections following.

4.1 Program-Level Impact Evaluation Results

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Low-Income sector in the section below.

4.1.1 Low-Income Program

The Low-Income Program delivers energy efficiency measures to low-income residential customers in its Washington service territory with a partnership with five network Community Action Agencies ("Agencies") and one tribal weatherization organization. The Agencies qualify income to prioritize and treat households based on several characteristics. In-house or contract crews install approved program measures. In addition, the Agencies have access to other monetary resources which allow them to weatherize a home or install additional energy efficiency measures.

Avista provides CAP agencies with the following approved measure list, which are reimbursed in full by Avista. Avista also provides a rebate list of additional energy saving measures the CAP agencies are able to utilize which are partially reimbursed. Weatherization measures under this program may also be funded by CEEP. The following table summarizes the measures offered under this program.

Table 4-3 summarizes the measures offered under this program.

Table 4-3: Low-Income Program Measures

Measure	Impact Analysis Methodology
Air Infiltration	Avista TRM
Air source heat pump	
Attic insulation	
Duct insulation	
Duct sealing	
Electric to air source heat pump	
Electric to ductless heat pump	
ENERGY STAR® door	
ENERGY STAR® refrigerator	
ENERGY STAR® window	
Floor insulation	
Heat pump water heater	
LED lighting	
Wall insulation	
High efficiency furnace	
High efficiency tankless natural gas water heater	
Natural gas boiler	

Table 4-4 summarizes the verified electric energy savings for the Low-Income Program impact evaluation.

Table 4-4: Low-Income Program Verified Electric Savings

Measure	PY2020 Participation	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Realization Rate

E Air Infiltration	24	26,499	26,499	33,717	127.24%
E Duct Sealing	5	2,984	3,445	3,445	115.45%
E Ductless Heat Pump	17	35,839	39,916	39,916	111.38%
E ENERGY STAR® Doors	29	5,636	5,793	5,606	99.47%
E ENERGY STAR® Refrigerator	2	78	78	78	100.00%
E ENERGY STAR® Windows	38	4,425	4,425	4,672	105.60%
E HE Air Heat Pump	6	12,321	12,321	12,321	100.00%
E INS - Attic	23	10,208	10,192	11,010	107.86%
E INS - Duct	8	2,119	1,844	2,281	107.67%
E INS - Floor	22	27,617	32,650	30,011	108.67%
E INS - Wall	5	4,085	5,889	6,367	155.87%
E To Heat Pump Conversion	10	48,858	58,653	58,653	120.05%
Health And Safety	33	0	0	0	N/A
LED Bulbs	18	1,941	1,943	2,394	123.34%
Tier2-3 Anysize HPWH	1	1,166	1,175	0	0.00%
Total	**241**	**183,775**	**204,822**	**210,472**	**114.53%**

The following table summarizes the incentive and non-incentive costs associated with the program.

Table 4-5: Low-Income Program Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
E Air Infiltration	$24,131.89	$35,573.65	$59,705.54
E Duct Sealing	$1,825.99	$4,921.14	$6,747.13
E Ductless Heat Pump	$130,520.79	$41,758.46	$172,279.25
E ENERGY STAR® Doors	$42,620.25	$15,837.48	$58,457.73
E ENERGY STAR® Refrigerator	$1,353.32	$84.08	$1,437.40
E ENERGY STAR® Windows	$127,374.25	$13,200.33	$140,574.58
E HE Air Heat Pump	$46,538.70	$12,889.72	$59,428.42
E INS - Attic	$53,352.58	$31,106.10	$84,458.68
E INS - Duct	$9,755.62	$6,444.66	$16,200.28
E INS - Floor	$75,040.86	$84,786.27	$159,827.13
E INS - Wall	$9,635.38	$17,987.90	$27,623.28
E To Heat Pump Conversion	$98,971.93	$61,360.64	$160,332.57
Health And Safety	$109,542.06	$0.00	$109,542.06
LED Bulbs	$2,359.10	$1,996.09	$4,355.19
Tier2-3 Anysize HPWH	N/A	N/A	N/A
Total	**$733,022.72**	**$327,946.52**	**$1,060,969.24**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for Low-Income Program in the section below.

4.1.1.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Low-Income Program.

4.1.1.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Low-Income Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. The Evaluators, updated quantity based on project documentation.

The Evaluators note that some project data account numbers do not match the account numbers referenced in the project documentation. In addition, the Evaluators found conflicting information in the project documentation on a number of homes' heating type. The Evaluators recommend confirming and documenting all rebate applications for completed and accurate heating type details.

The Evaluators also note that project documentation contains additional equipment included in some invoices. These additional equipment contribute to the total project cost. The Evaluators identified and removed three duplicated rebates. These rebates seem to have been duplicated due to rebate administration corrections.

The Evaluators also utilized the delivered billing data to check the household-level annual usage. The Low-Income Program requires a 20% annual energy usage cap on claimed energy savings. The Evaluators found some discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

4.1.1.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Low-Income Program.

4.1.1.4 Impact Analysis

This section summarizes the verified savings results for the Low-Income Program. The Evaluators calculated verified savings for Low-Income Program measures using the Avista TRM. However, a whole building billing analysis was completed to supplement the findings from the desk review.

4.1.1.5 Billing Analysis

The results of the billing analysis for the Low-Income Program are provided below. Table 4-6 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolated each unique measure. In doing so, the Evaluators also isolate the measure effects using the customer's consumption billing data. However, participation for the Low-

Income program resulted in a small number of customers with isolated measures, as displayed in Table 4-6 and therefore the Evaluators were unable to estimate measure-level savings through billing analysis.

Table 4-6: Measures Considered for Billing Analysis, Low-Income Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis*
Electric to air source heat pump	✓	24	
Electric to ductless heat pump	✓	9	
Air source heat pump	✓	1	
ENERGY STAR® door	✓	0	
ENERGY STAR® refrigerator	✓	8	
ENERGY STAR® window	✓	0	
Air Infiltration	✓	0	
Duct sealing	✓	0	
Attic Insulation	✓	2	
Duct insulation	✓	0	
Wall insulation	✓	0	
Floor insulation	✓	4	
LED lighting	✓	20	

*No measures had sufficient participation of isolated measures

The Evaluators instead conducted a whole-home billing analysis for all the electric measures combined in order to estimate savings for the average household participating in the program, across all measures. The Evaluators successfully created a matched cohort for the electric measure households. Customers were matched on zip code (exact match) and their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household. The Evaluators were provided a considerable pool of control customers to draw upon. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers.

Table 4-7 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the Low-Income Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for all measures and the adjusted R-squared shows the model provided an excellent fit for the data (adjusted R-squared > 0.90).

Table 4-7: Measure Savings, Low-Income Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (kWh)	90% Lower CI	90% Upper CI	Adjusted R-Squared	Model
All Electric Measures	77	364	1,693	1145	2624	0.73	Model 2: PPR

The Evaluators applied these regression savings estimates to the program as a whole, by the number of unique households in the program and found a realization rate of 129.86% for all electric measures in the program. Further details of the billing analysis can be found in Appendix A.

4.1.1.6 Verified Savings

Due to insufficient participation to conduct measure-level billing analyses, the Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net program savings for those measures. Adjusted savings were estimated using the Avista TRM. The Low-Income Program in total displays a realization rate of 114.53% with 210,471.58 kWh verified electric energy savings in the Washington service territory, as displayed in Table 4-4. The billing analysis supports this estimate, with the billing analysis estimating a 129.86% realization. Due to requirements for measure-level verified savings for cost-effectiveness testing, the Evaluators designated the adjusted savings as final.

The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation. The Evaluators updated the quantity based on new project data.

4.1.2 Community Energy Efficiency Program (CEEP)

The Community Energy Efficiency Program was created from the Washington State Legislature in 2009 to tackle hard to reach markets in both the residential and commercial sectors by encouraging energy efficiency improvements. The CEEP pilot was funded by the U.S. Department of Energy's State Energy Program and the American Recovery and Reinvestment Act. CEEP partners are selected by a competitive request for proposals and independent review committee. Avista has been a CEEP recipient since 2014.

The Company received a $750,000 CEEP allocation for the 202-21 funding year that is set to complete in June 2021. Avista is providing a $750,000 match along with in-kind program administrative support. Three community action agencies have partnered with Avista to implement the CEEP funds under two programs: energy efficiency improvements for multifamily housing and converting income qualified homes with alternative heat sources (e.g. wood, oil) to a heat pump system. In addition, CEEP funds are being used to match utility rebates for energy efficiency work done in small businesses in rural communities.

This section summarizes the impact results of the evaluation results for CEEP. Table 4-8 summarizes the measures offered under this program.

Table 4-8: CEEP Measures

Measure	Description	Impact Analysis Methodology
CEEP Multi Family - E Ductless Heat Pump Conversion Zonal	Ductless heat pump for multi-family units	Avista TRM
CEEP Multi Family - E Windows	Window replacement for multi-family units	Avista TRM
CEEP Multi Family - E Air Infiltration	Air infiltration for multi-family units	Avista TRM
CEEP Multi Family - E Attic Insulation	Attic insulation for multi-family units	Avista TRM
CEEP Multi Family - E Ductless Heat Pump Conversion	Ductless heat pump for multi-family units	Avista TRM
CEEP Multi Family - E Health & Safety	Health and safety improvements for multi-family units	Avista TRM
CEEP Multi Family - E Lighting	Efficient lighting giveaways for multi-family units	Avista TRM
CEEP Single Family - E Alternative Heat Conversion	Alternative fuel conversion to electric in multi-family units	Avista TRM
CEEP Multi Family - E Floor Insulation	Floor insulation for multi-family units	Avista TRM
CEEP Single Family - E Ductless Heat Pump	Ductless heat pump for single-family homes	Avista TRM
CEEP Single Family - E Lighting	Efficient lighting giveaways for single-family units	Avista TRM

The following table summarizes the verified electric energy savings for the CEEP impact evaluation.

Table 4-9: CEEP Verified Electric Savings

Measure	PY2020 Participation	Expected Savings (kWh)	Adjusted Savings (kWh)	Verified Savings (kWh)	Realization Rate
CEEP Multi Family - E Ductless Heat Pump Conversion Zonal	1	36,254	54,004	29,900	82.47%
CEEP Multi Family - E Windows	2	11,344	4,382	11,344	100.00%
CEEP Multi Family - E Air Infiltration	2	10,324	14,324	6,244	60.48%
CEEP Multi Family - E Attic Insulation	3	6,852	6,764	5,120	74.73%
CEEP Multi Family - E Ductless Heat Pump Conversion	4	82,134	174,169	67,464	82.14%
CEEP Multi Family - E Health & Safety	3	0	0	0	N/A
CEEP Multi Family - E Lighting	2	955	867	1,036	108.47%
CEEP Single Family - E Alternative Heat Conversion	1	5,098	5,865	2,177	42.70%
CEEP Multi Family - E Floor Insulation	1	2,745	3,070	4,717	171.86%
CEEP Single Family - E Ductless Heat Pump	1	4,814	2,348	2,177	45.22%
CEEP Single Family - E Lighting	1	450	450	626	139.09%
Total	**21**	**160,970**	**266,243**	**130,805**	**81.26%**

CEEP displayed verified savings of 130,805 kWh with a realization rate of 81.26% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 4-10: CEEP Costs by Measure

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
CEEP Multi Family - E Ductless Heat Pump Conversion Zonal	$99,142.12	$31,280.14	$130,422.26
CEEP Multi Family - E Windows	$124,456.15	$32,049.01	$156,505.16
CEEP Multi Family - E Air Infiltration	$3,319.45	$6,587.41	$9,906.86
CEEP Multi Family - E Attic Insulation	$33,275.75	$14,465.88	$47,741.63
CEEP Multi Family - E Ductless Heat Pump Conversion	$261,181.20	$70,578.03	$331,759.23
CEEP Multi Family - E Health & Safety	$44,528.40	$0.00	$44,528.40
CEEP Multi Family - E Lighting	$1,877.00	$863.71	$2,740.71
CEEP Single Family - E Alternative Heat Conversion	$6,725.66	$2,296.88	$9,022.54
CEEP Multi Family - E Floor Insulation	$9,938.69	$13,327.69	$23,266.38
CEEP Single Family - E Ductless Heat Pump	$5,243.99	$2,277.49	$7,521.48
CEEP Single Family - E Lighting	$610.09	$521.89	$1,131.98
Total	**$590,298.50**	**$174,248.12**	**$764,546.62**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for CEEP in the section below.

4.1.2.1 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for CEEP. The Evaluators requested additional documentation for the census of CEEP participants in order to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators collected and reviewed measure-level quantity and efficiencies for each project and found the project data to be consistent with the documentation.

The Evaluators attempted to utilize the delivered billing data to check the household-level annual usage. CEEP requires a 20% annual energy usage cap on claimed energy savings. However, the 20% cap is applied to the multi-family complex; therefore, the Evaluators were unable to estimate total building consumption and compare with total building energy savings. However, the project documentation contained information on eQuest savings estimates and detailed building-level annual usage. The Evaluators applied the same 20% cap to the verified savings estimates for each rebated project.

4.1.2.2 Verification Surveys

The Evaluators did not conduct verification surveys for CEEP.

4.1.2.3 Impact Analysis

This section summarizes the verified savings results for CEEP. The Evaluators calculated verified savings for the electric measures using the RTF workbook in place at the time the savings goals for the program was finalized

4.1.2.4 Billing Analysis

The program contained 21 unique customers across all measures. Due to the requirement of a sufficient number of pre/post billing month and the requirement that customers do not participate in more than one program, the Evaluators determined that a billing analysis was not feasible.

4.1.2.5 Verified Savings

Due to insufficient participation to conduct measure-level billing analyses, the Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net adjusted program savings for those measures. Final verified savings were estimated using the RTF UES values associated with each measure. CEEP displayed 81.26% realization with 130,805 kWh saved, as displayed in Table 4-9.

The Evaluators note that most deviations from 100% realization rate is due to differences between the Avista TRM values and the appropriate categories the Evaluators found and referenced in the RTF.

4.2 Conclusions and Recommendations

The Evaluators provide the following conclusions and recommendations for Avista's Low-Income Portfolio program implementation.

4.2.1 Conclusions

The Evaluators provide the following conclusions regarding Avista's Residential electric programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 341,277 kWh with a realization rate of 99%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 0.38 while the UCT value is 0.24. These values are expected, as the Low-Income portfolio is not expected to meet cost-effectiveness but are implemented in order to provide energy efficiency benefits to low-income customers. Further details on cost-effectiveness methodology can be found in Appendix C.
- The Low-Income Portfolio impact evaluation resulted in a nearly 100% realization rate. The Low-Income Program and CEEP individually resulted in a 115% and 81% realization, respectively. The realization rates for each program deviate from 100% due to differences between the Avista TRM values and the appropriately assigned RTF UES values. The Evaluators note several instances in which the Avista TRM value reflects an average of a range of RTF UES values for the electric measures offered in the Washington electric service territory. The values had been averaged across heating zones, equipment efficiency values, and fuel types. The Evaluators, instead of applying these averages, verified the appropriate RTF UES values for CEEP. For the Low-Income Program, the Evaluators applied a realization rate from a sample of rebates after verifying documentation for quantity and efficiency of measures.
- The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolate each unique measure. However, participation for the Low-Income program resulted in a small number of customers with isolated measures and

therefore the Evaluators conducted a whole-home billing analysis for all the electric measures combined in the Low-Income in order to estimate savings for the average household participating in the program, across all measures. The Evaluators found a realization rate of 130% for all electric measures in the program, which supported the realization rate of 115% from the desk review.

- CEEP contained 21 unique customers across all measures. Due to the requirement of a sufficient number of pre/post billing month and the requirement that customers do not participate in more than one program, the Evaluators determined that a billing analysis was not feasible.
- Some rebates included in the Low-Income Program and CEEP indicate that savings had been capped at 20% of consumption. The provided project data do not include adequate information to determine when savings values are being appropriately capped. The Evaluators recommend that annual consumption be provided for each measure in the tracking data, if practical, so that evaluation can include verifying that savings are being capped at 20% consumption for application measures.

4.2.2 Recommendations

The Evaluators offer the following recommendations regarding Avista's Low-Income electric programs:

- The Evaluators note that most deviations from 100% realization rate is due to differences between the limited measure category options Avista TRM values and the more detailed categories referencing heating zone, cooling zone, heating type, and bulb types present in the RTF. The Evaluators recommend that Avista reference the more detailed RTF measures when calculating expected savings for the programs.
- The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. In addition, the unit type, in terms of square footage or number of measures (windows, doors, etc) was not documented consistently and therefore savings values were applied inaccurately. The Evaluators recommend updating CC&B documentation standards to more accurately reflect values present on the rebate applications.
- The Evaluators identified two duplicated rebates. The Evaluators recommend conducting cleaning and data quality practices in order to avoid duplicated rebates and therefore unexpectedly low verified savings.
- The Evaluators found discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

5. Appendix A: Billing Analysis Results

This appendix provides additional details on the billing analyses conducted for each program.

5.1 HVAC Program

The results of the billing analysis for the HVAC program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2. Table 5-1 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

The Evaluators attempted to estimate measure-level HVAC Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolated each unique measure. In doing so, the Evaluators also isolate the measure effects using the customer's consumption billing data.

A billing analysis was completed for measures that had at least 75 customers with single-measure installations. This ensured that measures would have a sufficient sample size after applying PSM data restrictions (e.g. sufficient pre- and post-period data). The billing analysis included participants in both PY2019 and PY2020 in order to acquire the maximum number of customers possible. However, results from billing analyses are only extrapolated to PY2020 participants.

Table 5-1: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
E Electric To Air Source Heat Pump		N/A	N/A
E Electric to Ductless Heat Pump		N/A	N/A
E Smart Thermostat DIY with Electric Heat		N/A	N/A
E Smart Thermostat Paid Install with Electric Heat		N/A	N/A
E Variable Speed Motor	✓	206	✓

The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-2. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-2, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The "Starting Count" displays the beginning number of customers available prior to applying the data restrictions, while the "Ending Count" displays the number of customers after applying data restrictions and final matching.

Table 5-2: Cohort Restrictions, HVAC Program

Measure	Data Restriction	Treatment Customers	Control Customers
E Variable Speed Motor	Starting Count	206	132,725
	Install Date Range: 2019-01-01 to 2020-06-30	206	132,725
	Control Group Usage Outlier (>2X max treatment usage)	206	132,675
	Incomplete Post-Period Bills (<24 months)	147	78,645
	Incomplete Pre-Period Bills	126	72,062
	Ending Count (Matched by PSM)	126	630

Figure 5-1 and Figure 5-2 display the density of each variable employed in propensity score matching for the E Variable Speed Motor measure, before and after conducting matching. The figures following display the density of each variable employed in propensity score matching for the other billing analysis measures, before and after matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-1: Covariate Balance Before Matching, Electric Variable Speed Motor

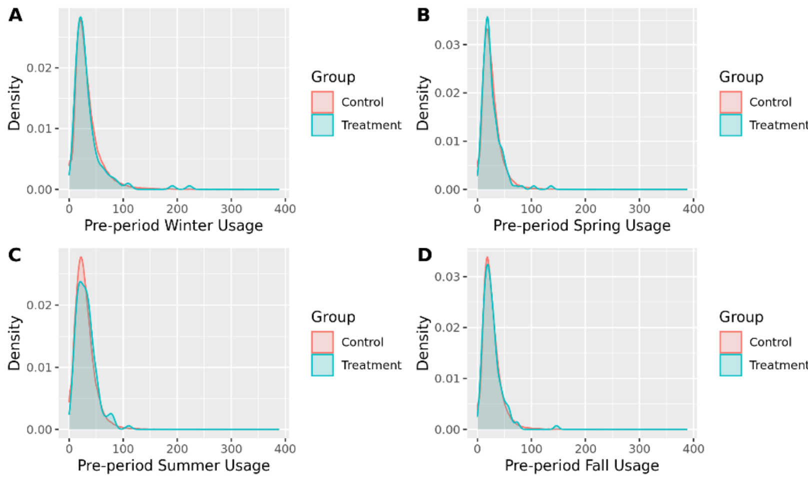
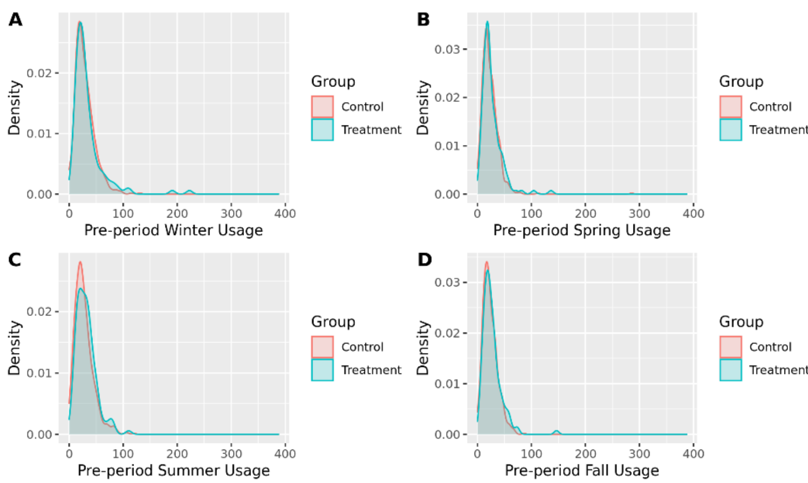


Figure 5-2: Covariate Balance After Matching, Electric Variable Speed Motor



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for the measure. *T*-tests of monthly pre period usage can yield a statistically significant difference 40% of the time for one to two months out of 12. Thus, the Evaluators set a tolerance band allowing two months out of 12 to vary in pre-period usage at the 95% confidence level. All groups passed this threshold. In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups.

Lastly, the standardized difference test returned values well under the recommended cutoff of 25, typically falling under 10, further indicating the groups were well matched on all included covariates.

Table 5-3 provides results for the *t*-test on pre-period usage between the treatment and control groups after matching for the HVAC program. The Evaluators placed a threshold of two rejects for each measure as there is a 40% likelihood that one or two months may show statistical variance due to chance. The variable speed motor measure did not exceed this threshold.

Table 5-3: Pre-period Usage T-test for Electric Variable Speed Motor, HVAC Program

Month	Average Daily Usage (kWh), Control	Average Daily Usage (kWh), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	29.52	35.01	-1.57	3.49	0.118	No
Feb	28.54	32.01	-1.27	2.74	0.206	No
Mar	25.57	29.30	-1.65	2.25	0.101	No
Apr	22.68	25.32	-1.51	1.75	0.133	No
May	22.25	24.29	-1.30	1.57	0.195	No
Jun	24.46	26.32	-1.06	1.76	0.289	No
Jul	30.72	35.06	-2.04	2.13	0.043	Yes
Aug	28.76	32.84	-2.19	1.86	0.030	Yes
Sep	23.53	24.68	-0.57	2.01	0.566	No
Oct	22.95	25.43	-1.35	1.84	0.177	No
Nov	27.34	30.29	-1.28	2.30	0.201	No
Dec	30.83	34.59	-1.32	2.84	0.187	No

Table 5-4 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-4: TMY Weather, HVAC Program

Measure	USAF Station ID	Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
E Variable Speed Motor	720322	1	727834	6,915	376	6,527	475
E Variable Speed Motor	726817	1	727834	6,915	376	6,527	475
E Variable Speed Motor	727827	1	727827	5,428	731	6,527	475
E Variable Speed Motor	727830	5	727830	5,511	907	6,527	475
E Variable Speed Motor	727834	43	727834	6,915	376	6,527	475
E Variable Speed Motor	727850	3	727850	6,707	379	6,527	475
E Variable Speed Motor	727855	5	727855	7,360	439	6,527	475
E Variable Speed Motor	727856	57	727856	6,246	519	6,527	475

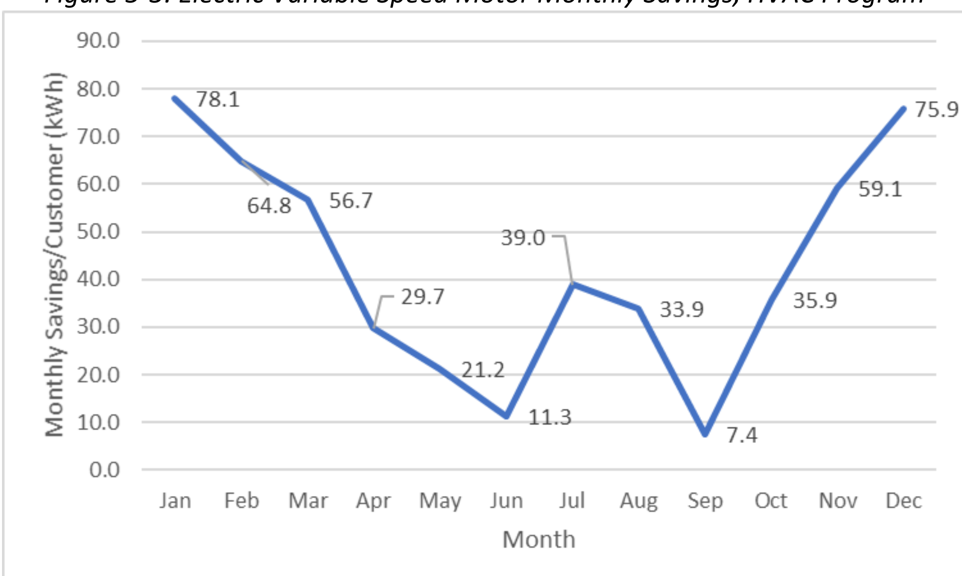
Table 3-16 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the HVAC Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for E Variable Speed Motor The adjusted R-squared shows the model provided an excellent fit for the data.

Table 5-5: Measure Savings, HVAC Program

Measure	Treatment Customers	Control Customers	Annual kWh Savings per Customer	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared	Model
E Variable Speed Motor	126	630	513	126	900	75.4%	0.88	Model 2: PPR

Figure 5-3 provides the monthly verified savings per customer for the variable speed motor measure.

Figure 5-3: Electric Variable Speed Motor Monthly Savings, HVAC Program



In addition to the net savings value represented above, the Evaluators also conducted a treatment-only regression model for each of the measures described above. Table 5-6 provides annual savings/customer for the HVAC program for each measure and regression model. The PPR model was selected for ex-post net savings because it provided the best fit for the data (highest adjusted R-squared). The treatment-only model represents estimated gross savings for this measure. However, the Evaluators were unable to estimate a statistically significant value.

Table 5-6: Measure Savings for All Regression Models, HVAC Program

Measure	Model	Treatment Customers	Control Customers	Annual Savings per Customer (kWh)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared
E Variable Speed Motor	Diff-in-diff	126	630	687*	-821	2,195	220%	0.02
E Variable Speed Motor	PPR	126	630	513	126	900	75%	0.88
E Variable Speed Motor	Treatment Only (Gross)	126	N/A	256*	-316	829	223%	0.76

*Not statistically significant

5.2 Low-Income Program

The Evaluators conducted a whole-home billing analysis for all the electric measures combined in order to estimate savings for the average household participating in the program, across all measures. The Evaluators successfully created a matched cohort for the electric measure households. Customers were matched on zip code (exact match) and their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household.

The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-7. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-7, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The "Starting Count" displays the beginning number of customers available prior to applying the data restrictions, while the "Ending Count" displays the number of customers after applying data restrictions and final matching.

Table 5-7: Cohort Restrictions, Low-Income Program

Measure	Data Restriction	# of Treatment Customers	# of Control Customers
Whole home electric	Starting Count	147	2,632
	Install Date Range: January 1, 2019 to June 30, 2020	90	2,632
	Control Group Usage Outlier (>2X max treatment usage)	90	2,630
	Incomplete Post-Period Bills (<4 months)	83	2,172
	Incomplete Pre-Period Bills (<10 months)	77	1,932
	Ending Count (Matched by PSM)	77	364

Figure 5-4 and Figure 5-5 display the density of each variable employed in propensity score matching for the combined electric measures before and after conducting matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-4: Covariate Balance Before Matching, Low-Income Electric Measures

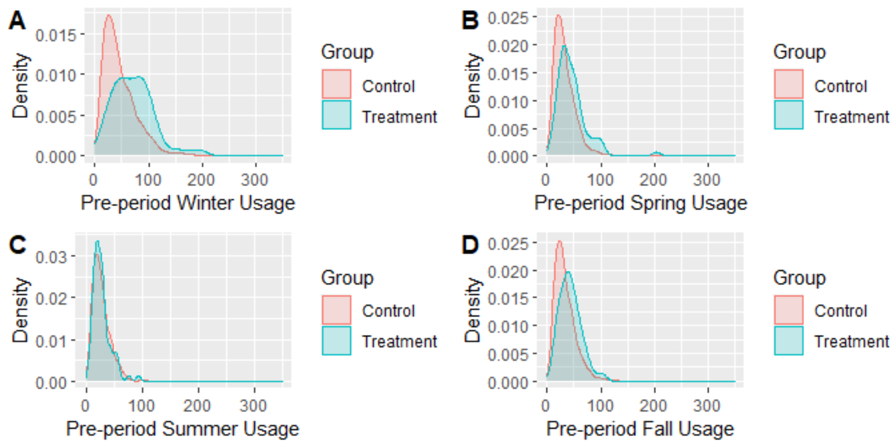
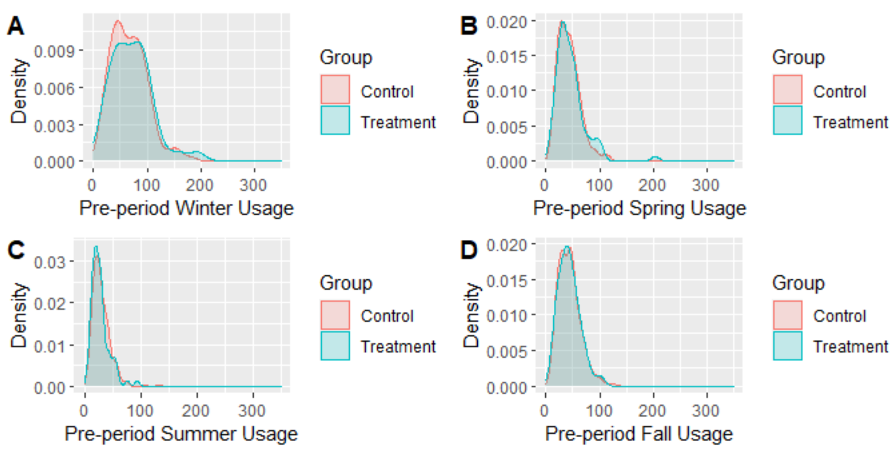


Figure 5-5: Covariate Balance After Matching, Low-Income Electric Measures



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure. The t-test displayed no statistically significant differences at the 95% level in average daily consumption between the treatment and control groups for any month in the pre-period. In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values were under 10 (well under the recommended cutoff of 25), further indicating the groups were well matched on all included covariates.

Table 5-8 provides results for the *t*-test on pre-period usage between the treatment and control groups after matching for the Low-Income program. The P-Value is over 0.05 for each month, meaning pre-period usage between treatment and control groups is similar at the 95% confidence level.

Table 5-8: Pre-period Usage T-test for Electric Measures, Low-Income Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	69.94	70.41	-0.130	3.608	0.897	No
Feb	53.51	56.83	-1.235	2.687	0.217	No
Mar	63.85	66.38	-0.778	3.255	0.437	No
Apr	40.20	43.70	-1.692	2.068	0.091	No
May	35.14	37.91	-1.529	1.814	0.127	No
Jun	22.69	24.73	-1.337	1.523	0.182	No
Jul	22.56	24.08	-0.990	1.528	0.322	No
Aug	28.73	28.07	0.228	2.869	0.819	No
Sep	22.87	25.08	-1.383	1.597	0.167	No
Oct	24.97	28.61	-2.192	1.661	0.029	No
Nov	52.77	57.49	-1.637	2.884	0.102	No
Dec	60.34	64.69	-1.355	3.206	0.176	No

Table 5-9 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-9: TMY Weather, Low-Income Program

Measure	USAF Station ID	# of Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
All Electric Measures	727827	9	727827	5,428	731	6,171	550
All Electric Measures	727830	18	727830	5,510	906	6,171	550
All Electric Measures	727834	4	727834	6,915	376	6,171	550
All Electric Measures	727850	3	727850	6,246	519	6,171	550
All Electric Measures	727855	3	727855	7,360	439	6,171	550
All Electric Measures	727856	94	727856	6,246	519	6,171	550
All Electric Measures	727857	16	727857	6,467	299	6,171	550

In addition to the net savings value represented above, the Evaluators also conducted a treatment-only regression model for each of the measures described above. Table 5-10 provides annual savings/customer for the Low-Income program for all electric measures and regression model. The PPR model was selected for ex-post net savings because it provided the best fit for the data (highest adjusted R-squared). The treatment-only model represents estimated gross savings for this measure. The Evaluators estimate gross savings for each Low-Income participant is 1,404 kWh per year.

Table 5-10: Household Savings for All Regression Models, Low-Income Program

Measure	Model	# of Treatment Customers	# of Control Customers	Annual Savings/Customer	90% Lower CI	90% Upper CI	Adjusted R-Squared
All Electric Measures	Diff-in-diff	77	364	2,097*	0	4,340	0.34
All Electric Measures	PPR	77	364	1,693	1,146	2,624	0.73
All Electric Measures	Treatment Only (Gross)	555	64	1,404	0	4,049	0.69

*Not statistically significant

6. Appendix B: Summary of Survey Respondents

This section summarizes additional insights gathered from the simple verification surveys deployed by the Evaluators for the impact evaluation of Avista's Residential and Low-Income Programs.

Survey respondents confirmed installing between one and three measures that were rebated by Avista, displayed in Table 6-1.

Table 6-1: Type and Number of Measures Received by Respondents

Measure Category	Total	Percent
One Measure	161	61%
Two Measures	69	26%
Three Measures	32	12%
HVAC	140	53%
Water Heater	138	53%
Smart Thermostat	113	43%
Variable Speed Motors	4	2%

The Evaluators asked respondents to provide information regarding their home, as displayed in Table 6-2. Most respondents noted owning a single-family home between 1,000-3,000 square feet with central air conditioning.

Table 6-2: Survey Respondent Home Characteristics[9]

Question	Response	Percent (n=258)
Do you rent or your home?	Own	97%
	Rent	3%
Which of the following best describe your home?	Single-family house detached from any other house	89%
	Single-family house attached to one or more other houses (e.g., duplex, condominium, townhouse)	4%
	Mobile or manufactured home	6%
	Apartment with 2 or 3 units	1%
	Garage/outbuilding	1%
	Don't Know	1%
Does your home have central air conditioning, window air conditioning, or neither?	Window air conditioning / a room AC unit	12%
	Central air conditioning	73%
	Neither	14%
	Don't Know	1%
About how many square feet is your home?	Less than 1,000 square feet	6%
	1,000-1,999 square feet	38%
	2,000-2,999 square feet	35%
	3,000-3,999 square feet	14%
	4,000 or more square feet	6%
	Don't know	1%
When was your home built?	Before 1960	21%
	1960 to 1969	5%
	1970 to 1979	17%
	1980 to 1989	12%
	1990 to 1999	12%
	2000 to 2009	16%
	2010 to 2018	15%
	Don't know	1%

[9] Four contractors or construction companies were not asked these questions.

7. Appendix C: Cost Benefit Analysis Results

The Evaluators estimated the cost-effectiveness for the Avista Residential and Low-Income Programs using evaluated savings results, economic inputs provided by Avista, and incremental costs and non-energy impacts from the RTF. The table below presents the cost-effectiveness results for the PY2020 portfolio.

Table 7-1: Cost-effectiveness Results

Program	TRC	UCT	RIM	PCT	TRC Net Benefits
Residential	1.11	1.74	0.37	2.21	$221,070
Low Income	0.38	0.24	0.16	N/A*	($949,806)
Total	**0.80**	**0.87**	**0.31**	**N/A***	**($728,735)**
***Low Income is offered at no cost to participants; PCT is not calculable.**					

7.1 Approach

The California Standard Practice Model was used as a guideline for the calculations. The cost-effectiveness analysis methods that were used in this analysis are among the set of standard methods used in this industry and include the Utility Cost Test (UCT)[10], Total Resource Cost Test (TRC), Ratepayer Impact Measure Test (RIM), and Participant Cost Test (PCT). All tests weigh monetized benefits against costs. These monetized amounts are presented as NPV evaluated over the lifespan of the measure. The benefits and costs differ for each test based on the perspective of the test. The definitions below are taken from the California Standard Practice Manual.

- The TRC measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.
- The UCT measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits. Costs are defined more narrowly.
- The PCT is the measure of the quantifiable benefits and costs to the customer due to participation in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test cannot be a complete measure of the benefits and costs of a program to a customer.
- The RIM test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates or bills will go up if revenues collected after program implementation is less than the total costs

[10] The UCT is also referred to as the Program Administrator Cost Test (PACT).

incurred by the utility in implementing the program. This test indicates the direction and magnitude of the expected change in customer bills or rate levels.

A common misperception is that there is a single best perspective for evaluation of cost-effectiveness. Each test is useful and accurate, but the results of each test are intended to answer a different set of questions. The questions to be addressed by each cost test are shown in the table below.[11]

Table 7-2: Questions Addressed by the Various Cost Tests

Cost Test	Questions Addressed
Participant Cost Test (PCT)	▪ Is it worth it to the customer to install energy efficiency?
	▪ Is it likely that the customer wants to participate in a utility program that promotes energy efficiency?
Ratepayer Impact Measure (RIM)	▪ What is the impact of the energy efficiency project on the utility's operating margin?
	▪ Would the project require an increase in rates to reach the same operating margin?
Utility Cost Test (UCT)	▪ Do total utility costs increase or decrease?
	▪ What is the change in total customer bills required to keep the utility whole?
Total Resource Cost Test (TRC)	▪ What is the regional benefit of the energy efficiency project (including the net costs and benefits to the utility and its customers)?
	▪ Are all of the benefits greater than all of the costs (regardless of who pays the costs and who receives the benefits)?
	▪ Is more or less money required by the region to pay for energy needs?

Overall, the results of all four cost-effectiveness tests provide a more comprehensive picture than the use of any one test alone. The TRC cost test addresses whether energy efficiency is cost-effective overall. The PCT, UCT, and RIM address whether the selection of measures and design of the program are balanced from the perspective of the participants, utilities, and non-participants. The scope of the benefit and cost components included in each test are summarized in the table below.[12]

[11] http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf
[12] Ibid.

Table 7-3: Benefits and Costs Included in Each Cost-Effectiveness Test

Test	Benefits	Costs
PCT (Benefits and costs from the perspective of the customer installing the measure)	▪ Incentive payments ▪ Bill Savings ▪ Applicable tax credits or incentives	▪ Incremental equipment costs ▪ Incremental installation costs
UCT (Perspective of utility, government agency, or third party implementing the program	▪ Energy-related costs avoided by the utility ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs ▪ Utility/program administrator incentive costs
TRC (Benefits and costs from the perspective of all utility customers in the utility service territory)	▪ Energy-related costs avoided by the utility ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution ▪ Additional resource savings ▪ Monetized non-energy benefits	▪ Program overhead costs ▪ Program installation costs ▪ Incremental measure costs
RIM (Impact of efficiency measure on non-participating ratepayers overall)	▪ Energy-related costs avoided by the utility ▪ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	▪ Program overhead costs ▪ Lost revenue due to reduced energy bills ▪ Utility/program administrator installation costs

7.2 Non-Energy Benefits

Non-energy Benefits (NEBs) were sourced from the RTF workbook in place at the time the savings goals for the program was finalized. NEBs included wood fuel credits, increased comfort, and reductions in PM 2.5 emissions.

- Residential measures with NEBs included air source heat pumps, ductless heat pumps, windows, and insulation measures.
- Low Income NEBs included the NEBs described for Residential as well as a dollar-for-dollar benefit adder for health and safety spending.

7.3 Economic Inputs for Cost Effectiveness Analysis

The Evaluators used the economic inputs provided by Avista for the cost benefit analysis. Avista provided the Evaluators with avoided costs on the following basis:

- Hourly avoided commodity costs
- Modifications for the Clean Premium
- Avoided capacity costs
- Avoided transmission
- 10% Conservation Adder
- Line losses
- Discount rate (after tax Weighted Average Cost of Capital)

The values were aggregated to provide a single benefit multiplier on a kWh basis for every hour of the year (8,760). Savings by measure were then parsed out to the following load shapes provided by Avista:

- Residential Space Heating
- Residential Air Conditioning
- Residential Lighting
- Residential Refrigeration
- Residential Water Heating
- Residential Dishwasher
- Residential Washer/Dryer
- Residential Furnace Fan
- Residential Miscellaneous

The Evaluators in addition created a Residential Heat Pump load shape by weighting the relative magnitude of cooling versus heating savings from a heat pump and assigning these to weight the Residential Space Heating and Residential Air Conditioning load shapes.

7.4 Results

The tables below outline the results for each test, for both the programs and the portfolio as a whole. Summations may differ by $1 due to rounding.

Table 7-4: Cost-Effectiveness Results by Sector

Sector	TRC	UCT	RIM	PCT
Residential	1.11	1.74	0.37	2.21
Low Income	0.38	0.24	0.16	N/A*
Total	**0.80**	**0.87**	**0.31**	**N/A***
***Low Income is offered at no cost to participants; PCT is not calculable.**				

Table 7-5: Cost-Effectiveness Benefits by Sector

Program	TRC Benefits	UCT Benefits	RIM Benefits	PCT Benefits
Residential	$2,266,648	$2,044,124	$2,044,124	$2,495,503
Low Income	$581,136	$383,012	$383,012	$1,791,292
Total	**$2,847,784**	**$2,427,136**	**$2,427,136**	**$4,286,795**

Table 7-6: Cost-Effectiveness Costs by Sector

Program	TRC Costs	UCT Costs	RIM Costs	PCT Costs
Residential	$2,045,578	$1,173,511	$5,501,614	$1,131,337
Low Income	$1,530,941	$1,614,270	$2,434,974	$1,239,993
Total	**$3,576,519**	**$2,787,781**	**$7,936,588**	**$2,371,330**

Table 7-7: Cost-Effectiveness Net Benefits by Sector

Program	TRC Net Benefits	UCT Net Benefits	RIM Net Benefits	PCT Net Benefits
Residential	$221,070	$870,613	($3,457,490)	$1,364,166
Low Income	($949,806)	($1,231,258)	($2,051,962)	$551,300
Total	**($728,735)**	**($360,645)**	**($5,509,452)**	**$1,915,466**

APPENDIX D – 2020 WASHINGTON NATURAL GAS IMPACT EVALUATION REPORT – RESIDENTIAL AND LOW-INCOME

Evaluation, Measurement and Verification (EM&V) of Avista Washington Natural Gas PY2020 Residential and Low-Income Energy Efficiency Programs

Prepared for:

Avista Corporation

Delivered on:

May 12, 2021

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1. Executive Summary

This report is a summary of the Residential and Low-Income Gas Evaluation, Measurement, and Verification (EM&V) effort of the 2020 program year (PY2020) portfolio of programs for Avista Corporation (Avista) in the Washington service territory. The evaluation was administered by ADM Associates, Inc. and Cadeo Group, LLC (herein referred to as the "Evaluators").

1.1 Savings & Cost-Effectiveness Results

The Evaluators conducted an impact evaluation for Avista's Residential and Low-Income programs for PY2020. The Residential portfolio savings amounted to 408,149.18Therms with a 108.78% realization rate. The Low-Income portfolio savings amounted to 14,449.92 Therms with a 114.66% realization rate. The Evaluators summarize the Residential portfolio verified savings in Table 1-1and the Low-Income portfolio verified savings in Table 1-2 below.

The Residential portfolio reflects a TRC value of 1.01 and a UCT value of 2.36. The Low-Income portfolio reflects a TRC value of 0.34 and a UCT value of 0.25, leading to a total Residential and Low-Income TRC of 0.84 and a UCT of 1.57. Table 1-3 summarizes the evaluated TRC and UCT values with each the Residential and Low-Income portfolios.

Table 1-1: Residential Verified Impact Savings by Program

Program	Expected Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate	Total Costs
Water Heat	29,648.60	28,628.82	96.56%	$156,937.57
HVAC	272,409.80	330,928.95	121.48%	$1,366,930.09
Shell	72,863.84	47,874.54	65.70%	$612,498.51
ENERGY STAR Homes	268.00	669.90	249.96%	$2,754.49
Simple Steps, Smart Savings	2.13	46.96	2,209.44%	$0.00
Total Res	**375,192.37**	**408,149.18**	**108.78%**	**$2,139,120.66**

Table 1-2: Low-Income Verified Impact Savings by Program

Program	Expected Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate	Total Costs
Low-Income	12,602.93	14,449.92	114.66%	$1,318,017.21
CEEP	0.00	0.00	-	$0.00
Total Low-Income	**12,602.93**	**14,449.92**	**114.66%**	**$1,318,017.21**

Table 1-3: Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Residential	$5,547,107	$5,484,529	1.01	$5,042,640	$2,139,121	2.36
Low Income	$456,908	$1,336,787	0.34	$324,822	$1,318,017	0.25
Total	**$6,004,015**	**$6,821,318**	**0.88**	**$5,367,463**	**$3,457,140**	**1.55**

Table 1-4 summarizes the gas programs offered to residential and low-income customers in the Washington Avista service territory in PY2020 as well as the Evaluators' evaluation tasks and impact methodology for each program.

Table 1-4: Impact Evaluation Activities by Program and Sector

Sector	Program	Database Review	Survey Verification	Impact Methodology
Residential	Water Heat	✓	✓	Avista TRM
Residential	HVAC	✓	✓	Avista TRM/IPMVP Option A
Residential	Shell	✓		Avista TRM/Billing analysis with comparison group
Residential	ENERGY STAR® Homes	✓		Avista TRM
Residential	Simple Steps, Smart Savings	✓		RTF UES
Low-Income	Low-Income	✓		Avista TRM
Low-Income	Community Energy Efficiency Program (CEEP)	✓		Avista TRM

1.2 Conclusions and Recommendations

The following section details the Evaluators' conclusions and recommendations for each the Residential Portfolio and Low-Income Portfolio program evaluations.

1.2.1 Conclusions

The following section details the Evaluator's findings resulting from the program evaluations for each the Residential Portfolio and Low-Income Portfolio.

1.2.1.1 Residential Programs

The Evaluators provide the following conclusions regarding Avista's Residential gas programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 408,149.18 Therms with a realization rate of 108.78%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 1.01 while the UCT value is 2.36. Further details on cost-effectiveness methodology can be found in Appendix C.

- The Residential Portfolio impact evaluation resulted in a realization rate of 108.78% due to slight differences between the applied Avista TRM values and the most active Avista TRM value for each measure in addition to the difference in savings values between the results from billing analyses and the Avista TRM.
- The HVAC Program, which contributes 73% of the expected savings, resulted in a realization rate of 121% whereas each of the other programs resulted in a combined 74% realization rate. The Shell Program contributed to a 34% increase in the overall residential sector, which displayed a realization rate of 108.78%.
- The Evaluators conducted verification surveys via web survey and phone calls to collect information from customers who participated in the Water Heat and HVAC Programs. A total of 261 unique customers were surveyed between February and March 2021. The Evaluators collected information including the functionality of the efficient equipment, the functionality of the replaced equipment, and information on how the COVID19 stay-at-home orders have affected the household energy usage. The Evaluators calculated in-service rates for the measures within these two programs in order to apply findings to the verified savings results for each program.
- The realization rate for the natural gas savings in the Water Heat Program was 96.56%. This program deviated from 100% realization because one G Tankless Gas Water Heat measure rebate's documentation displayed documentation for a furnace replacement rather than a water heater. Therefore, the Evaluators removed this rebate from savings, lowering the realization rate for the program.
- The Evaluators explored a billing analysis for the natural gas water heater measures within the Water Heat Program. However, the G 50 Gallon Natural gas Water Heater lacked sufficient participation to estimate savings and the G Tankless Gas Water Heater measure resulted in savings that were not statistically significant. Therefore, the Evaluators elected to use Avista TRM values to estimate verified savings. The Evaluators will explore further billing analyses for these measures during the next program year.
- The HVAC Program in total displays a realization rate of 121.48% with 330,928.95 Therms verified natural gas savings in the Washington service territory. The realization rate for the natural gas savings in the HVAC Program deviate from 100% due to the differences between the applied Avista TRM prescriptive savings value and the updated Avista TRM or updated RTF UES value. The smart thermostat measures' realization rates are low because an outdated Avista TRM value was applied to the project data to calculate expected savings. The furnace measure has a high realization rate because the billing analysis resulted in a savings value that was 126% of the value previously used in the Avista TRM.
- The Evaluators attempted to estimate smart thermostat measure savings values for the HVAC Program. However, because the results from the billing analyses for smart thermostats were contradicting and/or inconclusive, the Evaluators elected to utilize Avista TRM values to estimate verified savings for these measures. The findings from the PY2020 billing analyses for these measures may have been impacted by the COVID19 pandemic. The Evaluators will explore additional billing analyses for these measures during program year 2021.
- The Shell Program displayed verified savings of 47,874.54 Therms with a realization rate of 65.70% against the expected savings for the program. The realization rate for the natural gas

savings in the Shell Program deviate from 100% due to the differences between the billing analysis results and the Avista TRM prescriptive savings values as well as outdated Avista TRM values being applied in the expected savings calculations.

- For the Shell Program, the Evaluators conducted a billing analysis for two measures that had sufficient participation. The Evaluators found the G Attic Insulation With Natural Gas Heat measure to display a statistically significant verified savings value of 63.56 Therms per year. In addition, the Evaluators found statistically significant savings of 39.13 Therms per year for the G Window Replacement with Natural Gas Heat measure. The Evaluators used these savings estimates towards calculating verified savings for the program. The G Attic Insulation With Natural Gas Heat measure totals 52% of the expected savings for the program and has a realization rate of 36%. The Avista TRM lists the savings for this measure at 0.15 therms per square foot of attic insulation, sourced from the Applied Energy Group (AEG) TRM. However, the Evaluators conducted a billing analysis and found the per square foot savings for this measure at 0.052 Therms, approximately one-third the value assigned in the TRM. The Evaluators recommend updating the value for this measure in the TRM to reflect observed savings in the Avista Washington gas service territory.
- Final verified savings for the Simple Steps, Smart Savings Program were estimated using the RTF UES values associated with each measure. Simple Steps, Smart Savings Program displayed -2,209.44% realization with 46.96 Therms saved. This program did not have any Therms savings expectations because the Avista TRM does not include a Therms savings for the measures provided in the program. However, the RTF UES includes Therms savings for the appliances measures, which the Evaluators applied to the project data. Therefore, the program displays savings with a large realization rate.

1.2.1.2 Low-Income Programs

The Evaluators provide the following conclusions regarding Avista's Low-Income natural gas programs:

- The Evaluators found the Low-Income portfolio to demonstrate a total of 14,449.92 Therms with a realization rate of 114.66%. The Low-Income Portfolio impact evaluation resulted verified savings that exceeded expected savings.
- The Evaluators conducted a cost-benefit analysis in order to estimate the Low-Income portfolio's cost-effectiveness. The resulting TRC value for this sector is 0.34 while the UCT value is 0.25. These values are expected, as the Low-Income portfolio is not expected to meet cost-effectiveness but are implemented in order to provide energy efficiency benefits to low-income customers. Further details on cost-effectiveness methodology can be found in Appendix C.
- The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolate each unique measure. However, participation for the Low-Income program resulted in a small number of customers with isolated measures and therefore the Evaluators conducted a whole-home billing analysis for all the natural gas measures combined in the Low-Income in order to estimate savings for the average household participating in the program, across all measures. The Evaluators found a realization rate of 139% for all natural gas measures in the program, which supported the realization rate of 115% from the desk review.

- The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation.
- The measures offered by the Community Energy Efficiency Program did not include any natural gas saving measures. Therefore, the impacts from this program amount to 0 Therms savings.

1.2.2 Recommendations

The following section details the Evaluator's recommendations resulting from the program evaluations for each the Residential Portfolio and Low-Income Portfolio.

1.2.2.1 Residential Programs

The Evaluators offer the following recommendations regarding Avista's Residential natural gas programs:

- The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. The values found in the project documentation should accurately reflect the values represented in the CC&B database.
- A number of rebates were not accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.
- The Evaluators note that some of the model numbers for the rebated equipment were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.
- The Evaluators cross-referenced the billing data to verify if customers demonstrated the required heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually. In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.
- For the Shell Program, the Evaluators conducted a billing analysis for two measures that had sufficient participation. The Evaluators found the G Attic Insulation With Natural Gas Heat measure to display a statistically significant verified savings value of 63.56 Therms per year. In addition, the Evaluators found statistically significant savings of 39.13 Therms per year for the G Window Replacement with Natural Gas Heat measure.
- The Avista TRM lists the savings for the G Attic Insulation With Natural Gas Heat measure in the Shell Program at 0.15 therms per square foot of attic insulation, sourced from the Applied Energy Group (AEG) TRM. However, the Evaluators conducted a billing analysis and found the per square foot savings for this measure at 0.052 Therms, approximately one-third the value assigned in the TRM. The Evaluators recommend updating the value for this measure in the TRM to reflect observed savings in the Avista Washington gas service territory.

- For the Shell Program, the Evaluators found rebates in which the R-values did not align with TRM or RTF values (R38 and R64). The Evaluators recommend collecting information in a standardized manner.
- The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows in order to correctly assign RTF UES values.
- The Evaluators note several instances in which the web-based rebate data indicates the household has electric space heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend updating data collection standards in order for all sources of information to reflect the same values as the project documentation.
- The Evaluators note that the realization for the E ENERGY STAR® Home – Manufactured, Gas & Electric measure is low because the Avista TRM savings was employed using an additive methodology between a gas-heated home and an electric-heated home for the electric savings. However, the Evaluators reviewed the RTF and determined manufactured home electric savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. The Evaluators recommend adjusting Avista TRM natural gas savings for this measure to reflect the RTF values associated with a fully natural gas-heated home at 133.98 Therms saved per year.
- The natural gas furnace measure in the HVAC has a high realization rate because the billing analysis resulted in a savings value that was 126% of the value previously used in the Avista TRM. The Evaluators recommend adjusting the Avista TRM to reflect the observed savings value from this impact evaluation.
- The Evaluators recommend adjusting expected savings calculations in the Simple Steps, Smart Savings Program to include Therms penalties and savings for the measures offered, in order to more accurately reflect the approved RTF savings values.

1.2.2.2 Low-Income Programs

The Evaluators offer the following recommendations regarding Avista's Low-Income natural gas programs:

- The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation. The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. In addition, the unit type, in terms of square footage or number of measures (windows, doors, etc) was not documented consistently and therefore savings values were applied inaccurately. The Evaluators recommend updating CC&B documentation standards to more accurately reflect values present on the rebate applications.
- The Evaluators identified one duplicated rebate. The Evaluators recommend conducting cleaning and data quality practices in order to avoid duplicated rebates and therefore unexpectedly low verified savings.
- The Evaluators found discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to

reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

2. General Methodology

The Evaluators performed an impact evaluation on each of the programs summarized in Table 1-4. The Evaluators used the following approaches to calculate energy impact defined by the International Performance Measurement and Verification Protocols (IPMVP)[1] and the Uniform Methods Project (UMP)[2]:

- Simple verification (web-based surveys supplemented with phone surveys)
- Document verification (review project documentation)
- Deemed savings (RTF UES and Avista TRM values)
- Whole facility billing analysis (IPMVP Option C)

The Evaluators completed the above impact tasks for each the electric impacts and the natural gas impacts for projects completed in the Washington Avista service territory.

The M&V methodologies are program-specific and determined by previous Avista evaluation methodologies as well as the relative contribution of a given program to the overall energy efficiency impacts. Besides drawing on IPMVP, the Evaluators also reviewed relevant information on infrastructure, framework, and guidelines set out for EM&V work in several guidebook documents that have been published over the past several years. These include the following:

- Northwest Regional Technical Forum (RTF)[3]
- National Renewable Energy Laboratory (NREL), United States Department of Energy (DOE) The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures, April 2013[4]
- International Performance Measurement and Verification Protocol (IPMVP) maintained by the Efficiency Valuation Organization (EVO) with sponsorship by the U.S. Department of Energy (DOE)[5]

The Evaluators kept data collection instruments, calculation spreadsheets, and monitored/survey data available for Avista records.

2.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators have provided a glossary of terms to follow:

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[1] https://www.nrel.gov/docs/fy02osti/31505.pdf

[2] https://www.nrel.gov/docs/fy18osti/70472.pdf

[3] https://rtf.nwcouncil.org/measures

[4] Notably, The Uniform Methods Project (UMP) includes the following chapters authored by ADM. Chapter 9 (Metering Cross-Cutting Protocols) was authored by Dan Mort and Chapter 15 (Commercial New Construction Protocol) was Authored by Steven Keates.

[5] Core Concepts: International Measurement and Verification Protocol. EVO 100000 – 1:2016, October 2016.

- **Deemed Savings** – An estimate of an energy savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) are applicable to the situation being evaluated.
- **Expected Savings** – Calculated savings used for program and portfolio planning purposes.
- **Adjusted Savings** – Savings estimates after database review and document verification has been completed using deemed unit-level savings provided in the Avista TRM. It adjusts for such factors as data errors and installation rates.
- **Verified Savings** – Savings estimates after the updated unit-level savings values have been updated and energy impact evaluation has been completed, integrating results from billing analyses and appropriate RTF UES and Avista TRM values.
- **Gross Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, regardless of why they participated.
- **Free Rider** – A program participant who would have implemented the program measure or practice in absence of the program.
- **Net-To-Gross** – A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.
- **Net Savings** – The change in energy consumption directly resulting from program-related actions taken by participants in an efficiency program, with adjustments to remove savings due to free ridership.
- **Non-Energy Benefits** – Quantifiable impacts produced by program measures outside of energy savings (comfort, health and safety, reduced alternative fuel, etc).
- **Non-Energy Impacts** – Quantifiable impacts in energy efficiency beyond the energy savings gained from installing energy efficient measures (reduced cost for operation and maintenance of equipment, reduced environmental and safety costs, etc).

2.2 Summary of Approach

This section presents our general cross-cutting approach to accomplishing the impact evaluation of Avista's Residential and Low-Income programs listed in Table 1-4. The Evaluators start by presenting our general evaluation approach. This chapter is organized by general task due to several overlap across programs. Section 3.3 describes the Evaluators' program-specific residential impact evaluation methods and results in further detail and Section 4.1 describes the Evaluator's program-specific low-income impact evaluation methods and results.

The Evaluators outline the approach to verifying, measuring, and reporting the residential portfolio impacts as well as cost-effectiveness and summarizing potential program and portfolio improvements. The primary objective of the impact evaluation is to determine ex-post verified net energy savings. On-site verification and equipment monitoring was not conducted during this impact evaluation due to stay-at-home orders due to the COVID19 pandemic.

Our general approach for this evaluation considers the cyclical feedback loop among program design, implementation, and impact evaluation. Our activities during the evaluation estimate and verify annual energy savings and identify whether a program is meeting its goals. These activities are aimed to provide guidance for continuous program improvement and increased cost effectiveness for the 2020 and 2021 program years.

The Evaluators employed the following approach to complete impact evaluation activities for the programs. The Evaluators define two major approaches to determining net savings for Avista's programs:

- A *Deemed Savings* approach involves using stipulated savings for energy conservation measures for which savings values are well-known and documented. These prescriptive savings may also include an adjustment for certain measures, such as lighting measures in which site operating hours may differ from RTF values.
- A *Billing Analysis* approach involves estimating energy savings by applying a linear regression to measured participant energy consumption utility meter billing data. Billing analyses included billing data from nonparticipant customers. This approach does not require on-site data collection for model calibration. This approach aligns with the IPMVP Option C.

The Evaluators accomplished the following quantitative goals as part of the impact evaluation:

- Verify savings with 10% precision at the 90% confidence level;
- Where appropriate, apply the RTF to verify measure impacts; and
- Where available data exists, conduct billing analysis with a suitable comparison group to estimate measure savings.

For each program, the Evaluators calculated adjusted savings for each measure based on the Avista TRM and results from the database review. The Evaluators calculated verified savings for each measure based on the RTF UES, Avista TRM, or billing analysis in combination with the results from document review. For the HVAC, Water Heat, and Fuel Efficiency programs, the Evaluators also applied in-service rates (ISRs) from verification surveys.

The Evaluators assigned methodological rigor level for each measure and program based on its contribution to the portfolio savings and availability of data.

The Evaluators analyzed billing data for all natural gas measure participants in the HVAC and Low-Income programs. The Evaluators applied billing analysis results to determine evaluated savings only for measures where savings could be isolated (that is, where a sufficient number of participants could be identified who installed only that measure). Program-level realization rates for the HVAC, Water Heat, and Fuel Efficiency programs incorporate billing analysis results for some measures.

2.2.1 Database Review

At the outset of the evaluation, the Evaluators reviewed the databases to ensure that each program tracking database conforms to industry standards and adequately tracks key data required for evaluation.

Measure-level net savings were evaluated primarily by reviewing measure algorithms and values in the tracking system to assure that they are appropriately applied using the Avista TRM. The Evaluators then aggregated and cross-check program and measure totals.

The Evaluators reviewed program application documents for a sample of incented measures to verify the tracking data accurately represents the program documents. The Evaluators ensured the home installed measures that meet or exceed program efficiency standards.

2.2.2 Verification Methodology

The Evaluators verified a sample of participating households for detailed review of the installed measure documentation and development of verified savings. The Evaluators verified tracking data by reviewing invoices and surveying a sample of participant customer households. The Evaluators also conducted a verification survey for program participants.

The Evaluators used the following equations to estimate sample size requirements for each program and fuel type. Required sample sizes were estimated as follows:

Equation 2-1: Sample Size for Infinite Sample Size

$$n = \left(\frac{Z \times CV}{d}\right)^2$$

Equation 2-2: Sample Size for Finite Population Size

$$n_0 = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

Where,

- n = Sample size
- Z = Z-value for a two-tailed distribution at the assigned confidence level.
- CV = Coefficient of variation
- d = Precision level
- N = Population

For a sample that provides 90/10 precision, *Z* = 1.645 (the critical value for 90% confidence) and *d* = 0.10 (or 10% precision). The remaining parameter is *CV*, or the expected coefficient of variation of measures for which the claimed savings may be accepted. A *CV* of .5 was assumed for residential programs due to the homogeneity of participation[6], which yields a sample size of 68 for an infinite population. Sample sizes were adjusted for smaller populations via the method detailed in Equation 2-2.

The following sections describe the Evaluator's methodology for conducting document-based verification and survey-based verification.

2.2.2.1 Document-Based Verification

The Evaluators requested rebate documentation for a subset of participating customers. These documents included invoices, rebate applications, pictures, and AHRI certifications for the following programs.

- Water Heat Program
- HVAC Program
- Shell Program
- ENERGY STAR® Homes Program
- Simple Steps, Smart Savings Program
- Low-Income Program
- Community Energy Efficiency Program

This sample of documents was used to cross-verify tracking data inputs. In the case the Evaluators found any deviations between the tracking data and application values, the Evaluators reported and summarized those differences in the Database Review sections presented for each program in Section 3.3 and Section 4.1.

The Evaluators developed a sampling plan that achieves a sampling precision of ±10% at 90% statistical confidence – or "90/10 precision" – to estimate the percentage of projects for which the claimed savings are verified or require some adjustment.

The Evaluators developed the following samples for each program's document review using Equation 2-1 and Equation 2-2. The Evaluators ensured representation in each state and fuel type for each measure.

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[6] Assumption based off California Evaluation Framework:

https://www.cpuc.ca.gov/uploadedFiles/CPUC_Public_Website/Content/Utilities_and_Industries/Energy/Energy_Programs/Demand_Side_Management/EE_and_Energy_Savings_Assist/CAEvaluationFramework.pdf

Table 2-1: Document-based Verification Samples and Precision by Program

Sector	Program	Gas Population	Sample (With Finite Population Adjustment)*	Precision at 90% CI
Residential	Water Heat	957	65	±9.85%
Residential	HVAC	7,401	69	±9.86%
Residential	Shell	1,337	68	±9.72%
Residential	ENERGY STAR® Homes	6	6	±0.00%
Residential	Simple Steps, Smart Savings	N/A	N/A	N/A
Low-Income	Low-Income	550	66	±9.50%
Low-Income	CEEP	21	21	±0.00%

*Assumes sample size of 68 for an infinite population, based on *CV* (coefficient of variation) = 0.5, *d* (precision) = 10%, *Z* (critical value for 90% confidence) = 1.645.

The table above represents the number of rebates in both Washington and Idaho territories. The Evaluators ensured representation of state and fuel type in the sampled rebates for document verification.

2.2.2.2 Survey-Based Verification

The Evaluators conducted survey-based verification for the Water Heat Program and HVAC Program. The primary purpose of conducting a verification survey is to confirm that the measure was installed and is still currently operational and whether the measure was early retirement or replace-on-burnout.

The Evaluators summarize the final sample sizes shown in Table 2-2 for the Water Heat and HVAC for the Washington Gas Avista projects. The Evaluators developed a sampling plan that achieved a sampling precision of ±4.24% at 90% statistical confidence for ISRs estimates at the measure-level during web-based survey verification.

Table 2-2: Survey-Based Verification Sample and Precision by Program

Sector	Program	Population	Respondents	Precision at 90% CI
Residential	Water Heat	957	115	±7.20%
Residential	HVAC	7,401	246	±5.16%
Total		**8,358**	**361**	**±4.24%**

The Evaluators implemented a web-based survey to complete the verification surveys. The Evaluators supplemented with phone interviews to reach the 90/10 precision goal. The findings from these activities served to estimate ISRs for each measure surveyed. These ISRs were applied to verification sample desk review rebates towards verified savings, which were then applied to the population of rebates. The measure-level ISRs resulting from the survey-based verification are summarized in Section 3.1.

2.2.3 Impact Evaluation Methodology

The Evaluators employed the following approach to complete impact evaluation activities for the programs. The Evaluators define two major approaches to determining net savings for Avista's programs:

- Deemed Savings
- Billing Analysis (IPMVP Option C)

In the following sections, the Evaluators summarize the general guidelines and activities followed to conduct each of the above analyses.

2.2.3.1 Deemed Savings

This section summarizes the deemed savings analysis method the Evaluators employed for the evaluation of a subset of measures for each program. The Evaluators completed the validation for specific measures across each program using the RTF unit energy savings (UES) values, where available. The Evaluators ensured the proper measure unit savings were recorded and used in the calculation of Avista's ex-ante measure savings. The Evaluators requested and used the technical reference manual Avista employed during calculation of ex-ante measure savings (Avista TRM). The Evaluators documented any cases where recommend values differed from the specific unit energy savings workbooks used by Avista.

In cases where the RTF has existing unit energy savings (UES) applicable to Avista's measures, the Evaluators verified the quantity and quality of installations and apply the RTF's UES to determine verified savings. For gas measures, this applies to the Therms penalties found in electric measures in the RTF.

2.2.3.2 Billing Analysis

This section describes the billing analysis methodology employed by the Evaluators as part of the impact evaluation and measurement of energy savings for measures with sufficient participation. The Evaluators performed billing analyses with a matched control group and utilized a quasi-experimental method of producing a post-hoc control group. In program designs where treatment and control customers are not randomly selected at the outset, such as for downstream rebate programs, quasi-experimental designs are required.

For the purposes of this analysis, a household is considered a treatment household if it has received a program incentive. Additionally, a household is considered a control household if the household has not received a program incentive. To isolate measure impacts, treatment households are eligible to be included in the billing analysis if they installed only one measure during the 2019 and 2020 program years. Isolation of individual measures are necessary to provide valid measure-level savings. Households that installed more than one measure may display interactive energy savings effects across multiple measures that are not feasibly identifiable. Therefore, instances where households installed isolated measures are used in the billing analyses. In addition, the pre-period identifies the period prior to measure installation while the post-period refers to the period following measure installation.

The Evaluators utilized propensity score matching (PSM) to match nonparticipants to similar participants using pre-period billing data. PSM allows the evaluators to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing.

After matching based on these variables, the billing data for treatment and control groups are compared, as detailed in IPMVP Option C. The Evaluators fit regression models to estimate weather-dependent daily consumption differences between participating customer and nonparticipating customer households.

Cohort Creation

The PSM approach estimates a propensity score for treatment and control customers using a logistic regression model. A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households. The Evaluators created a post-hoc control group by compiling billing data from a subset of nonparticipants in the Avista territory to compare against treatment households using quasi-experimental methods. This allowed the Evaluators to select from a large group of similar households that have not installed an incented measure. With this information, the Evaluators created statistically valid matched control groups for each measure via seasonal pre-period usage. The Evaluators matched customers in the control group to customers in the treatment group based on nearest seasonal pre-period usage (e.g., summer, spring, fall, and winter) and exact 3-digit zip code matching (the first three digits of the five-digit zip code). After matching, the Evaluators conducted a *t*-test for each month in the pre-period to help determine the success of PSM.

While it is not possible to guarantee the creation of a sufficiently matched control group, this method is preferred because it is likely to have more meaningful results than a treatment-only analysis. Some examples of outside variables that a control group can sufficiently control for are changes in economies and markets, large-scale social changes, or impacts from weather-related anomalies such as flooding or hurricanes. This is particularly relevant in 2020 due to COVID-19 related lockdowns and restrictions.

After PSM, the Evaluators ran the following regression models for each measure:

- Fixed effect Difference-in-Difference (D-n-D) regression model (recommended in UMP protocols)[7]
- Random effects post-program regression model (PPR) (recommended in UMP protocols)
- Gross billing analysis (treatment only)

The second model listed above (PPR) was selected because it had the best fit for the data, identified using the adjusted R-squared. Further details on regression model specifications can be found below.

Data Collected

The following lists the data collected for the billing analysis:

1. Monthly billing data for program participants (treatment customers)
2. Monthly billing data for a group of non-program participants (control customers)
3. Program tracking data, including customer identifiers, address, and date of measure installation

[7] National Renewable Energy Laboratory (NREL) Uniform Methods Project (UMP) Chapter 17 Section 4.4.7.

4. National Oceanic and Atmospheric Administration (NOAA) weather data between January 1, 2018 and December 31, 2020)
5. Typical Meteorological Year (TMY3) data

Billing and weather data were obtained for program years 2019 and 2020 and for one year prior to measure install dates (2018).

Weather data was obtained from the nearest weather station with complete data during the analysis years for each customer by mapping the weather station location with the customer zip code.

TMY weather stations were assigned to NOAA weather stations by geocoding the minimum distance between each set of latitude and longitude points. This data is used for extrapolating savings to long-run, 30-year average weather.

Data Preparation

The following steps were taken to prepare the billing data:

1. Gathered billing data for homes that participated in the program.
2. Excluded participant homes that also participated in the other programs, if either program disqualifies the combination of any other rebate or participation.
3. Gathered billing data for similar customers that did not participate in the program in evaluation.
4. Excluded bills missing address information (0.1% of bills).
5. Removed bills missing fuel type/Unit of Measure (UOM) (0.1% of bills).
6. Removed bills missing usage, billing start date, or billing end date (0.17% of bills).
7. Remove bills with outlier durations (<9 days or >60 days).
8. Excluded bills with consumption indicated to be outliers.
9. Calendarized bills (recalculates bills, usage, and total billed such that bills begin and end at the start and end of each month).
10. Obtained weather data from nearest NOAA weather station using 5-digit zip code per household.
11. Computed Heating Degree Days (HDD) and Cooling Degree Days (CDD) for a range of setpoints. The Evaluators assigned a setpoint of 65°F for both HDD and CDD. The Evaluators tested and selected the optimal temperature base for HDDs and CDDs based on model *R*-squared values.
12. Selected treatment customers with only one type of measure installation during the analysis years and combined customer min/max install dates with billing data (to define pre- and post-periods).
13. Restricted to treatment customers with install dates in specified range (typically January 1, 2019 through June 30, 2020) to allow for sufficient post-period billing data.
14. Restricted to control customers with usage less than or equal to two times the maximum observed treatment group usage. This has the effect of removing control customers with incomparable usage relative to the treatment group.

15. Removed customers with incomplete post-period bills (<4 months).
16. Removed customers with incomplete pre-period bills.
17. Restricted control customers to those with usage that was comparable with the treatment group usage.
18. Created a matched control group using PSM and matching on pre-period seasonal usage and zip code.

Regression Models

The Evaluators ran the following models for matched treatment and control customers for each measure with sufficient participation. For net savings, the Evaluators selected either Model 1 or Model 2. The model with the best fit (highest adjusted R-squared) was selected. The Evaluators utilized Model 3 to estimate gross energy savings.

Model 1: Fixed Effects Difference-in-Difference Regression Model

The following equation displays the first model specification to estimate the average daily savings due to the measure.

Equation 2-3: Fixed Effects Difference-in-Difference (D-n-D) Model Specification

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(Post \times Treatment)_{it} + \beta_3(HDD)_{it} + \beta_4(CDD)_{it} \\ &+ \beta_5(Post \times HDD)_{it} + \beta_6(Post \times CDD)_{it} + \beta_7(Post \times HDD \times Treatment)_{it} \\ &+ \beta_8(Post \times CDD \times Treatment)_{it} + \beta_9(Month)_t + \beta_{10}(Customer\ Dummy)_i + \varepsilon_{it} \end{aligned}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage reading *t* for household *i* during the post-treatment period
- $Post_{it}$ = A dummy variable indicating pre- or post-period designation during period *t* at home *i*
- $Treatment_i$ = A dummy variable indicating treatment status of home *i*
- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*
- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home i *(if electric usage)*
- $Month_t$= A set of dummy variables indicating the month during period *t*
- $Customer\ Dummy_i$ = a customer-specific dummy variable isolating individual household effects
- ε_{it} = The error term
- α_0= The model intercept
- β_{1-10} = Coefficients determined via regression

The Average Daily Consumption (ADC) is calculated as the total monthly billed usage divided by the duration of the bill month. β_2 represents the average change in daily baseload in the post-period between the treatment and control group and β_7 and β_8 represent the change in weather-related daily consumption in the post-period between the groups. Typical monthly and annual savings were estimated by extrapolating the β_7 and β_8 coefficients with Typical Meteorological Year (TMY) HDD and CDD data. However, in the case of gas usage, only the coefficient for HDD is utilized because CDDs were not included in the regression model.

The equation below displays how savings were extrapolated for a full year utilizing the coefficients in the regression model and TMY data. TMY data is weighted by the number of households assigned to each weather station.

Equation 2-4: Savings Extrapolation

$$Annual\ Savings = \beta_2 * 365.25 + \beta_7 * TMY\ HDD + \beta_8 * TMY\ CDD$$

Model 2: Random Effects Post-Program Regression Model

The following equation displays the second model specification to estimate the average daily savings due to the measure. The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the treatment and control customers; in particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between treatment and control customers will be reflected in the differences in their past energy use, which is highly correlated with their current energy use. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

Equation 2-5: Post-Program Regression (PPR) Model Specification

$$\begin{aligned} ADC_{it} = {} & \alpha_0 + \beta_1(Treatment)_i + \beta_2\ (PreUsage)_i + \beta_3\ (PreUsageSummer)_i \\ & + \beta_4(PreUsageWinter)_i + \beta_5(Month)_t + \beta_6(Month \times PreUsage)_{it} \\ & + \beta_7(Month \times PreUsageSummer)_{it} + \beta_8(Month \times PreUsageWinter)_{it} \\ & + \beta_9(HDD)_{it} + \beta_{10}(CDD)_{it} + \beta_{11}(Treatment \times HDD)_{it} + \beta_{12}(Treatment \times CDD)_{it} \\ & + \varepsilon_{it} \end{aligned}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period
- $Treatment_i$ = A dummy variable indicating treatment status of home *i*
- $Month_t$ = Dummy variable indicating month of month *t*
- $PreUsage_i$ = Average daily usage across household *i*'s available pre-treatment billing reads
- $PreUsageSummer_i$ = Average daily usage in the summer months across household *i*'s available pretreatment billing reads
- $PreUsageWinter_i$ = Average daily usage in the winter months across household *i*'s available pre-treatment billing reads

- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*
- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home i *(if electric usage)*
- ε_{it} = Customer-level random error
- α_0= The model intercept for home *i*
- β_{1-12} = Coefficients determined via regression

The coefficient β_1 represents the average change in consumption between the pre-period and post-period for the treatment group and β_{11} and β_{12} represent the change in weather-related daily consumption in the post-period between the groups. Typical monthly and annual savings were estimated by extrapolating the β_{11} and β_{12} coefficients with Typical Meteorological Year (TMY) HDD and CDD data.

The equation below displays how savings were extrapolated for a full year utilizing the coefficients in the regression model and TMY data.

Equation 2-6: Savings Extrapolation

$$Annual\ Savings = \beta_1 * 365.25 + \beta_{11} * TMY\ HDD + \beta_{12} * TMY\ CDD$$

Model 3: Gross Billing Analysis, Treatment-Only Regression Model

The sections above detail the Evaluator's methodology for estimating net energy savings for each measure. The results from the above methodology report net savings due to the inclusion of the counterfactual comparison group. However, for planning purposes, it is useful to estimate gross savings for each measure. To estimate gross savings, the Evaluators employed a similar regression model; however, only including participant customer billing data. This analysis does not include control group billing data and therefore models energy reductions between the pre-period and post-period for the measure participants (treatment customers).

To calculate the impacts of each measure, the Evaluators applied linear fixed effects regression using participant billing data with weather controls in the form of Heating Degree Days (HDD) and Cooling Degree Days (CDD). The following equation displays the model specification to estimate the average daily savings due to the measure.

Equation 2-7: Treatment-Only Fixed Effects Weather Model Specification

$$\begin{aligned} ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(HDD)_{it} + \beta_3(CDD)_{it} + \beta_4(Post \times HDD)_{it} + \beta_5(Post \times CDD)_{it} \\ + \beta_6(Customer\ Dummy)_i + \beta_7(Month)_t + \varepsilon_{it} \end{aligned}$$

Where,

- *i* = the *i*th household
- *t* = the first, second, third, etc. month of the post-treatment period
- ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period
- HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*

- CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period t at home i *(if electric usage)*
- $Post_{it}$ = A dummy variable indicating pre- or post-period designation during period t at home *i*
- $Customer\ Dummy_i$ = a customer-specific dummy variable isolating individual household effects
- ε_{it} = Customer-level random error
- α_0= The model intercept for home *i*
- β_{1-6} = Coefficients determined via regression

The results of the treatment-only regression models are gross savings estimates. The gross savings estimates are useful to compare against the net savings estimates. However, the treatment-only models are unable to separate the effects of the COVID19 pandemic. The post-period for PY2020 and perhaps also PY2021 are affected by the stay-at-home orders that had taken effect starting March 2020 in Washington. The stay-at-home orders most likely affect the post-period household usage. Because there is insufficient post-period data before the shelter-in-place orders, the Evaluators were unable to separate the effects on consumption due to the orders and the effects on consumption due to the measure installation. Therefore, the results from this additional gross savings analysis are unable to reflect actual typical year savings. However, for planning purposes, these estimates may be useful.

2.2.4 Net-To-Gross

The Northwest RTF UES measures do not require NTG adjustments as they are built into the deemed savings estimates. In addition, billing analyses with counterfactual control groups, as proposed in our impact methodology, does not require a NTG adjustment, as the counterfactual represents the efficiency level at current market (i.e. the efficiency level the customer would have installed had they not participated in the program).

2.2.5 Cost-Effectiveness Tests

The Evaluators calculated each program's cost-effectiveness, avoided energy costs, and implementation costs. The Evaluators used our company-developed cost-effectiveness tool to provide cost-effectiveness assessments for the Residential Portfolio by program, fuel type, program year, and measure, for each state.

As specified in this solicitation, the Evaluators determined the economic performance with the following cost-effectiveness tests:

- Total Resource Cost (TRC) test;
- Utility Cost Test (UCT);
- Participant Cost Test (PCT); and
- Rate Impact Measure (RIM).

2.2.6 Non-Energy Benefits

The Evaluators used the Regional Technical Forum (RTF) to quantify non-energy benefits (NEBs) for residential measures with established RTF values where available. Measures with quantified NEBs include residential insulation, high efficiency windows, air source heat pumps, and ductless heat pumps.

In addition to the residential NEBs, the Evaluators applied the end-use non-energy benefit and health and human safety non-energy benefit to the Low-Income Program. The Evaluators understand that the two major non-energy benefits referenced above are uniquely applicable to the Low-Income Program. The Evaluators applied those benefits to the program impacts as well as additional non-energy benefits associated with individual measures included in the program. The Evaluators incorporated additional NEBs to the impact evaluation, as applicable. Additional details on the non-energy benefits applied can be found in Section 7.2.

3. Residential Impact Evaluation Results

The Evaluators completed an impact evaluation on Avista's Residential portfolio to verify program-level and measure-level energy savings for PY2020. The following sections summarize findings for each natural gas impact evaluation in the Residential Portfolio in the Washington service territory. The Evaluators used data collected and reported in the tracking database, online application forms, Avista TRM, RTF, and billing analysis of participants and nonparticipants to evaluate savings. This approach provided the strongest estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, number of participants, and availability of data. Table 3-1 summarizes the Residential verified impact savings by program. Table 3-2 summarizes the Residential portfolio's cost-effectiveness.

Table 3-1: Residential Verified Impact Savings by Program

Program	Expected Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
Water Heat	29,648.60	28,628.82	96.56%
HVAC	272,409.80	330,928.95	121.48%
Shell	72,863.84	47,874.54	65.70%
ENERGY STAR® Homes	268.00	669.90	249.96%
Simple Steps, Smart Savings	2.13	46.96	2209.44%
Total Res	**375,192.37**	**408,149.18**	**108.78%**

Table 3-2: Residential Portfolio Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Residential	$5,547,107	$5,484,529	1.01	$5,042,640	$2,139,121	2.36

In PY2020, Avista completed and provided incentives for residential natural gas measures in Washington and reported total natur gas savings of 408,149.18 Therms. All programs except the Water Heat Program and the Shell Program met savings goals based on reported savings, leading to an overall achievement of 108.78% of the expected savings for the residential programs. The Evaluators estimated the TRC value for the Residential portfolio is 1.01 while the UCT value is 2.36. Further details of the impact evaluation results by program are provided in the sections following.

3.1 Simple Verification Results

The Evaluators surveyed 261 unique customers that participated in Avista's residential energy efficiency program in February and March 2021 using a mixed mode approach (phone/email). Customers with a valid email were sent the survey via an email invitation. Fifty-three did not have email addresses in program records and were invited to take the survey by the Evaluators' in-house survey administration team. The Evaluators also conducted targeted follow-up outreach to customers for certain measures.

The Evaluators surveyed customers that received rebates for HVAC and Water Heater Programs.

Table 3-3: Summary of Survey Response Rate

Population	Respondents
Initial email contact list	959
Invalid email addresses	3
Bounced email	43
Undeliverable email	27
Invalid email (%)	*8%*
Email invitations sent (unique valid)	886
Email completions	208
Email response rate (%)	23%
Initial phone list	190
Phone numbers w/ email addresses	138
Phone numbers w/ no email address	52
Disconnected/wrong number	20
Invalid phone (%)	*11%*
Phone calls (unique valid)	170
Phone completions	54
Phone response rate (%)	32%
Total invites (unique)	938
Total completions	262
Response rate (%)	28%
Initial email contact list	959
Invalid email addresses	3

3.1.1 In-Service Rates

The Evaluators calculated in-service rates of installed measures from simple verification surveys deployed to program participants for the Water Heat and HVAC Programs. The Evaluators asked participants if the rebated equipment is currently installed and working, in addition to questions about the new equipment fuel type. The Evaluators achieved ±4.24% precision across the programs surveyed for the natural gas measures in Avista's service territory, summarized in Table 3-4.

Table 3-4: Simple Verification Precision by Program

Sector	Program	Population	Respondents	Precision at 90% CI
Residential	Water Heat	957	115	±7.20%
Residential	HVAC	7,401	246	±5.16%
Total		**8,358**	**361**	**±4.24%**

The measure-level ISRs determined from the verification survey for each program in which simple verification was conducted is presented in Table 3-5 and Table 3-6.

Table 3-5: Water Heat Program ISRs by Measure

Measure	Respondents	ISR
G 50 Gallon Natural Gas Water Heater	11	100%
G Tankless Water Heater	102	100%

Table 3-6: HVAC Program ISRs by Measure

Measure	Respondents	ISR
G Natural Gas Boiler	4	100.00%
G Natural Gas Furnace	92	98.86%
G Natural Gas Wall Heater	2	100.00%
G Smart Thermostat DIY with Natural Gas Heat	20	100.00%
G Smart Thermostat Paid Install with Natural Gas Heat	52	94.12%

These ISR values were utilized in the desk reviews for the Water Heat and HVAC Programs in order to calculate verified savings. Additional insights from the survey responses are summarized in Appendix B.

3.2 Impacts of COVID-19 Pandemic

On average, about three people lived at the residence that had the rebated equipment installed and about 60% of respondents said that two or fewer lived at the residence that had the rebated equipment installed.

About two-thirds of respondents (66%) observed that the pandemic had not changed the number of people in their household that worked or went to school remotely.[8] Twenty-two percent of respondents said that more members of their household were attending school remotely or working from home since the COVID-19 pandemic began. Twelve percent of respondents indicated that more members of their household had gone to work or school remotely before the COVID-19 pandemic.

Three-quarters of respondents said that the amount of time they spend at home has increased since the COVID-19 pandemic began. A much smaller portion of respondents indicated that other members of their household were spending more time at home, as displayed in Figure 3-1. About half of respondents indicated that their utility bill had increased, as displayed in Figure 3-2.

[8] n=257

Figure 3-1: Change in amount of time spent at home

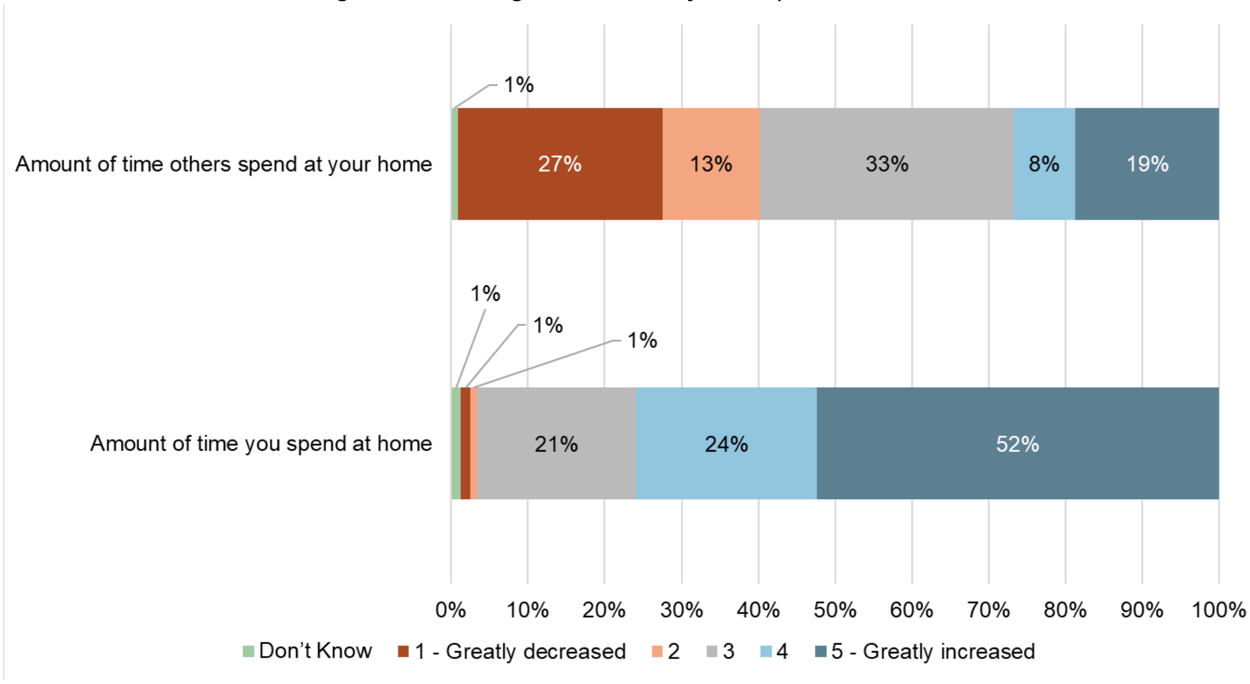
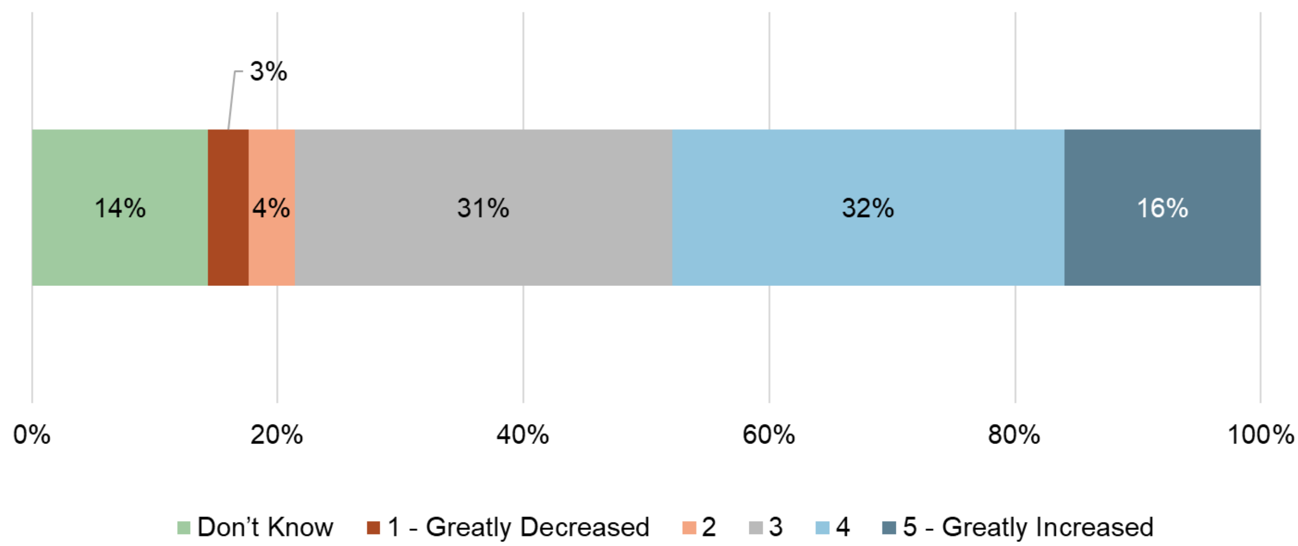


Figure 3-2: Change in natural gas bill since COVID19 pandemic began



3.3 Program-Level Impact Evaluation Results

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Residential sector in the section below.

3.3.1 Water Heat Program

The Water Heat Program encourages customers to replace their existing electric or natural gas water heater with high efficiency equipment. Customers receive incentives after installation and after submitting a completed rebate form. Table 3-7 summarizes the measures offered under this program.

Table 3-7: Water Heat Program Measures

Measure	Description	Impact Analysis Methodology
G 50 Gallon Natural Gas Water Heater	Storage tank natural gas water heater, 50 gallons or less	Avista TRM
G Tankless Water Heater	Tankless natural gas water heater	Avista TRM

The following table summarizes the verified natural gas savings for the Water Heat Program impact evaluation.

Table 3-8: Water Heat Program Verified Natural Gas Savings

Measure	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
G 50 Gallon Natural Gas Water Heater	97	2,114.60	2,114.60	2,114.60	100.00%
G Tankless Water Heater	353	27,534.00	27,534.00	26,514.22	96.30%
Total	**450**	**29,648.60**	**29,648.60**	**28,628.82**	**96.56%**

The Water Heat Program displayed verified savings of 28,629 Therms with a realization rate of 95.56% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs from the program.

Table 3-9: Water Heat Program Costs

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
G 50 Gallon Natural Gas Water Heater	$9,700.00	$322.17	$10,022.17
G Tankless Water Heater	$141,200.00	$5,715.40	$146,915.40
Total	**$150,900.00**	**$6,037.57**	**$156,937.57**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Water Heat Program in the section below.

3.3.1.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Water Heat Program.

3.3.1.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Water Heat Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators found all Water Heat Program rebates to have completed rebate applications with the associated water heater model number and efficiency values filled in either the Customer Care & Billing (CC&B) web rebate data or mail-in rebate applications.

However, the Evaluators note that the CC&B web rebate data does not reflect the same values found in the mail-in rebate applications and/or invoices or AHRI certification documents submitted with the rebate application. The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. For example, ten of the 111 sampled rebates were not found in the CC&B dataset. A number of the sampled rebates were found to have discrepancies in model numbers between the CC&B data and the mail-in rebate applications and/or invoices.

In addition, not all rebates were accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.

The Evaluators found all sampled rebate equipment met or exceeded the measure efficiency requirements for the Water Heat Program.

3.3.1.3 Verification Surveys

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measure. The Evaluators included questions such as:

- Was this water heater a new construction, or did it replace another water heater?
- Was the previous water heater functional?
- Is the newly installed water heater still properly functioning?

In addition, the Evaluators asked participants how the COVID19 pandemic stay-at-home orders have affected their household's energy consumption. The responses to this verification survey were used to calculate ISRs for the measures offered in the Water Heat Program.

Table 3-10 displays the ISRs for each of the Water Heat measures for Idaho and Washington territory combined.

Table 3-10: Water Heat Verification Survey ISR Results

Measure	Number of Rebates*	Number of Survey Completes	Program-Level Precision at 90% Confidence	In-Service Rate
G 50 Gallon Natural Gas Water Heater	119	11	7.20%*	100%
G Tankless Water Heater	838	104		100%

*This count includes rebates from Washington and Idaho

All survey respondents for each water heater measure described equipment to be currently functioning, leading to a 100% ISR. The Evaluators applied these ISRs to each rebate to quantify verified savings for each measure.

3.3.1.4 Impact Analysis

This section summarizes the verified savings results for the Water Heat Program. The Evaluators conducted a billing analysis for measures where participation allowed. The Evaluators calculated verified savings for the remaining measures using active values from the Avista TRM workbook. These values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.1.5 Billing Analysis

The Evaluators explored a billing analysis for the natural gas water heater measures within this program. However, the G 50 Gallon Natural gas Water Heater lacked sufficient participation to estimate savings and the G Tankless Gas Water Heater measure resulted in savings that were not statistically significant. Therefore, the Evaluators elected to use Avista TRM values to estimate verified savings. The Evaluators will explore further billing analyses for these measures during the next program year. Further details of the billing analysis for the variable speed motor measure can be found Appendix A.

3.3.1.6 Verified Savings

The Evaluators reviewed and applied the current Avista TRM values along with verified tracking data to estimate net program savings for this measure. The verified savings for the program is 28,629 Therms with a realization rate of 95.56%, as displayed in Table 3-8.

The realization rate for the natural gas savings in the Water Heat Program deviate from 100% for the G Tankless Gas Water Heat measure because one rebate’s documentation displayed documentation for a furnace replacement rather than a water heater. Therefore, the Evaluators removed this rebate from savings, lowering the realization rate for the program.

3.3.2 HVAC Program

The HVAC program encourages installation of high efficiency HVAC equipment and smart thermostats through customer incentives. The program is available to residential electric or natural gas customers with a winter heating season usage of 4,000 or more kWh, or at least 160 Therms of space heating in the prior year. Existing or new construction homes are eligible to participate in the program. Table 3-7 summarizes the measures offered under this program.

Table 3-11: HVAC Program Measures

Measure	Description	Impact Analysis Methodology
G Natural Gas Boiler	Natural gas boiler	Avista TRM
G Natural Gas Furnace	Natural gas forced air furnace	IPMVP Option A with billing data
G Natural Gas Wall Heater	Natural gas wall heater	Avista TRM
G Smart Thermostat DIY with Natural Gas Heat	Professionally installed connected thermostats in natural gas-heated home	Avista TRM
G Smart Thermostat Paid Install with Natural Gas Heat	Variable speed motor in natural gas-heated home	Avista TRM

The following table summarizes the verified natural gas savings for the HVAC Program impact evaluation.

Table 3-12: HVAC Program Verified Natural Gas Savings

Measure	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
G Natural Gas Boiler	22	2,266.00	2,244.00	2,244.00	99.03%
G Natural Gas Furnace	2,519	226,917.20	204,039.00	286,702.63	126.35%
G Natural Gas Wall Heater	1	103.00	103.00	103.00	100.00%
G Smart Thermostat DIY with Natural Gas Heat	575	15,186.80	15,344.64	15,359.34	101.14%
G Smart Thermostat Paid Install with Natural Gas Heat	1,055	27,936.80	28,211.76	26,519.99	94.93%
Total	**4,172**	**272,409.80**	**249,942.40**	**330,928.95**	**121.48%**

The HVAC Program displayed verified savings of 330,928.95 Therms with a realization rate of 121.48% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-13: HVAC Program Costs

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
G Natural Gas Boiler	$9,900.00	$483.72	$10,383.72
G Natural Gas Furnace	$1,136,250.00	$61,801.57	$1,198,051.57
G Natural Gas Wall Heater	$450.00	$22.20	$472.20
G Smart Thermostat DIY with Natural Gas Heat	$43,099.82	$3,310.86	$46,410.68
G Smart Thermostat Paid Install with Natural Gas Heat	$105,895.29	$5,716.64	$111,611.93
Total	**$1,295,595.11**	**$71,334.98**	**$1,366,930.09**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the HVAC Program in the section below.

3.3.2.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the HVAC Program.

3.3.2.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the HVAC Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in in Section 2.2.2.1.

The Evaluators found all HVAC Program rebates to have project documentation with the associated HVAC model number and efficiency values in either the CC&B web rebate data or mail-in rebate applications. However, the Evaluators note that some of the model numbers were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.

The Evaluators note that not all rebate applications contained existing/new construction field. This field is an input to apply correct RTF UES values. The Evaluators recommend requiring this field be completed in rebate applications, both mail-in and web-based.

The Evaluators cross-referenced the billing data to verify if customers that received a rebate for E Natural Gas To Air Source Heat Pump or E Natural Gas To Ductless Heat Pump demonstrate a heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually (not just heating months). In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.

3.3.2.3 Verification Surveys

The Evaluators randomly selected a subset of participant customers to survey for simple verification of installed measure described in Section 2.2.2.2. The Evaluators included questions such as:

- What type of thermostat did this thermostat replace?
- Is your home heating with electricity, natural gas, or another fuel?
- Was the previous equipment functional?
- Is the newly installed equipment still properly functioning?

The responses to this verification survey were used to calculate ISRs for the measures offered in the HVAC Program. In addition, the Evaluators asked participants how the COVID19 pandemic stay-at-home orders have affected their household’s energy consumption. The responses to these additional questions can be found in Appendix A.

Table 3-14 displays the ISRs for each of the HVAC measures for Idaho and Washington natural gas territory combined. The ISRs resulted in 5.16% precision at the 90% confidence interval for the program.

Table 3-14: HVAC Verification Survey ISR Results

Measure	Number of Rebates*	Number of Survey Completes	Precision at 90% Confidence	In-Service Rate
G Natural Gas Boiler	40	4	5.16%	100.00%
G Natural Gas Furnace	4,531	166		98.86%
G Natural Gas Wall Heater	1	1		100.00%
G Smart Thermostat DIY with Natural Gas Heat	765	20		100.00%
G Smart Thermostat Paid Install with Natural Gas Heat	2,064	55		94.12%

*This count includes rebates from Washington and Idaho

Survey respondents described equipment to be currently functioning, leading to a 100% ISR for all measures except the G Natural Gas Furnace and G Smart Thermostat Paid Install with Natural Gas Heat. Although less than 100%, the ISR for the referenced two measures measure still exceeded ISRs of 90%. The Evaluators applied the ISRs listed in Table 3-14 to each rebate to quantify verified savings for each measure.

3.3.2.4 Impact Analysis

This section summarizes the verified savings results for the HVAC Program. The Evaluators conducted a billing analysis for measures where participation allowed. The Evaluators calculated verified savings for the remaining measures using active values from the Avista TRM workbook. These values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.2.5 Billing Analysis

The results of the billing analysis for the HVAC program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2.

Table 3-15 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

Table 3-15: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations*	Sufficient Participation for Billing Analysis
G Natural Gas Boiler	✓	38	
G Natural Gas Furnace	✓	4,531	
G Natural Gas Wall Heater	✓	0	
G Smart Thermostat DIY with Natural Gas Heat	✓	1,053	✓
G Smart Thermostat Paid Install with Natural Gas Heat	✓	362	✓

*This count includes rebates from Washington and Idaho

The Evaluators were provided a considerable pool of control customers to draw upon. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. The final number of customers in each the treatment and control group are listed in Table 3-16.

The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure and the Evaluators conducted a linear regression using the matched participant and nonparticipant monthly billing data.

Table 3-16 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the HVAC Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for the DIY smart thermostat measure. However, the paid install smart thermostat displayed negative savings that were not statistically significant.

Table 3-16: Measure Savings, HVAC Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (Therms)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared	Model
Smart Thermostat DIY with Natural Gas Heat	373	1,865	14.79	6.29	23.30	57.5%	0.91	Model 2: PPR
Smart Thermostat Paid Install with Natural Gas Heat	148	740	-18.74	-37.67	0.19	101.0%	0.88	Model 2: PPR

Because the results from these two billing analyses for smart thermostats are contradicting and/or inconclusive, the Evaluators elected to utilize Avista TRM values to estimate verified savings for these measures. The findings from the PY2020 billing analyses for these measures may have been impacted by the COVID19 pandemic. Further details of the billing analysis for the variable speed motor measure can be found Appendix A.

Retrofit Isolation Results

A retrofit isolation approach was used to estimate savings for Natural Gas Furnaces. Although this measure was initially considered as part of the scope of the billing data regression analysis, the Evaluators could not isolate statistically significant savings via a regression approach. Because the retrofit isolation approach relies on extracting baseload usage estimates from June, July, and August billing data, the sample was restricted to customers who had a full 12 months of post-installation data prior to February of 2020. This was to prevent a potential comparison of higher baseload to lower seasonal load just as an artifact of increased occupation due to COVID-19 restrictions.

Table 3-17 presents the total number of customers and the number of sampled customers.

Table 3-17: Customer Counts for Natural Gas Furnaces, HVAC Program

Measure	Data Restriction	# of Treatment Customers
G Natural Gas Furnace	Starting Count	2,958
	12 Months of Post Data prior to 2020-02-01	125

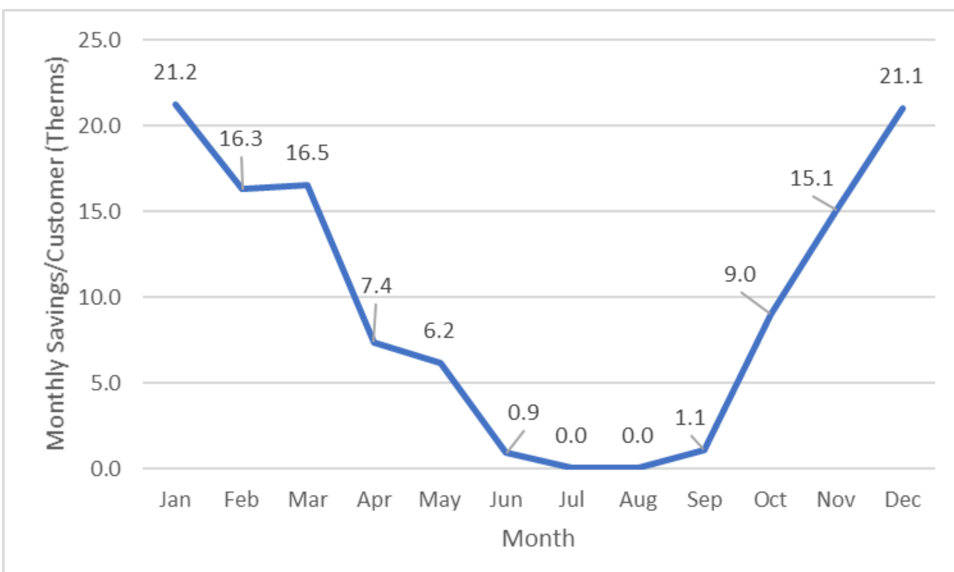
Table 3-18 provides annual savings for Natural Gas Furnaces. The Evaluators estimate the G Natural Gas Furnace measure to display an annual savings of 114.79 Therms. This verified value was applied to all associated rebates in the Washington gas service territory.

Table 3-18: Measure Savings for Natural Gas Furnaces, HVAC Program

Measure	# of Treatment Customers	Annual Savings/Customer (Therms)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)
G Natural Gas Furnace	125	114.79	112.96	116.62	1.6%

Figure 3-3 provides monthly weather-normalized savings for natural gas furnaces.

Figure 3-3 Natural Gas Furnaces Monthly Savings, HVAC Program



The savings for the natural gas furnace range between 15 and 22 Therms per month in the winter months, with summer months displaying no Therms savings.

3.3.2.6 Verified Savings

The HVAC Program in total displays a realization rate of 121.48% with 330,928.95 Therms verified natural gas savings in the Washington service territory, as displayed in Table 3-12. The realization rate for the natural gas savings in the HVAC Program deviate from 100% due to the differences between the applied Avista TRM prescriptive savings value and the updated Avista TRM or updated RTF UES value.

The Evaluators applied the results of the retrofit isolation results to each of the G Natural Gas Furnace measures. The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net program adjusted savings for measures not evaluated through billing analysis. In addition, the Evaluators reviewed and applied the current Avista TRM values for the natural gas measures along with verified tracking data to estimate net program verified savings for this measure.

The smart thermostat measures' realization rates are low because an outdated Avista TRM value was applied to the project data to calculate expected savings. The Evaluators assigned the appropriate, active Avista TRM value for each smart thermostat measure.

The G Natural Gas Furnace measure has a high realization rate because the billing analysis resulted in a savings value that was 126% of the value previously used in the Avista TRM. The Evaluators recommend adjusting the Avista TRM to reflect the observed savings value from this impact evaluation.

3.3.3 Shell Program

The Shell Program provides incentives to customers for improving the integrity of the home's envelope with upgrades to windows and storm windows. Rebates are issued after the measure has been installed for insulation and window measures. Participating homes must have natural gas or natural gas heating and itemized invoices including measure details such as insulation levels, window values, and square footage. In order to be eligible for incentive, the single-family households, including fourplex or less, must demonstrate an annual electricity usage of at least 8,000 kWh or an annual gas usage of at least 340 Therms. Multifamily homes have no usage requirement. This program includes free manufactured home duct sealing implemented by UCONS. Table 3-7 summarizes the measures offered under this program.

Table 3-19: Shell Program Measures

Measure	Description	Impact Analysis Methodology
G Attic Insulation With Natural Gas Heat	Attic insulation for homes heated with natural gas	Billing analysis with counterfactual group
G Floor Insulation With Natural Gas Heat	Floor insulation for homes heated with natural gas	Avista TRM
G Storm Windows with Natural Gas Heat	High-efficiency storm window replacement for homes heated with natural gas	Avista TRM
G Wall Insulation With Natural Gas Heat	Wall insulation for homes heated with natural gas	Avista TRM
G Window Replc With Natural Gas Heat	High-efficiency window replacement for homes heated with natural gas	Billing analysis with counterfactual group

The following table summarizes the adjusted and verified natural gas savings for the Shell Program impact evaluation.

Table 3-20: Shell Program Verified Natural Gas Savings

Measure	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
G Attic Insulation With Natural Gas Heat	215	37,588.05	37,588.05	13,665.40	36.36%
G Floor Insulation With Natural Gas Heat	18	1,057.32	1,057.32	1,057.32	100.00%
G Storm Windows with Natural Gas Heat	5	223.98	38.10	274.36	122.49%
G Wall Insulation With Natural Gas Heat	45	2,786.49	2,368.92	2,786.49	100.00%
G Window Replc With Natural Gas Heat	769	31,208.00	29,882.49	30,090.97	96.42%
Total	**1,052**	**72,863.84**	**70,934.88**	**47,874.54**	**65.70%**

The Shell Program displayed verified savings of 47,874.54 Therms with a realization rate of 65.70% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-21: Shell Program Costs

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
G Attic Insulation With Natural Gas Heat	$187,766.51	$7,749.09	$195,515.60
G Floor Insulation With Natural Gas Heat	$13,216.50	$599.56	$13,816.06
G Storm Windows with Natural Gas Heat	$1,905.00	$59.14	$1,964.14
G Wall Insulation With Natural Gas Heat	$29,855.25	$1,580.10	$31,435.35
G Window Replc With Natural Gas Heat	$352,704.00	$17,063.36	$369,767.36

Total	**$585,447.26**	**$27,051.25**	**$612,498.51**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Shell Program in the section below.

3.3.3.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Shell Program.

3.3.3.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Shell Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators reviewed each measure number of units, square footage, and insulation where available. The Evaluators found one instance in which square footage quantity in the rebate application does not match the values presented in the project data attic insulation. Two rebates showed R-values that did not align with TRM or RTF values related to the measure (R38 and R64). The Evaluators recommend collecting information in a standardized manner. The Evaluators assumed insulation levels closest to those presented for those two instances.

The Evaluators found the square footage for the floor insulation, wall insulation, and storm windows to be equivalent between the project data and the rebate applications, where available. However, the Evaluators found one floor insulation rebate in which the new R-value did not match TRM or RTF values (R21). The Evaluators recommend collecting this information in a standardized manner in addition to the R-values, detailed above.

The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows.

The Evaluators also recommend collecting information on single-family/multi-family/manufactured in the web rebate form. This allows the Evaluators to categorize home type during the impact evaluation methodologies. The mail-in rebates collect this information; however, it does not seem to be required to complete the rebate and therefore many rebates are missing this information.

The Evaluators note several instances in which the web-based rebate data indicates the household has electric heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend verifying the household space heating type prior to completing the rebate.

The Evaluators also note one instance in which the R-values for a window was assigned incorrectly. The Evaluators reassigned this window from an insulation of R0 to R49 to an insulation of R11 to R49.

The Evaluators cross-referenced the billing data to verify if customers demonstrate a heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually (not just heating months). In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.

The Evaluators found no duplicate rebates in the project data and therefore did not remove any rebates from verified savings.

3.3.3.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Shell Program. Weatherization measures historically have high verification rates.

3.3.3.4 Impact Analysis

This section summarizes the verified savings results for the Shell Program. The Evaluators calculated verified savings for the natural gas measures using the active Avista TRM values. The Evaluators calculated adjusted savings for each measure using the active Avista TRM values and verified tracking data. These values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.3.5 Billing Analysis

The results of the billing analysis for the Shell program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2.

Table 3-15 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

Table 3-22: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
G Attic Insulation With Natural Gas Heat	✓	291	✓
G Floor Insulation With Natural Gas Heat	✓	8	
G Storm Windows with Natural Gas Heat	✓	9	
G Wall Insulation With Natural Gas Heat	✓	24	
G Window Replc With Natural Gas Heat	✓	1,309	✓

The Evaluators were provided a considerable pool of control customers to draw upon. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. The final number of customers in each the treatment and control group are listed in Table 3-16.

The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure and the Evaluators conducted a linear regression using the matched participant and nonparticipant monthly billing data.

Table 3-16 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the Shell Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for all measures and the adjusted R-squared shows the model provided an excellent fit for the data (adjusted R-squared > 0.90).

Table 3-23: Measure Savings, HVAC Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (Therms)	90% Lower CI	90% Upper CI	Adjusted R-Squared	Model
G Attic Insulation With Natural Gas Heat	97	485	63.56	45.47	81.66	0.93	Model 2: PPR
G Window Replc With Natural Gas Heat	555	2,772	39.13	32.65	45.61	0.92	Model 2: PPR

The Evaluators found the G Attic Insulation With Natural Gas Heat measure to display a statistically significant verified savings value of 63.56 Therms per year. In addition, the Evaluators found statistically significant savings of 39.13 Therms per year for the G Window Replacement with Natural Gas Heat measure. The Evaluators used these savings estimates towards calculating verified savings for the program. Further details of the billing analysis for the variable speed motor measure can be found Appendix A.

3.3.3.6 Verified Savings

The Shell Program in total displays a realization rate of 65.70% with a verified natural gas savings of 47,874.54 Therms in the Washington service territory, as displayed in Table 3-20. The realization rate for the natural gas savings in the Shell Program deviate from 100% due to the differences between the billing analysis results and the Avista TRM prescriptive savings values as well as outdated Avista TRM values being applied in the expected savings calculations.

The G Attic Insulation With Natural Gas Heat measure totals 52% of the expected savings for the program and has a realization rate of 36%. The Avista TRM lists the savings for this measure at 0.15 therms per square foot of attic insulation, sourced from the Applied Energy Group (AEG) TRM. However, the Evaluators conducted a billing analysis and found the per square foot savings for this measure at 0.052 therms, approximately one-third the value assigned in the TRM. The Evaluators recommend updating the value for this measure in the TRM to reflect observed savings in the Avista Washington gas service territory.

The Evaluators did not conduct a verification survey for the Shell Program and therefore did not adjust verified savings with an ISR.

3.3.4 ENERGY STAR® Homes Program

The ENERGY STAR® Homes Program provides rebates for homes within Avista's service territory that attain an ENERGY STAR® certification. This program incentivizes for ENERGY STAR® Eco-rated homes. Table 3-7 summarizes the measures offered under this program.

Table 3-24: ENERGY STAR® Homes Program Measures

Measure	Description	Impact Analysis Methodology
G ENERGY STAR Home - Manufactured, Gas & Electric	ENERGY STAR-rated manufactured home with gas and electric	RTF UES
E ENERGY STAR Home - Manufactured, Furnace	ENERGY STAR-rated manufactured home with natural gas Furnace	RTF UES
E ENERGY STAR Home - Manufactured, Gas & Electric	ENERGY STAR-rated manufactured home with gas and electric	RTF UES

The following table summarizes the verified natural gas savings for the ENERGY STAR® Homes Program impact evaluation.

Table 3-25: ENERGY STAR® Homes Program Verified Natural Gas Savings

Measure	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
G ENERGY STAR Home - Manufactured, Gas & Natural gas	3*	201.00	0.00	535.92	266.63%
E ENERGY STAR Home - Manufactured, Furnace	30**	0.00	0.00	0.00	-
E ENERGY STAR Home - Manufactured, Gas & Natural gas	1	67.00	0.00	133.98	199.97%
Total	**34**	**268.00**	**0.00**	**669.90**	**249.96%**

*Verified number of rebates for this measure is 4. One rebate was recategorized from a Washington Gas to a Washington Natural gas measure due to heating type found in project documentation.

**Verified number of rebates for this measure is 29 due to the reassigned rebate.

The ENERGY STAR® Homes Program displayed verified savings of 669.90 Therms with a realization rate of 249.96% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 3-26: ENERGY STAR® Homes Program Costs

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
G ENERGY STAR Home - Manufactured, Gas & Electric	$2,600.00	$154.49	$2,754.49
E ENERGY STAR Home - Manufactured, Furnace*	$0.00	$0.00	$0.00
E ENERGY STAR Home - Manufactured, Gas & Natural gas*	$0.00	$0.00	$0.00
Total	**$2,600.00**	**$154.49**	**$2,754.49**

*Costs associated with this measure are claimed in the Washington Electric Impact Evaluation Report

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the ENERGY STAR® Homes Program in the section below.

3.3.4.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the ENERGY STAR® Homes Program.

3.3.4.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the ENERGY STAR® Homes Program. The Evaluators selected a random subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators found one duplicate rebate in the project data. The Evaluators confirmed this instance with Avista and removed the rebate from verified savings.

3.3.4.3 Verification Surveys

The Evaluators did not conduct verification surveys for the ENERGY STAR® Homes Program.

3.3.4.4 Impact Analysis

This section summarizes the verified savings results for the ENERGY STAR® Homes Program. The Evaluators calculated verified savings for the natural gas measures using the most recent RTF workbook for the ENERGY STAR® Homes measures. These RTF UES values were applied to a random sample of participants, with verification of project documents such as rebate applications to verify installation, quantity, and efficiency of the equipment.

3.3.4.5 Verified Savings

The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate adjusted program savings for each of the ENERGY STAR® Homes measures. In addition, the Evaluators reviewed and applied the current RTF UES values for each measure along with verified tracking data to estimate net program savings.

The ENERGY STAR® Homes Program in total displays a realization rate of 249.96% with 669.90 Therms verified natural gas energy savings in the Washington service territory, as displayed in Table 3-25. The realization rate for the natural gas savings in the ENERGY STAR® Homes Program deviate from 100% due to the categorical differences between the applied Avista TRM prescriptive savings value and the more detailed RTF UES categories.

The Avista TRM applies RTF savings values from heating zone 2 to all rebates. In addition, the Avista TRM does not take into account cooling zone, which also affects savings assigned in the RTF. The Evaluators applied the appropriate RTF savings values for the heating zone and cooling zone for each rebated household. This change led to low realization rates for some rebates and high realization rates for others within the same Avista E ENERGY STAR® Home – Manufactured Furnace measure category. The overall effect this change had on the measure is an upward adjustment on natural gas savings for the program.

The realization for the E ENERGY STAR® Home – Manufactured, Furnace measure displayed no natural gas savings, as these homes are all-electric.

The realization for the E ENERGY STAR® Home – Manufactured, Gas & Natural gas measure is high because the expected savings employed an additive methodology between a gas-heated home and an natural gas-heated home for the natural gas savings. However, the Evaluators reviewed the RTF and determined manufactured home natural gas savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. Therefore, the Evaluators assigned natural gas savings from the RTF associated with a fully natural gas-heated home at 133.98 Therms saved per year.

The Evaluators did not conduct a verification survey for the ENERGY STAR® Homes Program and therefore did not adjust verified savings with an ISR.

3.3.5 Simple Steps, Smart Savings Program

The Simple Steps, Smart Savings Program is a midstream lighting and appliance program which encourages consumer to purchase and install high-quality LEDs, light fixtures, energy-efficient showerheads, and energy-efficient clothes washers by marking down retail prices in the Washington service territory. The Simple Steps, Smart Savings Program was implemented in Washington during the month of January 2020 and therefore reflect a small percentage of savings for the residential natural gas savings.

This section summarizes the impact results of the evaluation results for the Simple Steps, Smart Savings Program. Table 3-27 summarizes the measures offered under this program.

Table 3-27: Simple Steps, Smart Savings Program Measures

Measure	Description	Impact Analysis Methodology
Lighting	General purpose and specialty bulbs and fixtures	RTF UES
Showerhead	2.0 GPM showerheads	RTF UES
Appliance	High efficiency clothes washers	RTF UES

The following table summarizes the verified natural gas savings for the Simple Steps, Smart Savings Program impact evaluation.

Table 3-28: Simple Steps, Smart Savings Program Verified Natural Gas Savings

Measure	PY2020 Units	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
Lighting[9]	10,628	0.00	0.00	0.00	-
Showerhead	8	2.13	0.00	1.64	77.25%
Appliances	22	0.00	0.00	45.32	-
Total	**10,658**	**2.13**	**0.00**	**46.96**	**2,209.44%**

[9] The Evaluators estimated that the lighting measures in the Simple Steps, Smart Savings Program displayed a verified Therms penalty of 900.21 Therms. This amount does not contribute to the gas savings in the Washington Gas Impact Evaluation Report.

The Simple Steps, Smart Savings Program displayed verified savings of 46.96 Therms with a realization rate of 2,209.44% against the expected savings for the program. The costs associated with this program are entirely claimed in the Washington Electric Impact Evaluation Report.

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for Simple Steps, Smart Savings Program in the section below.

3.3.5.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Simple Steps, Smart Savings Program.

3.3.5.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for Simple Steps, Smart Savings Program. The Evaluators requested the monthly invoices for each month in PY2020 for the Simple Steps, Smart Savings Program from Avista.

The Evaluators collected and reviewed product-level quantity and pricing on each invoice. The Evaluators found no discrepancies between the invoiced amounts and quantities and the project data provided by Avista.

3.3.5.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Simple Steps, Smart Savings Program. Ninety-eight percent of expected Therms savings were from retail markdown LEDs and these were discontinued in Washington as of January 2020.

3.3.5.4 Impact Analysis

This section summarizes the verified savings results for the Simple Steps, Smart Savings Program. The Evaluators calculated verified savings for this program's measures using the RTF UES values in effect before October 1, 2019.

The Evaluators note that the RTF version used to evaluate this program represents the residential lighting workbook active at the time the Bonneville Power Administration (BPA) planning for this program was established (October 1, 2019).

3.3.5.5 Verified Savings

The Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net adjusted program savings for those measures. Final verified savings were estimated using the RTF UES values associated with each measure. Simple Steps, Smart Savings Program displayed 2,209.44% realization with 46.96 Therms saved, as displayed in Table 3-28.

The Simple Steps, Smart Savings Program did not have any Therms savings expectations for the appliance measures because the Avista TRM does not include a Therms savings for the appliances measures provided in the program. However, the RTF UES includes a Therms savings, which the Evaluators applied to the project data. Therefore, the program displays savings with a large realization rate.

3.4 Conclusions and Recommendations

The Evaluators provide the following conclusions and recommendations for Avista's Residential Portfolio program implementation.

3.4.1 Conclusions

The Evaluators provide the following conclusions regarding Avista's Residential natural gas programs:

- The Evaluators found the Residential portfolio to demonstrate a total of 408,149.18 Therms with a realization rate of 108.78%. The Evaluators also conducted a cost-benefit analysis in order to estimate the Residential portfolio's cost-effectiveness. The resulting TRC value for this sector is 1.01 while the UCT value is 2.36. Further details on cost-effectiveness methodology can be found in Appendix C.
- The Residential Portfolio impact evaluation resulted in a realization rate of 108.78% due to slight differences between the applied Avista TRM values and the most active Avista TRM value for each measure in addition to the difference in savings values between the results from billing analyses and the Avista TRM.
- The HVAC Program, which contributes 73% of the expected savings, resulted in a realization rate of 121% whereas each of the other programs resulted in a combined 74% realization rate. The Shell Program contributed to a 34% increase in the overall residential sector, which displayed a realization rate of 108.78%.
- The Evaluators conducted verification surveys via web survey and phone calls to collect information from customers who participated in the Water Heat and HVAC Programs. A total of 261 unique customers were surveyed between February and March 2021. The Evaluators collected information including the functionality of the efficient equipment, the functionality of the replaced equipment, and information on how the COVID19 stay-at-home orders have affected the household energy usage. The Evaluators calculated in-service rates for the measures within these two programs in order to apply findings to the verified savings results for each program.
- The realization rate for the natural gas savings in the Water Heat Program was 96.56%. This program deviated from 100% realization because one G Tankless Gas Water Heat measure rebate's documentation displayed documentation for a furnace replacement rather than a water heater. Therefore, the Evaluators removed this rebate from savings, lowering the realization rate for the program.
- The Evaluators explored a billing analysis for the natural gas water heater measures within the Water Heat Program. However, the G 50 Gallon Natural gas Water Heater lacked sufficient participation to estimate savings and the G Tankless Gas Water Heater measure resulted in savings that were not statistically significant. Therefore, the Evaluators elected to use Avista TRM values to estimate verified savings. The Evaluators will explore further billing analyses for these measures during the next program year.
- The HVAC Program in total displays a realization rate of 121.48% with 330,928.95 Therms verified natural gas savings in the Washington service territory. The realization rate for the natural gas savings in the HVAC Program deviate from 100% due to the differences between the

applied Avista TRM prescriptive savings value and the updated Avista TRM or updated RTF UES value. The smart thermostat measures' realization rates are low because an outdated Avista TRM value was applied to the project data to calculate expected savings. The furnace measure has a high realization rate because the billing analysis resulted in a savings value that was 126% of the value previously used in the Avista TRM.

- The Evaluators attempted to estimate smart thermostat measure savings values for the HVAC Program. However, because the results from the billing analyses for smart thermostats were contradicting and/or inconclusive, the Evaluators elected to utilize Avista TRM values to estimate verified savings for these measures. The findings from the PY2020 billing analyses for these measures may have been impacted by the COVID19 pandemic. The Evaluators will explore additional billing analyses for these measures during program year 2021.
- The Shell Program displayed verified savings of 47,874.54 Therms with a realization rate of 65.70% against the expected savings for the program. The realization rate for the natural gas savings in the Shell Program deviate from 100% due to the differences between the billing analysis results and the Avista TRM prescriptive savings values as well as outdated Avista TRM values being applied in the expected savings calculations.
- For the Shell Program, the Evaluators conducted a billing analysis for two measures that had sufficient participation. The Evaluators found the G Attic Insulation With Natural Gas Heat measure to display a statistically significant verified savings value of 63.56 Therms per year. In addition, the Evaluators found statistically significant savings of 39.13 Therms per year for the G Window Replacement with Natural Gas Heat measure. The Evaluators used these savings estimates towards calculating verified savings for the program. The G Attic Insulation With Natural Gas Heat measure totals 52% of the expected savings for the program and has a realization rate of 36%. The Avista TRM lists the savings for this measure at 0.15 therms per square foot of attic insulation, sourced from the Applied Energy Group (AEG) TRM. However, the Evaluators conducted a billing analysis and found the per square foot savings for this measure at 0.052 Therms, approximately one-third the value assigned in the TRM. The Evaluators recommend updating the value for this measure in the TRM to reflect observed savings in the Avista Washington gas service territory.
- Final verified savings for the Simple Steps, Smart Savings Program were estimated using the RTF UES values associated with each measure. Simple Steps, Smart Savings Program displayed -2,209.44% realization with 46.96 Therms saved. This program did not have any Therms savings expectations because the Avista TRM does not include a Therms savings for the measures provided in the program. However, the RTF UES includes Therms savings for the appliances measures, which the Evaluators applied to the project data. Therefore, the program displays savings with a large realization rate.

3.4.2 Recommendations

The Evaluators offer the following recommendations regarding Avista's Residential natural gas programs:

- The Evaluators recommend Avista work to improve methods for collecting mail-in rebate application information to reconcile the CC&B database. The values found in the project documentation should accurately reflect the values represented in the CC&B database.

- A number of rebates were not accompanied with AHRI certification. In order to acquire accurate equipment efficiencies and tank sizes, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the model number found in the AHRI certification.
- The Evaluators note that some of the model numbers for the rebated equipment were incomplete and the Evaluators were unable to identify a single AHRI certification that matched the description in the rebate application. In order to acquire accurate equipment efficiencies, AHRI certifications are recommended to be required and submitted with the rebate application, with an invoice that matches the manufacturer and model number found in the AHRI certification.
- The Evaluators cross-referenced the billing data to verify if customers demonstrated the required heating season electricity usage of 8,000 kWh and natural gas usage of less than 340 Therms, as defined in the program requirements. The Evaluators found many customers used less than 8,000 kWh or 340 Therms annually. In addition, some customers had insufficient pre-period data to determine annual usage. The Evaluators recommend Avista verify if customers meet the requirements prior to completing the rebate.
- For the Shell Program, the Evaluators conducted a billing analysis for two measures that had sufficient participation. The Evaluators found the G Attic Insulation With Natural Gas Heat measure to display a statistically significant verified savings value of 63.56 Therms per year. In addition, the Evaluators found statistically significant savings of 39.13 Therms per year for the G Window Replacement with Natural Gas Heat measure.
- The Avista TRM lists the savings for the G Attic Insulation With Natural Gas Heat measure in the Shell Program at 0.15 therms per square foot of attic insulation, sourced from the Applied Energy Group (AEG) TRM. However, the Evaluators conducted a billing analysis and found the per square foot savings for this measure at 0.052 Therms, approximately one-third the value assigned in the TRM. The Evaluators recommend updating the value for this measure in the TRM to reflect observed savings in the Avista Washington gas service territory.
- For the Shell Program, the Evaluators found rebates in which the R-values did not align with TRM or RTF values (R38 and R64). The Evaluators recommend collecting information in a standardized manner.
- The Evaluators recommend collecting information on single/double pane windows of the baseline windows and class of the efficient windows in order to correctly assign RTF UES values.
- The Evaluators note several instances in which the web-based rebate data indicates the household has electric space heating, but all other sources (project data and document verification) indicate natural gas space heating, and vice versa. The Evaluators recommend updating data collection standards in order for all sources of information to reflect the same values as the project documentation.
- The Evaluators note that the realization for the E ENERGY STAR® Home – Manufactured, Gas & Electric measure is low because the Avista TRM savings was employed using an additive methodology between a gas-heated home and an electric-heated home for the electric savings. However, the Evaluators reviewed the RTF and determined manufactured home electric savings for a fully natural gas heated home would be closer to the savings a gas heated home with electricity would save. The Evaluators recommend adjusting Avista TRM natural gas savings for

this measure to reflect the RTF values associated with a fully natural gas-heated home at 133.98 Therms saved per year.

- The natural gas furnace measure in the HVAC has a high realization rate because the billing analysis resulted in a savings value that was 126% of the value previously used in the Avista TRM. The Evaluators recommend adjusting the Avista TRM to reflect the observed savings value from this impact evaluation.
- The Evaluators recommend adjusting expected savings calculations in the Simple Steps, Smart Savings Program to include Therms penalties and savings for the measures offered, in order to more accurately reflect the approved RTF savings values.

4. Low-Income Impact Evaluation Results

The Low-Income Program delivers energy efficiency measures to low-income residential customers in its Washington service territory with a partnership with five network Community Action Agencies ("Agencies") and one tribal weatherization organization. The Agencies qualify income to prioritize and treat households based on several characteristics. In-house or contract crews install approved program measures. In addition, the Agencies have access to other monetary resources which allow them to weatherize a home or install additional energy efficiency measures.

The Evaluators completed an impact evaluation on Avista's Low-Income portfolio to verify program-level and measure-level energy savings for PY2020. The following sections summarize findings for each natural gas impact evaluation in the Low-Income Portfolio in the Washington service territory. The Evaluators used data collected and reported in the tracking database, online application forms, Avista TRM, and RTF values to evaluate verified savings. This approach provided the strongest estimate of achieved savings practical for each program, given its delivery method, magnitude of savings, number of participants, and availability of data. Table 4-1 summarizes the Low-Income verified impact savings by program. Table 4-2 summarizes the Low-Income portfolio cost-effectiveness results.

Table 4-1: Low-Income Verified Impact Savings by Program

Program	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
Low-Income	12,602.93	12,990.11	14,449.92	114.66%
CEEP	0.00	0.00	0.00	-
Total	**12,602.93**	**12,990.11**	**14,449.92**	**114.66%**

Table 4-2: Low-Income Portfolio Cost-Effectiveness Summary

Sector	TRC			UCT		
	Benefits	Costs	B/C Ratio	Benefits	Costs	B/C Ratio
Low Income	$456,908	$1,336,787	0.34	$324,822	$1,318,017	0.25

In PY2020, Avista completed and provided incentives for low-income gas measures in Washington and achieved total natural gas savings of 14,449.92 Therms. The Low-Income Program exceeded savings expectations based on reported savings with an achieved realization rate of 114.66%. The Evaluators estimated the TRC value for the Low-Income portfolio is 0.34 while the UCT value is 0.25. Further details of the impact evaluation results by program are provided in the sections following.

4.1 Program-Level Impact Evaluation Results

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Low-Income sector in the section below.

4.1.1 Low-Income Program

The Low-Income Program delivers energy efficiency measures to low-income residential customers in its Washington service territory with a partnership with five network Community Action Agencies ("Agencies") and one tribal weatherization organization. The Agencies qualify income to prioritize and treat households based on several characteristics. In-house or contract crews install approved program measures. In addition, the Agencies have access to other monetary resources which allow them to weatherize a home or install additional energy efficiency measures.

Avista provides CAP agencies with the following approved measure list, which are reimbursed in full by Avista. Avista also provides a rebate list of additional energy saving measures the CAP agencies are able to utilize which are partially reimbursed. Weatherization measures under this program may also be funded by CEEP. The following table summarizes the measures offered under this program.

Table 4-3 summarizes the measures offered under this program.

Table 4-3: Low-Income Program Measures

Measure	Impact Analysis Methodology
Air Infiltration	Avista TRM
Air source heat pump	
Attic insulation	
Duct insulation	
Duct sealing	
Natural gas to air source heat pump	
Natural gas to ductless heat pump	
ENERGY STAR® door	
ENERGY STAR® refrigerator	
ENERGY STAR® window	
Floor insulation	
Heat pump water heater	
LED lighting	
Wall insulation	
High efficiency furnace	

Measure	Impact Analysis Methodology
High efficiency tankless natural gas water heater	
Natural gas boiler	

Table 4-4 summarizes the verified natural gas savings for the Low-Income Program impact evaluation.

Table 4-4: Low-Income Program Verified Natural Gas Savings

Measure	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
G Air Infiltration	39	414.46	476.97	476.97	115.08%
G Duct Sealing	4	39.00	80.68	80.68	206.87%
G Energy Star Doors	62	637.62	695.52	927.36	145.44%
G Energy Star Windows	88	1,501.27	1,493.56	1,493.73	99.50%
G HE Furnace	42	2,476.16	2,614.08	2,614.08	105.57%
G HE WH 50G	3	21.15	21.15	21.15	100.02%
G INS - Attic	58	4,437.99	4,437.99	5,200.56	117.18%
G INS - Duct	5	26.20	26.08	51.48	196.47%
G INS - Floor	18	992.98	992.98	1,326.10	133.55%
G INS - Wall	29	1,486.10	1,486.10	1,592.81	107.18%
Health and Safety	43	0.00	0.00	0.00	-
G Tankless Water Heater	10	570.00	665.00	665.00	116.67%
Total	**401**	**12,602.93**	**12,990.11**	**14,449.92**	**114.66%**

The Low-Income Program displayed verified savings of 14,449.92 Therms with a realization rate of 114.66% against the expected savings for the program. The following table summarizes the incentive and non-incentive costs associated with the program.

Table 4-5: Low-Income Program Costs

Measure	Incentive Costs	Non-Incentive Costs	Total Costs
G Air Infiltration	$27,573.29	$2,040.51	$29,613.80
G Duct Sealing	$3,029.90	$488.35	$3,518.25
G Energy Star Doors	$93,272.28	$12,808.11	$106,080.39
G Energy Star Windows	$299,058.12	$23,834.23	$322,892.35
G HE Furnace	$230,460.18	$15,822.83	$246,283.01
G HE WH 50G	$11,142.94	$76.17	$11,219.11
G INS - Attic	$126,484.54	$82,808.69	$209,293.23
G INS - Duct	$11,587.92	$819.64	$12,407.56
G INS - Floor	$65,580.66	$21,115.47	$86,696.13
G INS - Wall	$66,967.49	$25,362.33	$92,329.82
Health and Safety	$99,510.00	$52,679.21	$152,189.21
G Tankless Water Heater	$41,469.15	$4,025.20	$45,494.35
Total	**$1,076,136.47**	**$241,880.74**	**$1,318,017.21**

The Evaluators summarize the program-specific and measure-specific impact analysis activities, results, conclusions, and recommendations for the Low-Income Program in the section below.

4.1.1.1 Database Review & Verification

The following sections describe the Evaluator's database review and document verification findings for the Low-Income Program.

4.1.1.2 Database Review & Document Verification

Before conducting the impact analysis, the Evaluators conducted a database review for the Low-Income Program. The Evaluators selected a subset of rebate applications to cross-verify tracking data inputs, summarized in Section 2.2.2.1.

The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. The Evaluators, updated quantity based on project documentation.

The Evaluators note that some project data account numbers do not match the account numbers referenced in the project documentation. In addition, the Evaluators found conflicting information in the project documentation on a number of homes' heating type. The Evaluators recommend confirming and documenting all rebate applications for completed and accurate heating type details.

The Evaluators also note that project documentation contains additional equipment included in some invoices. These additional equipment contribute to the total project cost. The Evaluators identified and removed three duplicated rebates. These rebates seem to have been duplicated due to rebate administration corrections.

The Evaluators also utilized the delivered billing data to check the household-level annual usage. The Low-Income Program requires a 20% annual energy usage cap on claimed energy savings. The Evaluators found some discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

4.1.1.3 Verification Surveys

The Evaluators did not conduct verification surveys for the Low-Income Program.

4.1.1.4 Impact Analysis

This section summarizes the verified savings results for the Low-Income Program. The Evaluators calculated verified savings for Low-Income Program measures using the Avista TRM. However, a whole building billing analysis was completed to supplement the findings from the desk review.

4.1.1.5 Billing Analysis

The results of the billing analysis for the Low-Income Program are provided below. Table 4-6 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolated each unique measure. In doing so, the Evaluators also isolate the measure effects using the customer's consumption billing data. However, participation for the Low-Income program resulted in a small number of customers with isolated measures, as displayed in Table 4-6 and therefore the Evaluators were unable to estimate measure-level savings through billing analysis.

Table 4-6: Measures Considered for Billing Analysis, Low-Income Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis*
G Air Infiltration	✓	0	
G Duct Sealing	✓	0	
G Energy Star Doors	✓	0	
G Energy Star Windows	✓	6	
G HE Furnace	✓	27	
G HE WH 50G	✓	0	
G INS – Attic	✓	0	
G INS – Duct	✓	0	
G INS – Floor	✓	0	
G INS – Wall	✓	0	
Health And Safety	✓	0	
G Tankless Water Heater	✓	2	

*No measures had sufficient participation of isolated measures

The Evaluators instead conducted a whole-home billing analysis for all the natural gas measures combined in order to estimate savings for the average household participating in the program, across all measures. The Evaluators successfully created a matched cohort for the natural gas measure households. Customers were matched on zip code (exact match) and their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household. The Evaluators were provided a considerable pool of control customers to draw upon. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers.

Table 4-7 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the Low-Income Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for all measures and the adjusted R-squared shows the model provided an excellent fit for the data (adjusted R-squared > 0.90).

Table 4-7: Measure Savings, Low-Income Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (Therms)	90% Lower CI	90% Upper CI	Adjusted R-Squared	Model
All Gas Measures (Therms)	79	369	54.53	26.33	83.1	0.91	Model 2: PPR

The Evaluators applied these regression savings estimates to the program as a whole, by the number of unique households in the program and found a realization rate of 139.64% for all natural gas measures in the program. Further details of the billing analysis can be found in Appendix A.

4.1.1.6 Verified Savings

Due to insufficient participation to conduct measure-level billing analyses, the Evaluators reviewed the Avista TRM values along with verified tracking data to estimate net program savings for those measures. Adjusted savings were estimated using the Avista TRM. The Low-Income Program in total displays a realization rate of 114.66% with 14,449.92 Therms verified natural gas savings in the Washington service territory, as displayed in Table 4-4. The billing analysis supports this estimate, with the billing analysis estimating a 139.64% realization. Due to requirements for measure-level verified savings for cost-effectiveness testing, the Evaluators designated the adjusted savings as final.

The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation. The Evaluators updated the quantity based on new project data.

4.1.2 Community Energy Efficiency Program (CEEP)

The Community Energy Efficiency Program was created from the Washington State Legislature in 2009 to tackle hard to reach markets in both the residential and commercial sectors by encouraging energy efficiency improvements. The CEEP pilot was funded by the U.S. Department of Energy's State Energy Program and the American Recovery and Reinvestment Act. CEEP partners are selected by a competitive request for proposals and independent review committee. Avista has been a CEEP recipient since 2014.

The Company received a $750,000 CEEP allocation for the 202-21 funding year that is set to complete in June 2021. Avista is providing a $750,000 match along with in-kind program administrative support. Three community action agencies have partnered with Avista to implement the CEEP funds under two programs: energy efficiency improvements for multifamily housing and converting income qualified homes with alternative heat sources (e.g. wood, oil) to a heat pump system. In addition, CEEP funds are being used to match utility rebates for energy efficiency work done in small businesses in rural communities.

This section summarizes the impact results of the evaluation results for CEEP. Table 4-8 summarizes the measures offered under this program.

Table 4-8: CEEP Measures

Measure	Description	Impact Analysis Methodology
CEEP Multi Family - E Ductless Heat Pump Conversion Zonal	Ductless heat pump for multi-family units	Avista TRM
CEEP Multi Family - E Windows	Window replacement for multi-family units	Avista TRM
CEEP Multi Family - E Air Infiltration	Air infiltration for multi-family units	Avista TRM
CEEP Multi Family - E Attic Insulation	Attic insulation for multi-family units	Avista TRM
CEEP Multi Family - E Ductless Heat Pump Conversion	Ductless heat pump for multi-family units	Avista TRM
CEEP Multi Family - E Health & Safety	Health and safety improvements for multi-family units	Avista TRM
CEEP Multi Family - E Lighting	Efficient lighting giveaways for multi-family units	Avista TRM
CEEP Single Family - E Alternative Heat Conversion	Alternative fuel conversion to electric in multi-family units	Avista TRM
CEEP Multi Family - E Floor Insulation	Floor insulation for multi-family units	Avista TRM
CEEP Single Family - E Ductless Heat Pump	Ductless heat pump for single-family homes	Avista TRM
CEEP Single Family - E Lighting	Efficient lighting giveaways for single-family units	Avista TRM

The following table summarizes the verified electric energy savings for the CEEP impact evaluation.

Table 4-9: CEEP Verified Gas Savings

Program	PY2020 Participation	Expected Savings (Therms)	Adjusted Savings (Therms)	Verified Savings (Therms)	Verified Realization Rate
CEEP	21	0.00	0.00	0.00	-

There were no natural gas saving measures in CEEP, and there are no Therms penalties for the electric measures presented above. Therefore, the total natural gas savings for CEEP is 0. In addition, the total incentive and non-incentive costs for the program is $0.

4.2 Conclusions and Recommendations

The Evaluators provide the following conclusions and recommendations for Avista's Low-Income Portfolio program implementation.

4.2.1 Conclusions

The Evaluators provide the following conclusions regarding Avista's Low-Income natural gas programs:

- The Evaluators found the Low-Income portfolio to demonstrate a total of 14,449.92 Therms with a realization rate of 114.66%. The Low-Income Portfolio impact evaluation resulted verified savings that exceeded expected savings.
- The Evaluators conducted a cost-benefit analysis in order to estimate the Low-Income portfolio's cost-effectiveness. The resulting TRC value for this sector is 0.34 while the UCT value is 0.25. These values are expected, as the Low-Income portfolio is not expected to meet cost-

effectiveness but are implemented in order to provide energy efficiency benefits to low-income customers. Further details on cost-effectiveness methodology can be found in Appendix C.

- The Evaluators attempted to estimate measure-level Low-Income Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolate each unique measure. However, participation for the Low-Income program resulted in a small number of customers with isolated measures and therefore the Evaluators conducted a whole-home billing analysis for all the natural gas measures combined in the Low-Income in order to estimate savings for the average household participating in the program, across all measures. The Evaluators found a realization rate of 139% for all natural gas measures in the program, which supported the realization rate of 115% from the desk review.
- The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation.
- The measures offered by the Community Energy Efficiency Program did not include any natural gas saving measures. Therefore, the impacts from this program amount to 0 Therms savings.

4.2.2 Recommendations

The Evaluators offer the following recommendations regarding Avista's Low-Income natural gas programs:

- The Evaluators note that the majority of deviations from 100% realization rate is due to the change in square footage or number of units verified in the project documentation. The Evaluators reviewed the project documentation provided by Avista and identified conflicting square footage or number of units between the aggregated project data from the CC&B and the rebate project documentation provided in the data request for document verification. In addition, the unit type, in terms of square footage or number of measures (windows, doors, etc) was not documented consistently and therefore savings values were applied inaccurately. The Evaluators recommend updating CC&B documentation standards to more accurately reflect values present on the rebate applications.
- The Evaluators identified one duplicated rebate. The Evaluators recommend conducting cleaning and data quality practices in order to avoid duplicated rebates and therefore unexpectedly low verified savings.
- The Evaluators found discrepancies between the 20% annual consumption cap and the claimed energy savings. The Evaluators recommend checking each project against billing data prior to reporting energy savings for the project, as well as documenting each household's usage as well as the date range used to calculate the household consumption estimate.

5. Appendix A: Billing Analysis Results

This appendix provides additional details on the billing analyses conducted for each program.

5.1 Water Heat Program

The results of the billing analysis for the Water Heat program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2. Table 5-1 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

The Evaluators attempted to estimate measure-level HVAC Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolated each unique measure. In doing so, the Evaluators also isolate the measure effects using the customer's consumption billing data.

A billing analysis was completed for measures that had at least 75 customers with single-measure installations. This ensured that measures would have a sufficient sample size after applying PSM data restrictions (e.g. sufficient pre- and post-period data). The billing analysis included participants in both PY2019 and PY2020 in order to acquire the maximum number of customers possible. However, results from billing analyses are only extrapolated to PY2020 participants.

Table 5-1: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
G 50 Gallon Natural Gas Water Heater[10]	✓	83	
G Tankless Gas Water Heater	✓	285	✓

The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-2. However, the G 50 Gallon Natural Gas Water Heater measure had insufficient participation to conduct a billing analysis. The Evaluators moved forward with billing analysis for the G Tankless Gas Water Heater.

The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-7, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The "Starting Count" displays the beginning number of customers available prior to applying the data restrictions, while the "Ending Count" displays the number of customers after applying data restrictions and final matching.

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[10] The 50 Gallon Natural Gas Water Heaters had insufficient participation after data restrictions/filtering criteria and was thus dropped from the billing analysis.

Table 5-2: Cohort Restrictions, HVAC Program

Measure	Data Restriction	Treatment Customers	Control Customers
G Tankless Gas Water Heater	Starting Count	285	74,548
	Install Date Range: 2019-01-01 to 2020-06-30	152	74,548
	Control Group Usage Outlier (>2X max treatment usage)	151	74,546
	Incomplete Post-Period Bills (<24 months)	110	51,606
	Incomplete Pre-Period Bills	100	47,570
	Ending Count (Matched by PSM)	100	500

Figure 5-1 and Figure 5-2 display the density of each variable employed in propensity score matching for the G Tankless Gas Water Heater, before and after conducting matching. The figures following display the density of each variable employed in propensity score matching for the other billing analysis measures, before and after matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-1: Covariate Balance Before Matching, G Tankless Gas Water Heater

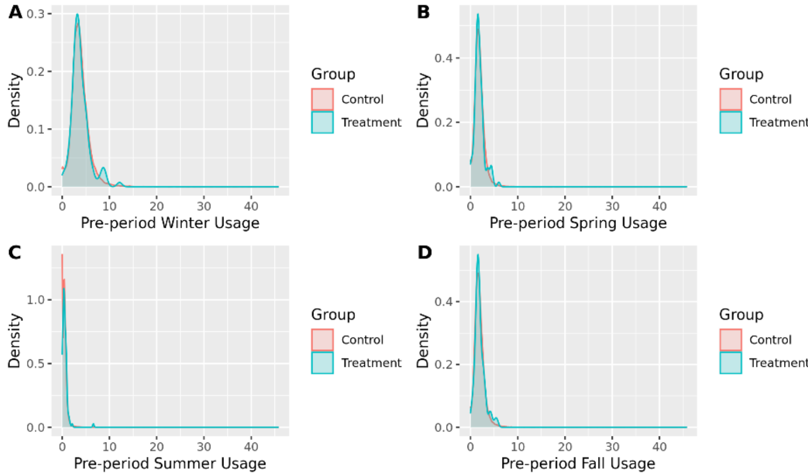
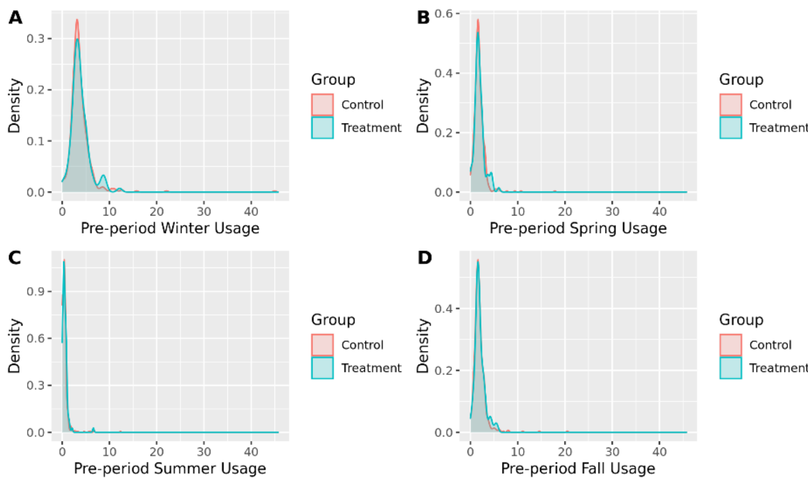


Figure 5-2: Covariate Balance After Matching, G Tankless Gas Water Heater



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for the measure. *T*-tests of monthly pre period usage can yield a statistically significant difference 40% of the time for one to two months out of 12. Thus, the Evaluators set a tolerance band allowing two months out of 12 to vary in pre-period usage at the 95% confidence level. All groups passed this threshold. In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values well under the recommended cutoff of 25, typically falling under 10, further indicating the groups were well matched on all included covariates.

Table 5-3 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-3: TMY Weather, HVAC Program

Measure	USAF Station ID	Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
G Tankless Gas Water Heater	726988	1	726988	4,561	882	6,350	492
G Tankless Gas Water Heater	727850	2	727850	6,707	379	6,350	492
G Tankless Gas Water Heater	727855	8	727855	7,360	439	6,350	492
G Tankless Gas Water Heater	727856	77	727856	6,246	519	6,350	492
G Tankless Gas Water Heater	727857	10	727857	6,467	299	6,350	492
G Tankless Gas Water Heater	727870	2	727856	6,246	519	6,350	492

Table 5-4 provides annual savings/customer for the HVAC program for each measure and regression model. However, savings are not statistically significant at the 90% level for any of the models explored for the G Tankless Gas Water Heater.

Table 5-4: Measure Savings for All Regression Models, HVAC Program

Measure	Model	Treatment Customers	Control Customers	Annual Savings per Customer (Therms)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared
G Tankless Gas Water Heater	Diff-in-diff	100	500	11.68	-64.50	87.85	653%	0.35
G Tankless Gas Water Heater	PPR	100	500	-11.57	-33.20	10.06	187%	0.88
G Tankless Gas Water Heater	Treatment Only (Gross)	100	N/A	-24.77	-73.96	24.42	199%	0.64

*Not statistically significant

Table 5-5 provides results for the *t*-test on pre-period usage between the treatment and control groups after matching for the Water Heat program. The Evaluators placed a threshold of two rejects for each measure as there is a 40% likelihood that one or two months may show statistical variance due to chance. The variable speed motor measure did not exceed this threshold.

Table 5-5: Pre-period Usage T-test for Tankless Gas Water Heater, Water Heater Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	3.50	3.60	-0.60	0.17	0.549	No
Feb	3.60	3.74	-0.78	0.18	0.437	No
Mar	3.00	3.09	-0.56	0.15	0.575	No
Apr	1.91	1.96	-0.44	0.10	0.658	No
May	0.82	0.84	-0.30	0.06	0.766	No

Jun	0.60	0.64	-0.95	0.05	0.344	No
Jul	0.48	0.51	-0.77	0.04	0.444	No
Aug	0.48	0.50	-0.61	0.04	0.542	No
Sep	0.83	0.85	-0.25	0.06	0.807	No
Oct	1.69	1.71	-0.20	0.09	0.843	No
Nov	2.84	2.93	-0.57	0.15	0.571	No
Dec	3.41	3.56	-0.83	0.17	0.407	No

5.2 HVAC Program

The results of the billing analysis for the HVAC program are provided in this section. The methodology for the billing analysis is provided in Section 2.2.3.2. Table 5-6 displays customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis.

The Evaluators attempted to estimate measure-level HVAC Program energy savings through billing analysis regression with a counterfactual group selected via propensity score matching. The Evaluators attempted to isolated each unique measure. In doing so, the Evaluators also isolate the measure effects using the customer’s consumption billing data.

A billing analysis was completed for measures that had at least 75 customers with single-measure installations. This ensured that measures would have a sufficient sample size after applying PSM data restrictions (e.g. sufficient pre- and post-period data). The billing analysis included participants in both PY2019 and PY2020 in order to acquire the maximum number of customers possible. However, results from billing analyses are only extrapolated to PY2020 participants.

Table 5-6: Measures Considered for Billing Analysis, HVAC Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Isolated-Measure Installations	Sufficient Participation for Billing Analysis
G Natural Gas Boiler	✓	38	
G Natural Gas Furnace	✓	2,958	✓
G Natural Gas Wall Heater	✓	0	
G Smart Thermostat DIY with Natural Gas Heat	✓	1,053	✓
G Smart Thermostat Paid Install with Natural Gas Heat	✓	362	✓

The Evaluators conducted a separate analysis for the G Natural Gas Furnace measure, displayed in Section 3.3.2.5 as it provided more reasonable and statistically significant results than the billing analysis. The following details the billing analysis for the remaining measures.

The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-7. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-7, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The "Starting Count" displays the beginning number of customers available prior to applying the data restrictions, while the "Ending Count" displays the number of customers after applying data restrictions and final matching.

Table 5-7: Cohort Restrictions, HVAC Program

Measure	Data Restriction	Treatment Customers	Control Customers
Smart Thermostat DIY with Natural Gas Heat	Starting Count	1,053	74,548
	Install Date Range: 2019-01-01 to 2020-06-30	661	74,548
	Control Group Usage Outlier (>2X max treatment usage)	657	74,545
	Incomplete Post-Period Bills (<24 months)	447	51,602
	Incomplete Pre-Period Bills	373	47,566
	Ending Count (Matched by PSM)	373	1,865
Smart Thermostat Paid Install with Natural Gas Heat	Starting Count	362	74,548
	Install Date Range: 2019-01-01 to 2020-06-30	225	74,548
	Control Group Usage Outlier (>2X max treatment usage)	225	74,546
	Incomplete Post-Period Bills (<24 months)	166	51,605
	Incomplete Pre-Period Bills	148	47,569
	Ending Count (Matched by PSM)	178	740

Figure 5-3 and Figure 5-4 display the density of each variable employed in propensity score matching for the DIY installed smart thermostat with natural gas heat measure, before and after matching. Additionally, Figure 5-5 and

Figure *5-6* display the density of each variable employed in propensity score matching for the professionally installed smart thermostat with natural gas heat measure, before and after matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-3: Covariate Balance Before Matching, Smart Thermostat DIY with Natural Gas Heat

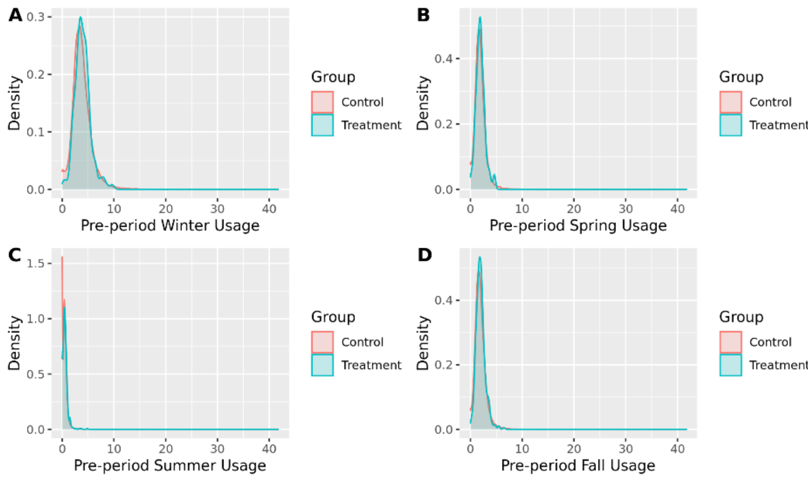


Figure 5-4: Covariate Balance After Matching, Smart Thermostat DIY with Natural Gas Heat

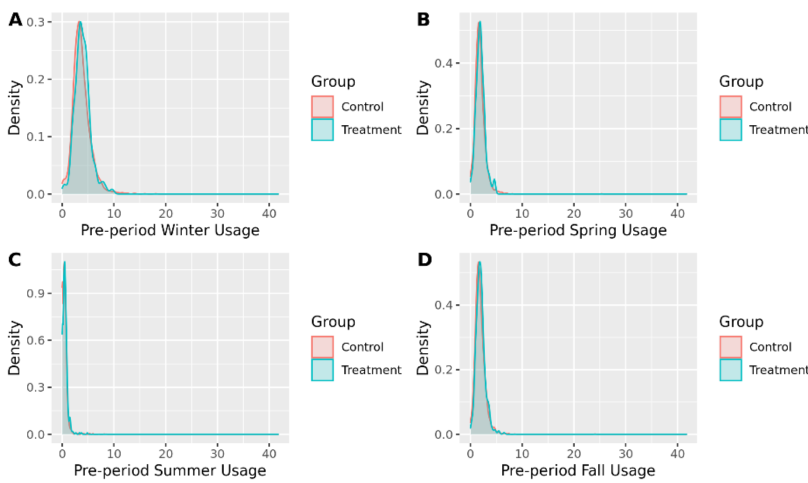


Figure 5-5: Covariate Balance Before Matching, Smart Thermostat Paid Install with Natural Gas Heat

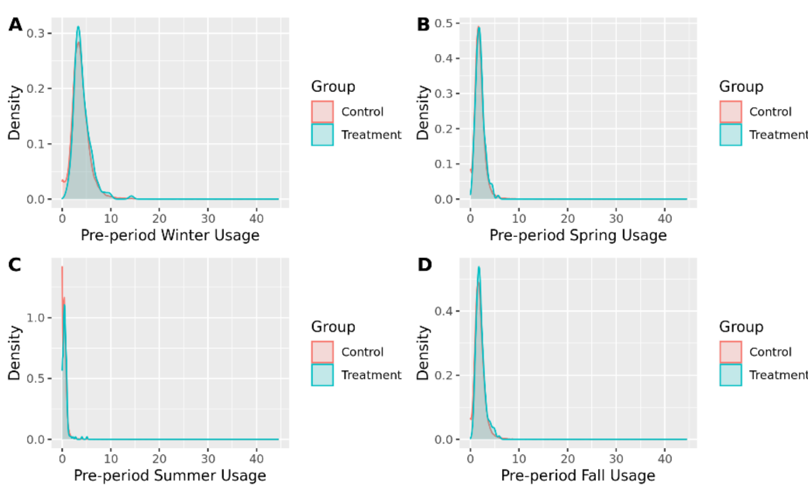
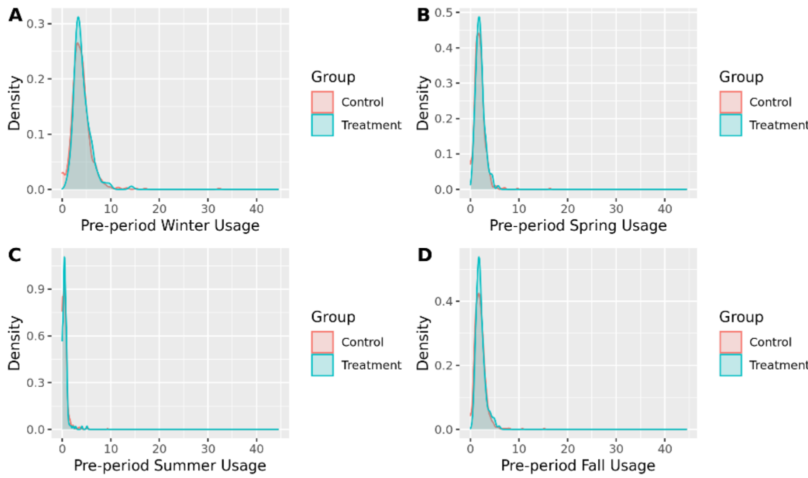


Figure 5-6: Covariate Balance After Matching, Smart Thermostat Paid Install with Natural Gas Heat



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure. T-tests of monthly pre period usage can yield a statistically significant difference 40% of the time for one to two months out of 12. Thus, the Evaluators set a tolerance band allowing two months out of 12 to vary in pre-period usage at the 95% confidence level. All groups passed this threshold. In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values well under the recommended cutoff of 25, typically falling under 10, further indicating the groups were well matched on all included covariates. Further details on the results of the three tests performed to determine PSM success are available in the Appendix.

Table 5-8 and Table 5-9 provide results for the *t*-test on pre-period usage between the treatment and control groups after matching for the HVAC program. The Evaluators placed a threshold of two rejects for each measure as there is a 40% likelihood that one or two months may show statistical variance due to chance. All three measures do not exceed this threshold.

Table 5-8: Pre-period Usage T-test for Smart Thermostat DIY with Natural Gas Heat, HVAC Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	4.156	4.113	0.198	0.214	0.843	No
Feb	4.064	4.083	-0.087	0.212	0.931	No
Mar	3.214	3.347	-0.761	0.175	0.447	No
Apr	1.946	1.988	-0.353	0.119	0.724	No
May	0.849	0.805	0.439	0.099	0.662	No

Jun	0.699	0.640	0.416	0.140	0.678	No
Jul	0.574	0.508	0.511	0.129	0.610	No
Aug	0.577	0.595	-0.101	0.171	0.920	No
Sep	0.902	0.912	-0.063	0.148	0.950	No
Oct	1.883	1.849	0.294	0.116	0.769	No
Nov	3.320	3.333	-0.074	0.180	0.941	No
Dec	3.969	4.166	-0.934	0.211	0.351	No

Table 5-9: Pre-period Usage T-test for Smart Thermostat Paid Install with Natural gas Heat, HVAC Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	3.951	4.128	-0.992	0.179	0.322	No
Feb	3.919	4.060	-0.864	0.164	0.389	No
Mar	3.127	3.295	-1.233	0.136	0.219	No
Apr	1.879	1.969	-1.028	0.087	0.305	No
May	0.799	0.835	-0.768	0.048	0.443	No
Jun	0.638	0.660	-0.325	0.068	0.746	No
Jul	0.555	0.558	-0.051	0.063	0.960	No
Aug	0.554	0.536	0.332	0.053	0.740	No
Sep	0.875	0.888	-0.229	0.053	0.819	No
Oct	1.846	1.964	-1.344	0.088	0.180	No
Nov	3.254	3.416	-1.129	0.144	0.260	No
Dec	3.889	4.111	-1.223	0.182	0.222	No

Table 5-10 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-10: TMY Weather, HVAC Program

Measure	USAF Station ID	# of Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
Smart Thermostat DIY with Natural Gas Heat	727850	20	727850	6,707	379	6,383	491
Smart Thermostat DIY with Natural Gas Heat	727855	33	727855	7,360	439	6,383	491

Smart Thermostat DIY with Natural Gas Heat	727856	295	727856	6,246	519	6,383	491
Smart Thermostat DIY with Natural Gas Heat	727857	23	727857	6,467	299	6,383	491
Smart Thermostat DIY with Natural Gas Heat	727870	2	727856	6,246	519	6,383	491
Smart Thermostat Paid Install with Natural Gas Heat	727850	5	727850	6,707	379	6,377	496
Smart Thermostat Paid Install with Natural Gas Heat	727855	14	727855	7,360	439	6,377	496
Smart Thermostat Paid Install with Natural Gas Heat	727856	122	727856	6,246	519	6,377	496
Smart Thermostat Paid Install with Natural Gas Heat	727857	7	727857	6,467	299	6,377	496

Table 5-11 provides annual savings per customer for each measure. Model 2 (PPR) was selected as the final model for the HVAC Program as it provided the highest adjusted R-squared among the regression models. Savings are statistically significant at the 90% level for the DIY Smart Thermostat with Natural Gas Heat. However, savings for Smart Thermostat Paid Install with Natural Gas Heat were not statistically significant. The adjusted R-squared shows the model provided an excellent fit for the data (adjusted R-squared > 0.88).

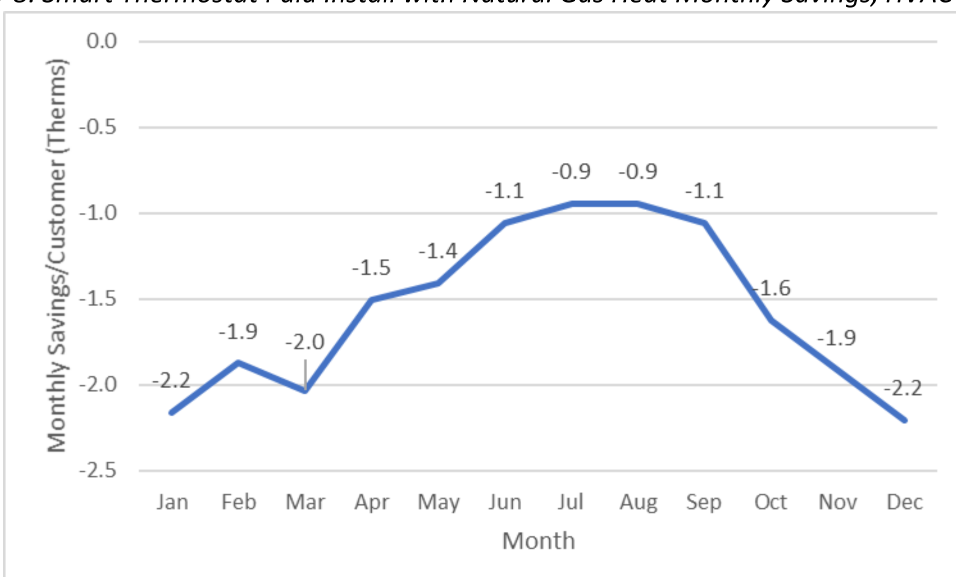
Table 5-11: Measure Savings, HVAC Program

Measure	Treatment Customers	Control Customers	Annual Savings per Customer (Therms)	90% Lower CI	90% Upper CI	Relative Precision (90% CI)	Adjusted R-Squared	Model
Smart Thermostat DIY with Natural Gas Heat	373	1,865	14.79	6.29	23.30	57.5%	0.91	Model 2: PPR
Smart Thermostat Paid Install with Natural Gas Heat	148	740	-18.74	-37.67	0.19	101.0%	0.88	Model 2: PPR

Figure 5-7 and Figure 5-8 provide monthly TMY savings per customer for the HVAC program.

Figure 5-7: Smart Thermostat DIY with Natural Gas Heat Monthly Savings, HVAC Program

Figure 5-8: Smart Thermostat Paid Install with Natural Gas Heat Monthly Savings, HVAC Program



The Evaluators note that the savings for DIY and Paid Smart Thermostats are lower than anticipated. This may be attributable to increased household occupation during the post-treatment period due to COVID-19 pandemic restrictions. Additionally, Smart Thermostats may be subject to a snapback effect in which energy usage increases due to the replacement of faulty or ineffective equipment.

5.3 Shell Program

The results of the billing analysis for the Shell program are provided below. Table 5-12 shows customer counts for customers considered for billing analysis (i.e. customer with single-measure installations) and identifies measures that met the requirements for a billing analysis. A billing analysis was completed for measures that had at least 75 customers with single-measure installations. This ensured that measures would have a sufficient sample size after applying PSM data restrictions (e.g. sufficient pre- and post-period data).

Table 5-12: Measures Considered for Billing Analysis, Shell Program

Measure	Measure Considered for Billing Analysis	Number of Customers w/ Single-Measure Installations	Sufficient Participation for Billing Analysis
G Attic Insulation With Natural Gas Heat	✓	291	✓
G Floor Insulation With Natural Gas Heat	✓	8	
G Storm Windows with Natural Gas Heat	✓	9	
G Wall Insulation With Natural Gas Heat	✓	24	
G Window Replc With Natural Gas Heat	✓	1,309	✓

The Evaluators were successful in creating a matched cohort for each of the measures with sufficient participation. Customers were matched on zip code (exact match) and their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household. The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-13. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-13, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The "Starting Count" displays the beginning number of customers available prior to applying the data restrictions, while the "Ending Count" displays the number of customers after applying data restrictions and final matching.

Table 5-13: Cohort Restrictions, Shell Program

Measure	Data Restriction	# of Treatment Customers	# of Control Customers
G Attic Insulation With Natural Gas Heat	Starting Count	291	74,548
	Install Date Range: January 1, 2019 to June 30, 2020	166	74,548
	Control Group Usage Outlier (>2X max treatment usage)	166	74,543
	Incomplete Post-Period Bills (<24 months)	118	51,594
	Incomplete Pre-Period Bills (<10 months)	97	47,560
	Ending Count (Matched by PSM)	97	485
G Window Replc With Natural Gas Heat	Starting Count	1,309	74,548
	Install Date Range: January 1, 2019 to June 30, 2020	783	74,548
	Control Group Usage Outlier (>2X max treatment usage)	777	74,528

	Incomplete Post-Period Bills (<24 months)	619	51,468
	Incomplete Pre-Period Bills (<10 months)	555	47,447
	Ending Count (Matched by PSM)	555	2,772

Figure 5-9 and Figure 5-10 display the density of each variable employed in propensity score matching for the attic insulation measure, before and after conducting matching. In addition, Figure 5-11 and Figure 5-12 display the density of each variable employed in propensity score matching for the window replacement measure, before and after conducting matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-9: Covariate Balance Before Matching, Shell Attic Insulation

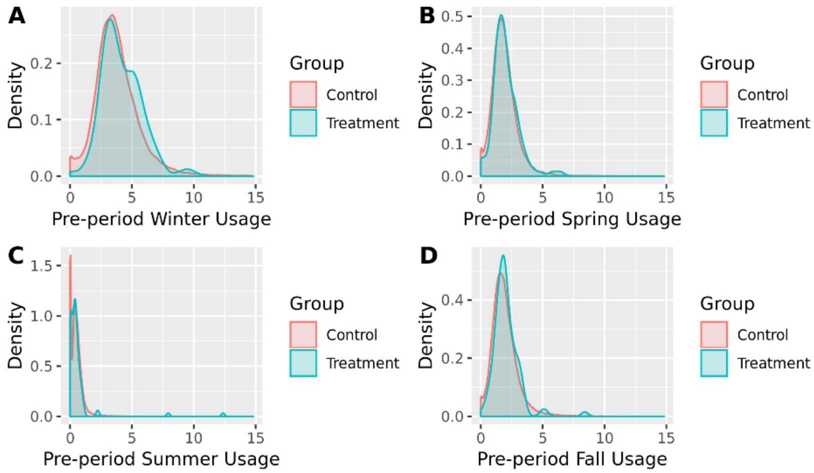


Figure 5-10: Covariate Balance After Matching, Shell Attic Insulation

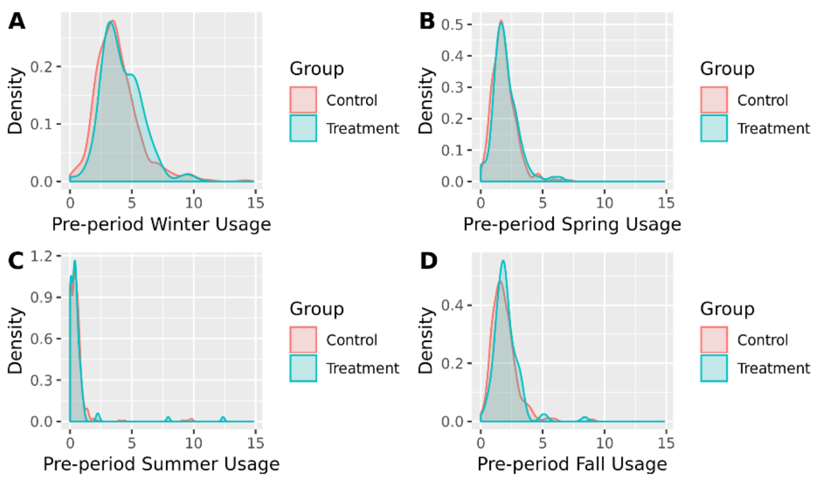


Figure 5-11: Covariate Balance Before Matching, Shell Window Replacement

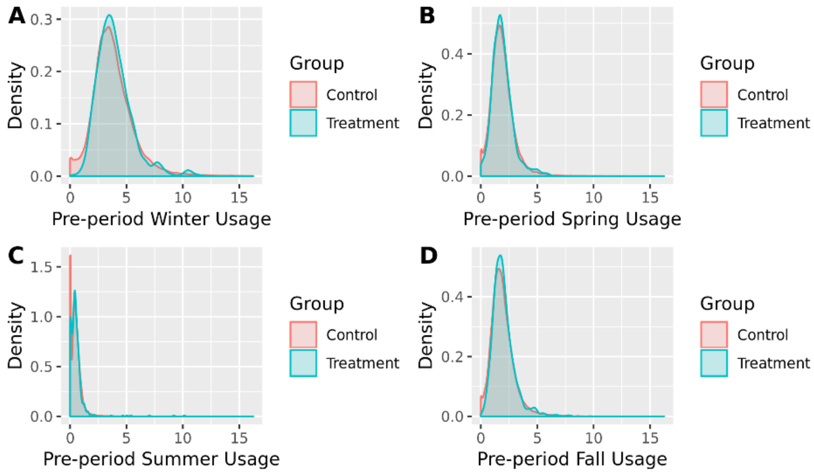
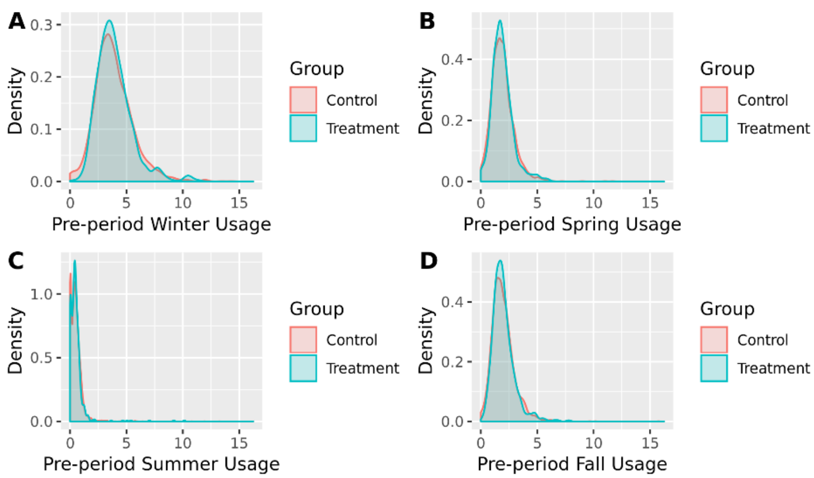


Figure 5-12: Covariate Balance After Matching, Shell Window Replacement



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure. The t-test displayed no statistically significant differences at the 95% level in average daily consumption between the treatment and control groups for any month in the pre-period. In addition, the chi-squared test returned a p-value well over 0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values well under the recommended cutoff of 25, and always falling under 10, further indicating the groups were well matched on all included covariates. Further details on the results of the three tests performed to determine PSM success are available in the Appendix.

Table 5-14 and Figure 5-13 provide results for the *t*-test on pre-period usage between the treatment and control groups after matching for the Shell program. The P-Value is over 0.05 for each month, meaning pre-period usage between treatment and control groups is similar at the 95% confidence level.

Table 5-14: Pre-period Usage T-test for Attic Insulation, Shell Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	4.038	4.187	-0.707	0.211	0.480	No
Feb	4.023	4.129	-0.506	0.210	0.613	No
Mar	3.153	3.393	-1.373	0.174	0.171	No
Apr	1.869	2.007	-1.133	0.122	0.258	No
May	0.789	0.827	-0.350	0.107	0.727	No
Jun	0.639	0.663	-0.153	0.153	0.879	No
Jul	0.544	0.530	0.095	0.144	0.924	No
Aug	0.548	0.623	-0.393	0.191	0.695	No
Sep	0.841	0.929	-0.545	0.161	0.587	No
Oct	1.806	1.864	-0.503	0.116	0.616	No
Nov	3.219	3.364	-0.811	0.179	0.418	No
Dec	3.893	4.222	-1.511	0.218	0.132	No

Table 5-15: Pre-period Usage T-test for Window Replacement, Shell Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	3.930	3.957	-0.337	0.080	0.736	No
Feb	3.900	3.940	-0.512	0.078	0.609	No
Mar	3.114	3.164	-0.754	0.067	0.451	No
Apr	1.866	1.894	-0.649	0.043	0.516	No
May	0.783	0.764	0.615	0.031	0.539	No
Jun	0.586	0.570	0.422	0.037	0.673	No
Jul	0.478	0.490	-0.311	0.036	0.756	No
Aug	0.489	0.515	-0.634	0.041	0.526	No
Sep	0.832	0.852	-0.537	0.038	0.591	No
Oct	1.828	1.852	-0.542	0.044	0.588	No
Nov	3.226	3.275	-0.714	0.068	0.475	No
Dec	3.875	3.927	-0.672	0.078	0.501	No

Figure 5-14 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-16: TMY Weather, Shell Program

Measure	USAF Station ID	# of Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
G Attic Insulation With Natural Gas Heat	727856	88	727856	6,246	519	6,310	508
G Attic Insulation With Natural Gas Heat	727855	5	727855	7,360	439	6,310	508
G Attic Insulation With Natural Gas Heat	727857	3	727857	6,467	299	6,310	508
G Attic Insulation With Natural Gas Heat	727870	1	727856	6,246	519	6,310	508
G Window Replc With Natural Gas Heat	727856	440	727856	6,246	519	6,324	486
G Window Replc With Natural Gas Heat	727857	71	727857	6,467	299	6,324	486
G Window Replc With Natural Gas Heat	727855	23	727855	7,360	439	6,324	486
G Window Replc With Natural Gas Heat	727850	13	727850	6,707	379	6,324	486
G Window Replc With Natural Gas Heat	727870	4	727856	6,246	519	6,324	486
G Window Replc With Natural Gas Heat	727827	3	727827	5,428	731	6,324	486
G Window Replc With Natural Gas Heat	726988	1	726988	4,561	882	6,324	486

Table 5-17 provides annual savings per customer for the Shell program for each measure and regression model. The PPR model was selected for ex post savings because it provided the best fit for the data (highest adjusted R-squared).

Table 5-17: Measure Savings for All Regression Models, Shell Program

Measure	Model	# of Treatment Customers	# of Control Customers	Annual Savings/Customer (Therms)	90% Lower CI	90% Upper CI	Adjusted R-Squared
G Attic Insulation With Natural Gas Heat	Diff-in-diff	97	485	60.60*	-23.75	144.95	0.34
G Attic Insulation With Natural Gas Heat	PPR	97	485	63.56	45.47	81.66	0.93
G Attic Insulation With Natural Gas Heat	Treatment Only (Gross)	97	N/A	50.92	16.30	85.54	0.81

G Window Replc With Natural Gas Heat	Diff-in-diff	555	2,772	32.16	9.33	54.98	0.54
G Window Replc With Natural Gas Heat	PPR	555	2,772	39.13	32.65	45.61	0.92
G Window Replc With Natural Gas Heat	Treatment Only (Gross)	555	N/A	24.33	12.08	36.57	0.83

Savings are statistically significant at the 90% level for all measures and the adjusted R-squared shows the model provided an excellent fit for the data (adjusted R-squared > 0.90).

Table 5-18: Measure Savings, Shell Program

Measure	# of Treatment Customers	# of Control Customers	Annual Savings/Customer (Therms)	90% Lower CI	90% Upper CI	Adjusted R-Squared	Model
G Attic Insulation With Natural Gas Heat	97	485	63.56	45.47	81.66	0.93	Model 2: PPR
G Window Replc With Natural Gas Heat	555	2,772	39.13	32.65	45.61	0.92	Model 2: PPR

Figure 5-13 and Figure 5-14 provide monthly TMY savings per customer for the Shell program. As expected for gas weatherization measures, the greatest savings occur during the winter months.

Figure 5-13: Attic Insulation Monthly Savings, Shell Program

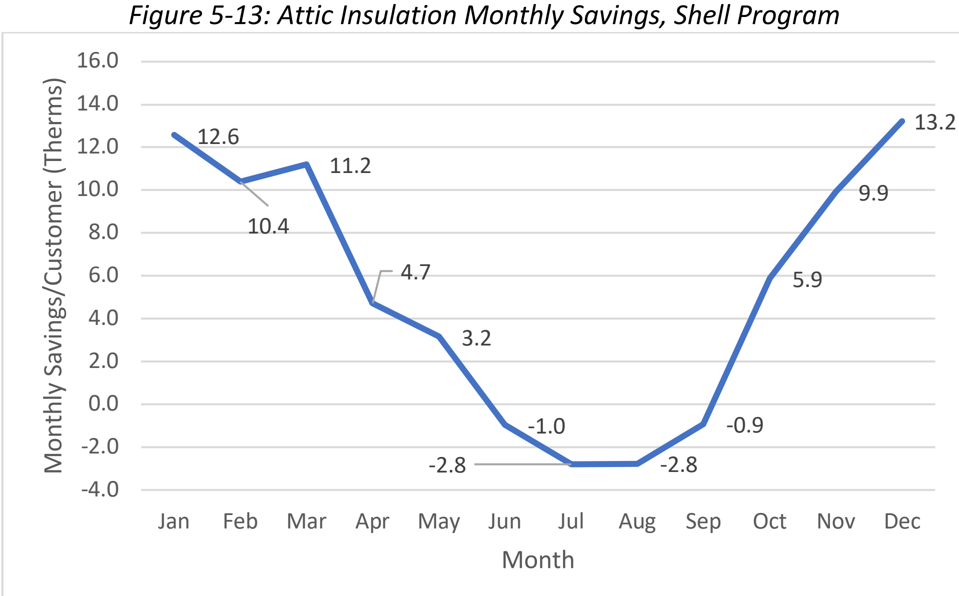
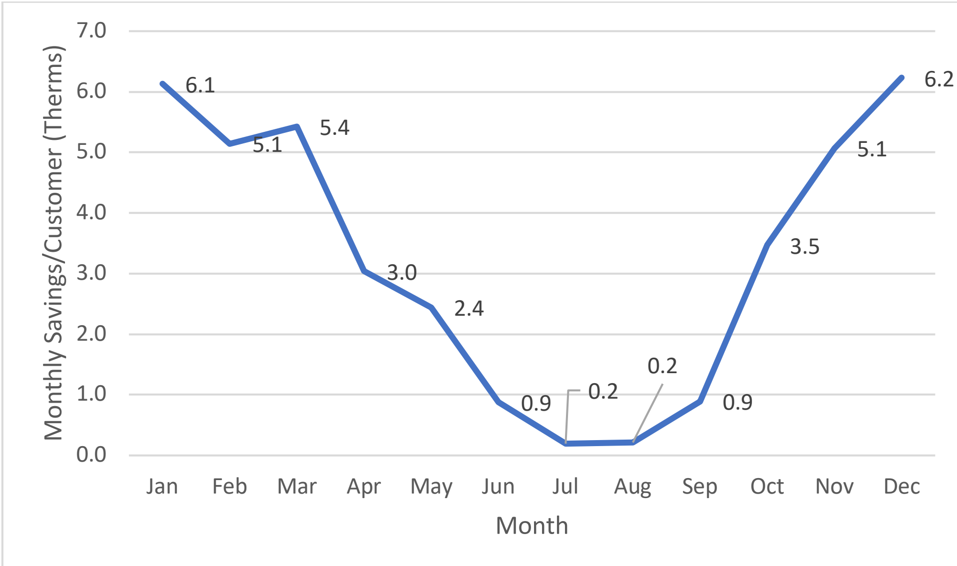


Figure 5-14: Window Replacement Monthly Savings, Shell Program



5.4 Low-Income Program

The Evaluators conducted a whole-home billing analysis for all the natural gas measures combined in order to estimate savings for the average household participating in the program, across all measures. The Evaluators successfully created a matched cohort for the natural gas measure households. Customers were matched on zip code (exact match) and their average pre-period seasonal usage, including summer, fall, winter, and spring for each control and treatment household.

The Evaluators were provided a considerable pool of control customers to draw upon, as shown in Table 5-19. The Evaluators used nearest neighbor matching with a 5 to 1 matching ratio. Therefore, each treatment customer was matched to 5 similar control customers. Also shown in Table 5-19, are the impact of various restrictions on the number of treatment and control customers that were included in the final regression model. The “Starting Count” displays the beginning number of customers available prior to applying the data restrictions, while the “Ending Count” displays the number of customers after applying data restrictions and final matching.

Table 5-19: Cohort Restrictions, Low-Income Program

Measure	Data Restriction	# of Treatment Customers	# of Control Customers
Whole home natural gas	Starting Count	146	1,252
	Install Date Range: January 1, 2019 to June 30, 2020	89	1,252
	Control Group Usage Outlier (>2X max treatment usage)	89	1,252
	Incomplete Post-Period Bills (<4 months)	82	1058
	Incomplete Pre-Period Bills (<10 months)	79	970
	Ending Count (Matched by PSM)	79	369

Figure 5-15 and Figure 5-16 display the density of each variable employed in propensity score matching for the combined natural gas measures before and after conducting matching.

The distributions prior to matching appear to be less similar in summer, with control customers averaging higher usage. However, after matching, the pre-period usage distribution in summer is more similar between the groups. The remaining pre-period seasons (winter, summer, fall), closely overlap before and after matching, indicating little differences exist on average between the groups prior to matching and validating the initial selection of control customers.

Figure 5-15: Covariate Balance Before Matching, Low Income Gas Measures

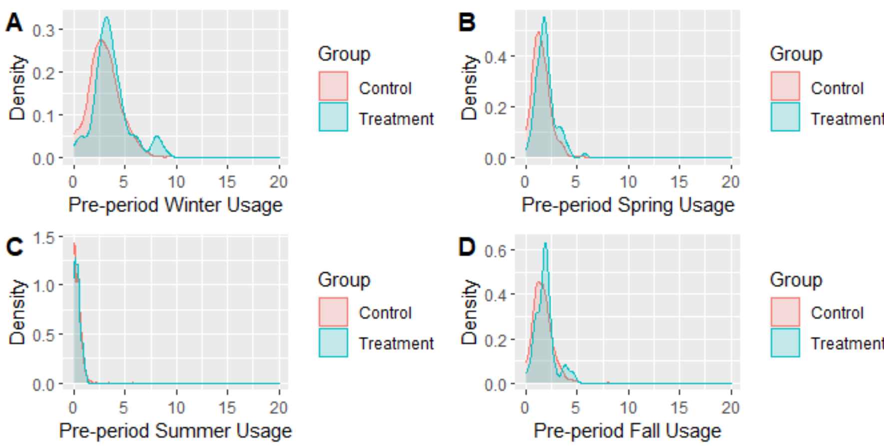
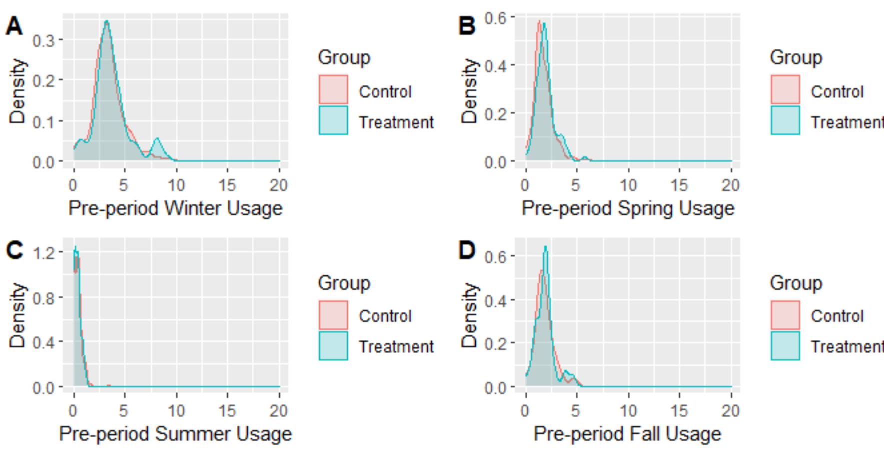


Figure 5-16: Covariate Balance After Matching, Low Income Gas Measures



The Evaluators performed three tests to determine the success of PSM:

1. *t*-test on pre-period usage by month
2. Joint chi-square test to determine if any covariates are imbalanced
3. Standardized difference test for each covariate employed in matching

All tests confirmed that PSM performed well for each measure. The t-test displayed no statistically significant differences at the 95% level in average daily consumption between the treatment and control groups for any month in the pre-period. In addition, the chi-squared test returned a p-value well over

0.05 for all measures, indicating that pre-period usage was balanced between the groups. Lastly, the standardized difference test returned values were under 10 (well under the recommended cutoff of 25), further indicating the groups were well matched on all included covariates.

Table 5-20 provides customer counts for customers in the final regression model by assigned weather station ID for each measure. In addition, TMY HDD and CDD from the nearest available TMY weather station is provided as well as the weighted HDD/CDD for each measure. The HDD and CDD was weighted by the number of treatment customers assigned to a weather station.

Table 5-20: TMY Weather, Low-Income Program

Measure	USAF Station ID	# of Treatment Customers	TMY USAF ID	TMY HDD	TMY CDD	Weighted TMY HDD	Weighted TMY CDD
All Natural Gas Measures	727827	2	727827	5,428	731	6,300	501
All Natural Gas Measures	727830	5	727830	5,510	906	6,300	501
All Natural Gas Measures	727834	7	727834	6,915	376	6,300	501
All Natural Gas Measures	727850	2	727850	6,246	519	6,300	501
All Natural Gas Measures	727855	2	727855	7,360	439	6,300	501
All Natural Gas Measures	727856	49	727856	6,246	519	6,300	501
All Natural Gas Measures	727857	12	727857	6,467	299	6,300	501

Table 5-21 provides annual savings/customer for the Low-Income program for each measure and regression model. The PPR model was selected for ex post savings because it provided the best fit for the data (highest adjusted R-squared).

Table 5-21: Measure Savings for All Regression Models, Low-Income Program

Measure	Model	# of Treatment Customers	# of Control Customers	Annual Savings/Customer	90% Lower CI	90% Upper CI	Adjusted R-Squared
All Natural Gas Measures	Diff-in-diff	79	485	16.00*	0	84.41	0.61
All Natural Gas Measures	PPR	79	485	54.53	26.33	83.1	0.91
All Natural Gas Measures	Treatment Only (Gross)	79	485	46.22	0	128.56	0.81

*Not statistically significant

The Evaluators estimate each household in the Low-Income Program saved an average of 54.53 Therms per year. The treatment-only model displays an average household savings of 46.22 Therms per year. This estimate represents a gross savings estimate for the program rather than a net savings estimate.

Table 5-22 provides results for the *t*-test on pre-period usage between the treatment and control groups after matching for the Low-Income program. The P-Value is over 0.05 for each month, meaning pre-period usage between treatment and control groups is similar at the 95% confidence level.

Table 5-22: Pre-period Usage T-test for Natural Gas Measures, Low-Income Program

Month	Average Daily Usage (Therms), Control	Average Daily Usage (Therms), Treatment	T Statistic	Std Error	P-Value	Reject Null?
Jan	3.55	3.52	0.166	0.189	0.868	No
Feb	2.69	2.68	0.101	0.135	0.920	No
Mar	3.30	3.26	0.300	0.153	0.765	No
Apr	1.80	1.80	-0.021	0.083	0.983	No
May	1.40	1.38	0.302	0.080	0.763	No
Jun	0.58	0.60	-0.543	0.043	0.588	No
Jul	0.10	0.11	-0.127	0.045	0.899	No
Aug	0.05	0.04	0.153	0.044	0.879	No
Sep	0.14	0.16	-0.373	0.050	0.710	No
Oct	0.75	0.78	-0.511	0.063	0.609	No
Nov	2.65	2.69	-0.283	0.120	0.777	No
Dec	3.14	3.07	0.464	0.152	0.643	No

6. Appendix B: Summary of Survey Respondents

This section summarizes additional insights gathered from the simple verification surveys deployed by the Evaluators for the impact evaluation of Avista's Residential and Low-Income Programs.

Survey respondents confirmed installing between one and three measures that were rebated by Avista, displayed in Table 6-1.

Table 6-1: Type and Number of Measures Received by Respondents

Measure Category	Total	Percent
One Measure	161	61%
Two Measures	69	26%
Three Measures	32	12%
HVAC	140	53%
Water Heater	138	53%
Smart Thermostat	113	43%
Variable Speed Motors	4	2%

The Evaluators asked respondents to provide information regarding their home, as displayed in Table 6-2. Most respondents noted owning a single-family home between 1,000-3,000 square feet with central air conditioning.

Table 6-2: Survey Respondent Home Characteristics[11]

Question	Response	Percent (n=258)
Do you rent or your home?	Own	97%
	Rent	3%
Which of the following best describe your home?	Single-family house detached from any other house	89%
	Single-family house attached to one or more other houses (e.g., duplex, condominium, townhouse)	4%
	Mobile or manufactured home	6%
	Apartment with 2 or 3 units	1%
	Garage/outbuilding	1%
	Don't Know	1%
Does your home have central air conditioning, window air conditioning, or neither?	Window air conditioning / a room AC unit	12%
	Central air conditioning	73%
	Neither	14%
	Don't Know	1%
About how many square feet is your home?	Less than 1,000 square feet	6%
	1,000-1,999 square feet	38%
	2,000-2,999 square feet	35%
	3,000-3,999 square feet	14%
	4,000 or more square feet	6%
	Don't know	1%
When was your home built?	Before 1960	21%
	1960 to 1969	5%
	1970 to 1979	17%
	1980 to 1989	12%
	1990 to 1999	12%
	2000 to 2009	16%
	2010 to 2018	15%
	Don't know	1%

[11] Four contractors or construction companies were not asked these questions.

7. Appendix C: Cost Benefit Analysis Results

The Evaluators estimated the cost-effectiveness for the Avista Residential and Low-Income Programs using evaluated savings results, economic inputs provided by Avista, and incremental costs and non-energy impacts from the RTF. The table below presents the cost-effectiveness results for the PY2020 portfolio.

Table 7-1: Cost-Effectiveness Results

Sector	TRC	UCT	RIM	PCT
Residential	1.01	2.36	0.32	1.19
Low Income	0.34	0.25	0.17	N/A*
Total	**0.88**	**1.55**	**0.30**	**N/A***
***Low Income is offered at no cost to participants; PCT is not calculable.**				

7.1 Approach

The California Standard Practice Model was used as a guideline for the calculations. The cost-effectiveness analysis methods that were used in this analysis are among the set of standard methods used in this industry and include the Utility Cost Test (UCT)[12], Total Resource Cost Test (TRC), Ratepayer Impact Measure Test (RIM), and Participant Cost Test (PCT). All tests weigh monetized benefits against costs. These monetized amounts are presented as NPV evaluated over the lifespan of the measure. The benefits and costs differ for each test based on the perspective of the test. The definitions below are taken from the California Standard Practice Manual.

- The TRC measures the net costs of a demand-side management program as a resource option based on the total costs of the program, including both the participants' and the utility's costs.
- The UCT measures the net costs of a demand-side management program as a resource option based on the costs incurred by the program administrator (including incentive costs) and excluding any net costs incurred by the participant. The benefits are similar to the TRC benefits. Costs are defined more narrowly.
- The PCT is the measure of the quantifiable benefits and costs to the customer due to participation in a program. Since many customers do not base their decision to participate in a program entirely on quantifiable variables, this test cannot be a complete measure of the benefits and costs of a program to a customer.
- The RIM test measures what happens to customer bills or rates due to changes in utility revenues and operating costs caused by the program. Rates will go down if the change in revenues from the program is greater than the change in utility costs. Conversely, rates or bills will go up if revenues collected after program implementation is less than the total costs incurred by the utility in implementing the program. This test indicates the direction and magnitude of the expected change in customer bills or rate levels.

[12] The UCT is also referred to as the Program Administrator Cost Test (PACT).

A common misperception is that there is a single best perspective for evaluation of cost-effectiveness. Each test is useful and accurate, but the results of each test are intended to answer a different set of questions. The questions to be addressed by each cost test are shown in the table below.[13]

Table 7-2: Questions Addressed by the Various Cost Tests

Cost Test	Questions Addressed
Participant Cost Test (PCT)	▪ Is it worth it to the customer to install energy efficiency?
	▪ Is it likely that the customer wants to participate in a utility program that promotes energy efficiency?
Ratepayer Impact Measure (RIM)	▪ What is the impact of the energy efficiency project on the utility's operating margin?
	▪ Would the project require an increase in rates to reach the same operating margin?
Utility Cost Test (UCT)	▪ Do total utility costs increase or decrease?
	▪ What is the change in total customer bills required to keep the utility whole?
Total Resource Cost Test (TRC)	▪ What is the regional benefit of the energy efficiency project (including the net costs and benefits to the utility and its customers)?
	▪ Are all of the benefits greater than all of the costs (regardless of who pays the costs and who receives the benefits)?
	▪ Is more or less money required by the region to pay for energy needs?

Overall, the results of all four cost-effectiveness tests provide a more comprehensive picture than the use of any one test alone. The TRC cost test addresses whether energy efficiency is cost-effective overall. The PCT, UCT, and RIM address whether the selection of measures and design of the program are balanced from the perspective of the participants, utilities, and non-participants. The scope of the benefit and cost components included in each test are summarized in the table below.[14]

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[13] http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf
[14] Ibid.

Table 7-3: Benefits and Costs Included in Each Cost-Effectiveness Test

Test	Benefits	Costs
PCT (Benefits and costs from the perspective of the customer installing the measure)	■ Incentive payments ■ Bill Savings ■ Applicable tax credits or incentives	■ Incremental equipment costs ■ Incremental installation costs
UCT (Perspective of utility, government agency, or third party implementing the program	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	■ Program overhead costs ■ Utility/program administrator incentive costs
TRC (Benefits and costs from the perspective of all utility customers in the utility service territory)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution ■ Additional resource savings ■ Monetized non-energy benefits	■ Program overhead costs ■ Program installation costs ■ Incremental measure costs
RIM (Impact of efficiency measure on non-participating ratepayers overall)	■ Energy-related costs avoided by the utility ■ Capacity-related costs avoided by the utility, including generation, transmission, and distribution	■ Program overhead costs ■ Lost revenue due to reduced energy bills ■ Utility/program administrator installation costs

7.2 Non-Energy Benefits

Non-energy Benefits (NEBs) were sourced from the most updated RTF workbooks. NEBs included wood fuel credits, increased comfort, and reductions in PM 2.5 emissions.

- Residential measures with NEBs included air source heat pumps, ductless heat pumps, windows, and insulation measures.
- Low Income NEBs included the NEBs described for Residential as well as a dollar-for-dollar benefit adder for health and safety spending.

7.3 Economic Inputs for Cost Effectiveness Analysis

The Evaluators used the economic inputs provided by Avista for the cost benefit analysis. Avista provided the Evaluators with avoided costs on the following basis:

- Hourly avoided commodity costs
- Modifications for the Clean Premium
- Avoided capacity costs
- Avoided transmission
- 10% Conservation Adder
- Line losses
- Discount rate (after tax Weighted Average Cost of Capital)

The values were aggregated to provide a single benefit multiplier on a Therms basis for every hour of the year (8,760). Savings by measure were then parsed out to the following load shapes provided by Avista:

- Residential Space Heating
- Residential Air Conditioning
- Residential Lighting
- Residential Refrigeration
- Residential Water Heating
- Residential Dishwasher
- Residential Washer/Dryer
- Residential Furnace Fan
- Residential Miscellaneous

The Evaluators in addition created a Residential Heat Pump load shape by weighting the relative magnitude of cooling versus heating savings from a heat pump and assigning these to weight the Residential Space Heating and Residential Air Conditioning load shapes.

7.4 Results

The tables below outline the results for each test, for both the programs and the portfolio as a whole. Summations may differ by $1 due to rounding.

Table 7-4: Cost-Effectiveness Results by Sector

Sector	TRC	UCT	RIM	PCT
Residential	1.01	2.36	0.32	1.19
Low Income	0.34	0.25	0.17	N/A*
Total	**0.88**	**1.55**	**0.30**	**N/A***
***Low Income is offered at no cost to participants; PCT is not calculable.**				

Table 7-5: Cost-Effectiveness Benefits by Sector

Program	TRC Benefits	UCT Benefits	RIM Benefits	PCT Benefits
Residential	$5,547,107	$5,042,640	$5,042,640	$6,407,695
Low Income	$456,908	$324,822	$324,822	$1,219,176
Total	**$6,004,015**	**$5,367,463**	**$5,367,463**	**$7,626,871**

Table 7-6: Cost-Effectiveness Costs by Sector

Program	TRC Costs	UCT Costs	RIM Costs	PCT Costs
Residential	$5,484,529	$2,139,121	$15,717,223	$5,379,950
Low Income	$1,336,787	$1,318,017	$1,886,660	$1,094,906
Total	**$6,821,318**	**$3,457,140**	**$17,603,886**	**$6,474,856**

Table 7-7: Cost-Effectiveness Net Benefits by Sector

Program	TRC Net Benefits	UCT Net Benefits	RIM Net Benefits	PCT Net Benefits
Residential	$62,579	$2,903,520	($10,674,583)	$1,027,744
Low Income	($879,879)	($993,195)	($1,561,837)	$124,270
Total	**($817,303)**	**$1,910,322**	**($12,236,423)**	**$1,152,014**

APPENDIX E – 2020 WASHINGTON COST-EFFECTIVENESS TABLES

Washington Cost-Effectiveness Summary

Table 1 shows the overall cost-effectiveness results in Washington.

TABLE 1 – 2020 WASHINGTON COST-EFFECTIVENESS SUMMARY

Benefit Cost Ratios	Total Portfolio		Total Portfolio (w/o Low-Income)	
	Electric	Gas	Electric	Gas
Total Resource Cost (TRC)	1.30	0.84	1.43	0.94
Utility Cost Test (UCT)	1.75	1.52	2.09	2.10
Participant Cost Test (PCT)	3.08	1.14	3.31	1.14
Ratepayer Impact (RIM)	0.66	0.35	0.73	0.37

Washington Portfolio Cost-Effectiveness Results

Table 2 and Table 3 shows the portfolio level cost-effectiveness results in Washington by fuel type.

TABLE 2 – WASHINGTON ELECTRIC PORTFOLIO COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 17,026,048	$ 13,069,307	1.30
Utility Cost Test (UCT)	$ 15,316,468	$ 8,761,858	1.75
Participant Cost Test (PCT)	$ 30,947,840	$ 10,047,326	3.08
Ratepayer Impact (RIM)	$ 15,316,468	$ 23,346,115	0.66

TABLE 3 – WASHINGTON NATURAL GAS PORTFOLIO COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 7,131,618	$ 8,468,752	0.84
Utility Cost Test (UCT)	$ 6,392,555	$ 4,198,841	1.52
Participant Cost Test (PCT)	$ 8,867,812	$ 7,790,853	1.14
Ratepayer Impact (RIM)	$ 6,392,555	$ 18,391,442	0.35

Washington Commercial/Industrial Cost-Effectiveness Results

Table 4 and Table 5 shows commercial/industrial cost-effectiveness results in Washington by fuel type.

TABLE 4 – WASHINGTON COMMERCIAL/INDUSTRIAL ELECTRIC COST-EFFECTIVENESS RESULT

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 12,904,537	$ 8,253,943	1.56
Utility Cost Test (UCT)	$ 11,731,398	$ 5,040,889	2.33
Participant Cost Test (PCT)	$ 24,149,314	$ 6,654,693	3.63
Ratepayer Impact (RIM)	$ 11,731,398	$ 12,680,254	0.93

TABLE 5 – WASHINGTON COMMERCIAL/INDUSTRIAL NATURAL GAS COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 1,124,949	$ 1,640,539	0.69
Utility Cost Test (UCT)	$ 1,022,680	$ 734,806	1.39
Participant Cost Test (PCT)	$ 1,235,315	$ 1,313,292	0.94
Ratepayer Impact (RIM)	$ 1,022,680	$ 777,741	1.31

Washington Residential Cost-Effectiveness Results

Table 6 and Table 7 shows residential cost-effectiveness results in Washington by fuel type.

TABLE 6 – WASHINGTON RESIDENTIAL ELECTRIC COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 3,540,375	$ 3,284,423	1.08
Utility Cost Test (UCT)	$ 3,202,058	$ 2,106,699	1.52
Participant Cost Test (PCT)	$ 5,007,234	$ 2,152,640	2.33
Ratepayer Impact (RIM)	$ 3,202,058	$ 8,230,887	0.39

TABLE 7 – WASHINGTON RESIDENTIAL NATURAL GAS COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 5,549,761	$ 5,491,426	1.01
Utility Cost Test (UCT)	$ 5,045,053	$ 2,146,018	2.35
Participant Cost Test (PCT)	$ 6,413,321	$ 5,382,655	1.19
Ratepayer Impact (RIM)	$ 5,045,053	$ 15,727,041	0.32

Washington Low-Income Cost-Effectiveness Results

Table 8 and Table 9 shows low-income cost-effectiveness results in Washington by fuel type.

TABLE 8 – WASHINGTON LOW-INCOME ELECTRIC COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 581,136	$ 1,530,941	0.38
Utility Cost Test (UCT)	$ 383,012	$ 1,614,270	0.24
Participant Cost Test (PCT)	$ 1,791,292	$ 1,239,993	1.44
Ratepayer Impact (RIM)	$ 383,012	$ 2,434,974	0.16

TABLE 9 – WASHINGTON LOW-INCOME NATURAL GAS COST-EFFECTIVENESS RESULTS

Cost-Effectiveness Test	Benefits	Costs	Benefit/Cost Ratio
Total Resource Cost (TRC)	$ 456,908	$ 1,336,787	0.34
Utility Cost Test (UCT)	$ 324,822	$ 1,318,017	0.25
Participant Cost Test (PCT)	$ 1,219,176	$ 1,094,906	1.11
Ratepayer Impact (RIM)	$ 324,822	$ 1,886,660	0.17

APPENDIX F – 2020 PROGRAM ACTIVITY

	Electric				Natural Gas			
Program	**Participants**		**Evaluated Savings (kWh)**	**Utility Cost**	**Participants**		**Evaluated Savings (therms)**	**Utility Cost**
Low-Income								
Weatherization	154	Homes	97,109	$ 553,594	303	Sq ft/Units	11,150	$ 860,901
HVAC	33	Units	110,890	$ 392,040	42	Units	2,614	$ 246,051
Water Heat	1	Units	0	$ 0	13	Units	686	$ 56,654
Outreach/ Giveaways	18	Events	2,394	$ 4,355	-	NA	0	$ 0
Health and Safety	33	HHS	0	$ 109,542	43	HHS	0	$ 154,411
ENERGY STAR Refrigerator	2	Units	78	$ 1,437	-	Units	0	$ 0
CEEP	21	Units	130,805	$ 1,103,602	-	Units	0	$ 0
Low-Income Total			**341,276**	**$ 2,164,571**			**14,450**	**$ 1,318,017**
Residential								
ENERGY STAR Homes	34	Homes	84,256	$ 65,757	34	Homes	670	$ 2,755
HVAC	221	Furnace, Tstat	527,574	$ 249,333	4,172	Furnace, Tstat	330,929	$ 1,366,867
Water Heat	117	Units	148,557	$ 60,645	450	Units	28,629	$ 156,933
Multifamily Direct Install	42,669	Units (Measures)	1,740,162	$ 933,188	346	Units (Measures)	376	$ 6,897
Shell	260	Windows, Insulation	610,472	$ 669,148	1,052	Windows, Insulation	47,875	$ 612,566
Simple Steps, Smart Savings	10,658	LEDs, Washers, Showerheads	149,544	$ 48,734	10,658	Showerheads	47	$ 0
Residential Total			**3,260,565**	**$ 2,026,805**			**408,525**	**$ 2,146,018**
Commercial/Industrial								
Site-Specific	316	Projects	7,102,132	$ 1,783,761	11	Projects	117,228	$ 488,534
Compressed Air	0	Units	0	$ 0	-	NA	0	$ 0
Grocer	0	Projects	0	$ 0	-	Projects	0	$ 0
Food Services	13	Projects	54,257	$ 12,868	41	Projects	30,123	$ 112,057
Green Motors	6	Motor Rewinds	11,978	$ 2,762	-	NA	0	$ 0
HVAC	0	Units	0	$ 0	50	Units	18,126	$ 96,734
Shell	12	Projects	35,587	$ 16,041	6	Projects	6,880	$ 37,481
Exterior Lighting	855	Projects	5,482,211	$ 1,697,257	-	NA	0	$ 0
Interior Lighting	624	Projects	7,731,720	$ 1,496,004	-	NA	0	$ 0
Motor Control HVAC	2	Projects	166,470	$ 32,197	-	Projects	0	$ 0
Commercial/Industrial Total			**20,584,356**	**$ 5,040,889**			**172,357**	**$ 734,806**
Energy Efficiency Total			**24,186,197**	**$ 9,232,265**			**595,332**	**$ 4,198,841**

APPENDIX G – 2020 EXPENDITURES BY PROGRAM

Program	Electric		Natural Gas		Total	
Low-Income						
Low-Income	$	623,481	$	976,626	$	1,600,107
Health and Safety	$	109,542	$	99,510	$	209,052
CEEP	$	590,299	$	0	$	590,299
Residential						
ENERGY STAR Homes	$	19,500	$	2,600	$	22,100
HVAC	$	68,970	$	1,295,595	$	1,364,565
Multifamily Direct Install	$	715,646	$	2,705	$	718,351
Shell	$	135,318	$	585,447	$	720,766
Simple Steps, Smart Savings	$	10,113	$	0	$	10,113
Water Heater	$	25,370	$	150,900	$	176,270
Commercial/Industrial						
Site-Specific	$	1,230,300	$	274,356	$	1,504,656
Compressed Air	$	0	$	0	$	0
Grocer	$	0	$	0	$	0
Food Services	$	9,610	$	59,600	$	69,210
Green Motors	$	2,048	$	0	$	2,048
HVAC	$	0	$	55,106	$	55,106
Shell	$	8,958	$	18,497	$	27,455
Exterior Lighting	$	1,280,845	$	0	$	1,280,845
Interior Lighting	$	893,959	$	0	$	893,959
Motor Control HVAC	$	15,919	$	0	$	15,919
Energy Efficiency Total	**$**	**5,739,876**	**$**	**3,520,943**	**$**	**9,260,819**
Market Transformation						
NEEA	$	1,528,771	$	324,819	$	1,853,589
Market Transformation Total	**$**	**1,528,771**	**$**	**324,819**	**$**	**1,853,589**
Other Programs and Activities						
General Implementation	$	542,967	$	116,655	$	659,622
Labor Costs	$	2,060,474	$	429,517	$	2,489,991
Marketing Costs	$	297,352	$	33,768	$	331,120
Third Party Implementation	$	260,073	$	6,913	$	266,985
Pilot Programs	$	108,850	$	22,147	$	130,997
EM&V/CPA	$	332,696	$	92,772	$	425,469
Other Programs and Activities Total	**$**	**3,602,412**	**$**	**701,771**	**$**	**4,304,183**
Grand Total	**$**	**10,871,059**	**$**	**4,547,533**	**$**	**15,418,592**

APPENDIX H – 2020 PROCESS EVALUATION REPORT

CADMUS

Appendix to the 2020 Annual Conservation Report

Process Evaluation Report

April 16, 2021

Prepared for:

Avista

1411 E. Mission Avenue

Spokane, WA 99202

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Executive Summary

As part of the Avista 2020 demand-side management (DSM) portfolio evaluation, Cadmus conducted process evaluation activities for program year (PY) 2020. The process evaluation focused on three fundamental objectives:

- Assess participant and market actor program journey, including motivation for participation, barriers to participation, and satisfaction
- Assess Avista and implementer staff experiences, including organizational structure, communication, and program processes
- Document areas of success, challenges, and changes to the program

This report describes Cadmus' data collection and process methods, presents analysis results, summarizes findings, draws conclusions, and recommends possible improvements for the Nonresidential, Multifamily, and Residential programs listed in Table 1.

Table 1. PY 2020 Process Evaluations

Program	Idaho	Washington
Nonresidential Programs		
Site Specific	✓	✓
Prescriptive [a]	✓	✓
Multifamily Programs		
Multifamily Direct Install (MFDI)	✓	✓
Multifamily Market Transformation (MFMT)	✓	
Residential		
ENERGY STAR® Homes	✓	✓
Simple Steps, Smart Savings	✓	
HVAC		✓
Water Heat		✓
Shell and Windows		✓

[a] Includes Lighting, Food Service Equipment, Green Motors Rewind, Commercial HVAC, Insulation, HVAC Motor Controls, Grocer, Fleet Heat, and AirGuardian Compressed Air.

Summary of Milestones and Deliverables

Cadmus conducted the evaluation by reviewing documents, surveying participants, and interviewing program and implementation staff and contractors. Table 2 lists the completed process evaluation activities.

Table 2. PY 2020 Completed Milestones and Deliverables

Milestones and Deliverables	Completed
Document and Database Review	✓
Avista and Implementer Interviews	✓
Participant Surveys	✓
Trade Ally Interviews	
Multifamily Property Managers	✓
Builders	✓

Key Conclusions

Nonresidential

- **The impact of COVID-19 on project scope was minimal, but going forward there may be slight reductions in the number or scope of energy efficiency projects due to budget or staff constraints.**
  - Ten of 13 Site Specific respondents and 88% (n=59) of Prescriptive participants said COVID-19 did not create any obstacles to their 2020 project; most respondents who reported obstacles said the obstacles were minor.
  - Four of 13 Site Specific respondents and 24% of Prescriptive respondents expected reductions to budget or staff availability to support energy efficiency upgrades in PY 2021.
- **Although contractors drive a significant portion of participation, continued Avista outreach and messaging is important to support contractor sales.**
  - Eight of 15 Site Specific participants and 70% (n=63) of Prescriptive participants reported first hearing about the Avista program from a contractor, vendor, or retailer.
  - Twelve of 15 Site Specific participants and 55% (n=64) of Prescriptive participants thought the best way to learn about rebates and incentives was through Avista emails or direct mail, or communication from an Avista account representative.
- **Despite some process issues in PY 2020, participants are satisfied with the application process and the program overall.**
  - Site Specific satisfaction was lowest for process-related aspects, including submitting the rebate application (75% satisfied, n=15) and the time to process the application (87% satisfied), but 100% of respondents were satisfied with the program overall.
  - Though 14% of Prescriptive participants mentioned the application paperwork was burdensome, and 9% had some difficulty understanding requirements, 100% of participants were satisfied with the program overall, and several respondents mentioned the easy and fast process as an aspect of the program that worked well. Suggestions for process improvements were related to potential enhancements (such as a searchable database of eligible products, or chat feature for application support) rather than suggestions to correct significant problems.

Multifamily

- **MFDI: Collaborative relationships between Avista and the program implementer allowed new delivery methods and future implementation techniques to be conceptualized quickly in response to COVID-19. Open communication between the implementer and property managers ensured the quick dissemination of new implementation information to maintenance staff and tenants allowing the program to continue in PY 2020 despite challenges due to the pandemic.**
  - In response to continued COVID-19 restrictions, Avista and implementer staff developed a contactless delivery method.
  - Due to low uptake in the first post-COVID-19 implementation phase, Avista and the implementer adjusted the program to increase participation and measure installation by limiting measures and working with property managers.
- **MFDI: Property managers were satisfied with the program but suggested some tenants were not satisfied with all the measures included in the program. Additionally, some tenants did not install measures that were difficult to install or for which they did not have appropriate tools.**
  - Four of five property managers (4 of 5) were *very satisfied* with their MFDI program experience overall.
  - Two property managers reported tenants were not satisfied with faucet aerators and kitchen aerators due to low water pressure and appearance while three property managers reported tenants were dissatisfied with showerheads due to restricted water flow.
  - One property manager reported that tenants' participating in Phase 1 were *not at all satisfied* with installation and educational materials provided by Avista.
- **MFDI: The reliance of current data tracking on tenants' willingness to return uninstalled or unused equipment, together with low recovery rates, may be a contributing factor to minor inconsistencies in measure-level data.**
  - The drop-off delivery phases relied heavily on documentation filled out by maintenance staff and tenants detailing the location and type and quantity of both installed and removed measures. The implementer noted during the drop-off phases difficulty in tracking measure installation locations in tenants' units without the presence of a field technician to document measure implementation.
- **MFMT: Overall, the MFMT program was successful meeting the energy savings goal and achieving high program satisfaction.**
  - The program surpassed its electric savings goal of 476 MWh per year for PY 2020.
  - Builders have told Avista staff that they appreciate the incentive because it allows them to install natural gas appliances which provides a competitive advantage, since they say natural gas appliances are more attractive and can help increase the value of units.
  - The builder who completed a survey said they were *very satisfied* with the program and planned to participate to a greater extent in 2021.

- **The MFMT program has had success working with HVAC installers to help market the program, though more can be done to increase marketing efforts and participation, as a result.**
  - Avista reported success working with HVAC installers to help promote the program. Staff said this is a beneficial relationship as the HVAC installers are provided with additional work and the program with more participants.
  - Avista reported that there used to be a flyer handed out as promotional material for the program, though it is no longer used. Staff also said there is no current way in which they monitor effectiveness of their marketing efforts and do not cross-promote the MFMT program with other Avista programs.

Residential

- **Like some utility energy efficiency programs, the ENERGY STAR Homes program was negatively affected by the COVID-19 pandemic.**
  - Avista achieved its target number of rebates for electric and electric/natural gas homes in Idaho but otherwise fell short of other state-specific, fuel-specific, and overall goals. The pandemic forced local manufactured homes dealers to close down, slowed the ENERGY STAR certification process for newly constructed manufactured homes, and, as was seen nationally, likely increased income insecurity among Avista's target customer base.
- **Contractors remain an important way to learn about the Residential programs but survey respondents also indicated an increased interest in learning about the programs through email from Avista.**
  - The share of respondents who learned about Avista's program through contractors increased from 38% in PY 2019 to 52% in PY 2020. Additionally, 15% of PY 2020 respondents said that contractors would be the best way for Avista to inform them about energy efficiency, compared to 9% in PY 2019.
  - The most common way PY 2020 respondents would like for Avista to inform them about energy efficiency is through email from Avista (37%). This percentage increased from 10% in PY 2019 respondents, indicating more interest in this method of communication.
- **Saving money or energy are key drivers of motivation to participate in the program.**
  - Eighty-eight percent of PY 2020 respondents said that saving money or saving energy motivated them to participate, and 96% of respondents listed energy savings, rebates, or lower operating costs as a benefit of participating in the program.
- **Participants remain highly satisfied with most aspects of the program.**
  - More than 99% of respondents were *very satisfied* or *somewhat satisfied* with their interactions with Avista staff and the program overall, as well as with the time it took to receive the rebate, the application process, and their new energy-saving equipment.
- **Information from equipment retailers or installers heavily influenced respondents' decision to participate.**

- Ninety-six percent of respondents rated this information as *very important* or *somewhat important*, compared to information about the equipment from friends and relatives, which 67% of respondents rated as *very important* or *somewhat important.*

Third-Party Implementer

- **The implementer responded to the COVID-19 pandemic thoughtfully, which enabled the program to continue to perform well despite the circumstances until its termination in September 2020.**
  - The implementer let retailers permit or deny store visits from implementation field staff, allowed field staff the flexibility to reschedule store visits, and conducted virtual store visits to educate store associates about the program and products (such as LEDs) like it typically would. Avista and the implementer also scaled back marketing and outreach efforts and allowed each retail location to tailor marketing, including point-of-purchase materials provided by the implementer, to their individual needs.
- **Avista and the implementer faced uncertainty with the repeal of the Energy Independence and Security Act, which led to the Simple Steps, Smart Savings program being implemented differently in Washington.**
  - The implementer offered rebates for clothes washers in Washington and for LEDs, showerheads, and clothes washers in Idaho. Avista did not set goals for clothes washers in Washington or for LEDs in Idaho.
- **Avista observed unexpectedly low throughput for clothes washers, which the implementer attributed to the challenge it faced when recruiting retail locations to participate.**
  - Despite showing a willingness to participate, some retail locations for franchised and individually owned stores like Ace Hardware could not offer program rebates because of a lack of communication/direction from their corporate offices. Thus, fewer retailers offered buy-downs for clothes washers, and fewer customers obtained clothes washer rebates.

Recommendations

Nonresidential

Nonresidential Recommendation 1: Develop tools to help participants sort through options and scope eligible projects more quickly. For example, although the Avista website currently directs customers to search for eligible lighting on the ENERGY STAR Product Finder database or DesignLights Consortium websites, both of which have advanced search functionality, the search results can be overwhelming. A resource such as an "Energy Efficiency Buying Guide" for specific products could help customers with less technical background navigate their options or evaluate and understand proposals they receive from contractors.

Nonresidential Recommendation 2: If not already doing so, use email blasts, bill inserts, and other promotional tools that are direct from Avista to its customers, and use Avista branding to promote Nonresidential programs and incentives. Participants were more likely to want communication directly from Avista than through their contractor or vendor. These marketing efforts will enhance any contractor and vendor marketing or advertising, and give sales representatives better credibility, enabling them to make more sales through the program.

Multifamily

MFDI Recommendation 1: If the MFDI program continues to request tenants install measures directly, consider offering an additional incentive such as an entry in a drawing for returning measures that are not installed and for providing information on installed measures and their location.

MFDI Recommendation 2: If the MFDI program continues to operate using the drop-off delivery method which requires tenants to install measures directly, continue focusing on simple and easy-to-install measures like LEDs. Provide easy to follow installation instructions and remind tenants of the benefits of installation in the program materials.

MFMT Recommendation 1: Develop marketing materials which can be used by HVAC contractors to help promote the MFMT program. Due to the strengthening relationships between program staff and HVAC contractors, promotional materials could be greatly beneficial to provide information about the program in instances where the contractors may encounter potential participants.

MFMT Recommendation 2: Develop strategies to evaluate the effectiveness of marketing efforts and cross-promotion with other Avista programs. In order to understand if marketing efforts are successful, evaluation standards or goals should be set to better understand what the primary forces are that drive participation to the program. Cross-promotion is also a simple and effective way to increase visibility of the program and garner interest from potential participants.

Residential

Residential Recommendation 1: If not already doing so, use email blasts, bill inserts, and other promotional tools that are direct from Avista to customers, with Avista branding, to promote Residential programs and incentives. Although most participants learned about the programs from their contractor, they were more likely to want communication directly from Avista than through their contractor or vendor. These marketing efforts will enhance any contractor and vendor marketing or advertising, and give them better credibility, enabling them to make more sales through the program.

Residential Recommendation 2: Focus program outreach on home comfort to encourage participants since this was mentioned as a motivating factor for participation.

Third-Party Implementer

Because Simple Steps, Smart Savings discontinued in PY 2020, Cadmus does not have any recommendations to make for the program.

Introduction

In program year (PY) 2020, Avista provided rebates and services to its Nonresidential and Residential electric and natural gas customers throughout its Washington and Idaho service territories. The PY 2020 portfolio process evaluation sought to identify and document each program's successes and challenges by reviewing program materials; conducting interviews with program and implementation staff and trade allies; and conducting surveys with Nonresidential and Residential program participants.

Program Descriptions

Table 3 provides a summary of programs included in Avista's 2020 demand-side management (DSM) portfolio's evaluation.

Table 3. PY 2020 Evaluated Program Descriptions

Program	Measure(s)	Implementer	Program Summary
Nonresidential			
Site Specific	Custom measure(s)	Avista	Customers design energy efficiency projects with documented energy savings and a minimum 10-year measure life for a technical review and possible rebates.
Prescriptive	Lighting, HVAC, variable frequency drives (VFDs), food service equipment, grocer, and shell	Avista	Customers identify potential energy efficiency projects, submit paperwork, and receive Prescriptive rebates for projects.
Fleet Heat [a]	Smart block heating system	Avista	Electric customers receive a smart block heating system to install on vehicles. The device controls the water temperature in the block and the air temperature outside the block. HOTSTART can provide Installation help.
Green Motor Rewind	Repair/rewind of motors	The Green Motors Practices Group (CMPG)	Electric customers who receive a green motor rewind at a participating service receive a rebate. The rebate applies to 15 hp to 5,000 hp industrial motors.
AirGuardian [a]	Compressed air leak reduction device	Sight Energy Group	Following a compressed air audit, electric customers receive direct installation of a compressed air leak reduction device.
Multifamily			
Multifamily Direct Install (MFDI)	Lighting, water-saving measures, smart power strips, VendingMisers	SBW Consulting	Direct installation of energy-saving measures, on-site audits to identify opportunities and interest in existing Avista programs, and follow-up- visits to install supplemental lighting measures.
Multifamily Market Transformation (MFMT)	Natural gas space and water heat	Avista	New multifamily development receives incentives to install natural gas space and water heating.

Program	Measure(s)	Implementer	Program Summary
Residential			
HVAC	Space heat and smart thermostats	Avista	Customers complete energy efficiency projects, submit paperwork, and receive Prescriptive rebates for projects.
Water Heat	Water heat		
Shell and Windows	Wall, floor, and attic insulation; standard and storm windows		
ENERGY STAR Homes	New ENERGY STAR manufactured homes		Home dealers promote and sell ENERGY STAR-certified manufactured homes to customers.
Residential Third-Party Implementer Programs			
Simple Steps, Smart Savings	LEDs, LED fixtures, showerheads, clothes washers	CLEAResult	Midstream program markdowns are offered for certain products in retail stores; CLEAResult receives monthly sales data and provides program support through retailer visits.

[a] Cadmus planned to evaluate the Fleet Heat and AirGuardian programs, but there were no participants in 2020.

Methodology

This section describes the interview and survey methodology.

Program Administrator and Implementer Interviews

Cadmus conducted telephone interviews with the program staff and third-party implementers listed in Table 4. Interviews focused on the following program topics:

- Program roles and responsibilities
- Program goals and objectives
- Program design and implementation
- Data tracking
- Program participation
- Marketing and outreach
- Program successes
- Market barriers
- Program impacts on the market
- Future program changes, including redesigns

Table 4. PY 2020 Stakeholder Interviews

Program	Avista Staff	Implementer Staff
Nonresidential Programs		
Site Specific	✓	N/A
Prescriptive [a]	–	N/A
Multifamily Programs		
Multifamily Direct Install	✓	✓
Multifamily Market Transformation	✓	N/A
Residential Programs		
ENERGY STAR® Homes	✓	N/A
HVAC	–	
Water Heat	–	
Shell and Windows	–	
Simple Steps, Smart Savings	✓	✓

[a] Includes Lighting, Food Service Equipment, Green Motors Rewind, Commercial HVAC, Insulation, HVAC Motor Controls, Grocer, Fleet Heat, and AirGuardian Compressed Air.

Market Actor Ally Interviews

In PY 2020, Cadmus conducted telephone interviews with various market actors to assess levels of program awareness, experiences, successes, and challenges. Avista provided contact lists for each audience. Table 5 lists the program, audience, number of records provided by Avista, interview target, and number of interviews. Cadmus was unable to meet the MFDI target despite multiple attempts to contact every record and unable to meet the MFMT target due to a lower than expected population size.

Table 5. PY 2020 Trade Ally Interviews

Program	Audience	Number of Records	Target	Number of Interviews
Multifamily Direct Install	Participating Property managers	11	10	5
Multifamily Market Transformation	Participating multifamily home builders	3	5	1

Participant Surveys

Cadmus completed 119 online surveys in PY 2020 with Residential program participants in Washington and 81 online surveys in PY 2020 with Nonresidential program participants in Washington and Idaho. Cadmus relied on site visits and telephone reminder calls to increase Nonresidential survey participation. The participant survey guides gathered critical insights into participants' program journey, covering the following topics:

- Program awareness
- How respondents learned about the program
- General program participation
- Reasons for participation
- Program benefits
- Program delivery experience
- Overall program satisfaction
- Satisfaction with Avista
- Current energy-efficient behaviors and purchases
- Suggestions for program improvements

Residential Sampling

To prepare the participant contact list for the Residential survey, Cadmus removed duplicate records, records with incorrect or missing email addresses, and records selected by the Residential impact evaluator for impact analysis activities. After preparing the list, Cadmus randomly selected a sufficient number of records proportionate to participation in each of the programs to include in the sample frame. Cadmus sent an email invitation to participants included in the sample frame, followed by a reminder email. Overall, Cadmus collected 119 responses for process evaluation purposes, as shown in Table 6.

Table 6. Residential Participant Survey Sample Frame, Target, and Completes by Program

Program	Total		
	Sample Frame [a]	Target	Complete
HVAC	906	70	64
Shell and Windows	388		48
Water Heating	106		7
Total	**1,400**	**70**	**119**

[a] Sample frame refers to the records selected for the survey contact list.

Nonresidential Sampling

To prepare the contact lists for each Nonresidential survey, Cadmus removed duplicate records and records with incorrect or missing email addresses. Cadmus sent an email invitation to a census of all participants in each program, followed by two reminder emails. To increase the number of survey responses, the field engineers urged participants to complete the survey during virtual site visits if they had not yet done so. Additionally, because of low initial participation in the Site Specific survey, Cadmus made one telephone attempt to Site Specific participants to increase participation.

As shown in Table 7, Nonresidential participants completed 81 surveys in PY 2020.

Table 7. Nonresidential Participant Survey Sample Frame, Target, and Completes by Program

Program	PY 2020 Total		
	Sample Frame [a]	Target	Completes
Nonresidential Site Specific			
Electric	64	All eligible	**14**
Gas	5		**1**
Dual	4		-
Nonresidential Prescriptive			
Lighting	750	30 to 40	**63**
Food Service Equipment	8	AMAP (between 10 and 20)	**1**
Green Motors Rewind	8		**1**
Commercial HVAC	7		-
Insulation	5		**1**
HVAC Motor Controls	1		-
Grocer	1		-
Fleet Heat	0		-
AirGuardian	0		-
Total	**853**		**81**

[a] Sample frame refers to the records available for surveys after removing duplicate records, records with only installer contact information, and records with incomplete or bad contact information.

Nonresidential Programs

This section focuses on two Nonresidential programs: Site Specific and Prescriptive. The Site Specific program provides incentives to customers who install custom energy efficiency projects, while the Prescriptive program offers incentives for specific measures and services.

Nonresidential Site Specific Findings

This section describes the findings from 15 surveys completed with PY 2020 Site Specific participants. Where meaningful, Cadmus compares PY 2019 results to PY 2020.

Program Changes

In PY 2020, Avista made one change to the Site Specific program, transitioning to the iEnergy data tracking system. Avista now inputs all project level details, savings, payments, and sales after project approval in both iEnergy and InfoCRM. Avista plans to use iEnergy as the primary analysis and storage tool for all Site Specific projects moving forward and plans to transition to iEnergy fully by the end of 2021.

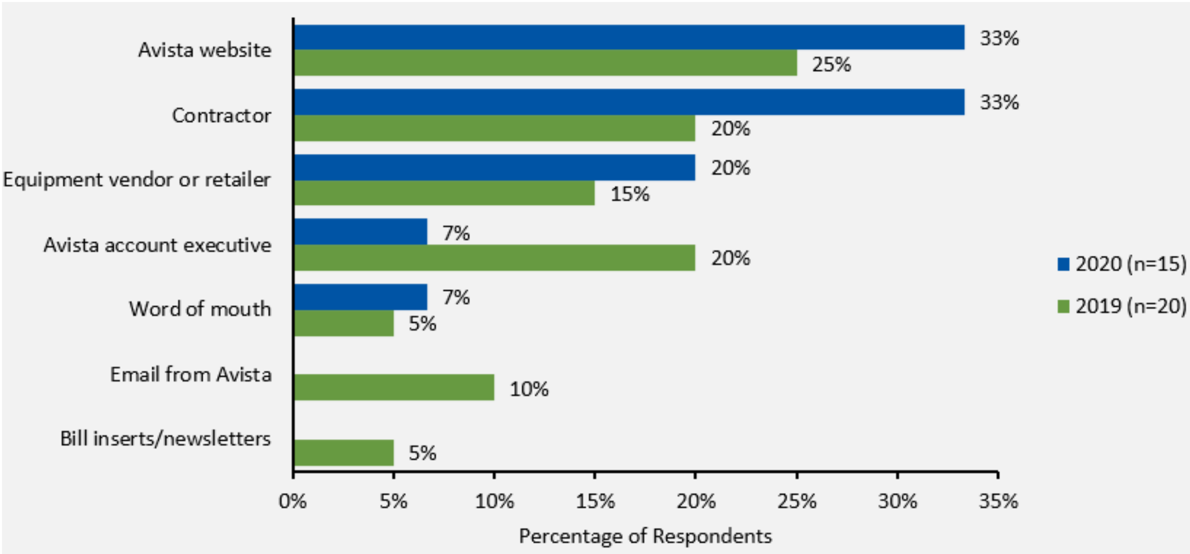
In addition to this program change, Avista specifically started targeting small businesses in rural service territories where Avista programs are less active. Avista targets rural customers through direct mail communication and informs them about the availability of energy efficiency and billing assistance services, along with other Avista resources.

The program manager did not report problems or issues in implementing the Site Specific program, other than customers were more focused on the financial viability of their businesses, due to COVID-19, instead of energy efficiency.

Customer Awareness

The PY 2020 Site Specific survey indicated that the majority of participants (10 of 14) had previously participated in an Avista energy efficiency program, which is consistent with PY 2019 results. As shown in Figure 1, survey respondents first learned about the Site Specific program through a variety of sources. The Avista website and contractors were both mentioned by 33% of PY 2020 respondents, followed by equipment vendors or retailers. PY 2020 respondents were less likely to mention contact with an Avista representative, word of mouth, or Avista direct marketing through emails or direct mail than PY 2019 respondents.

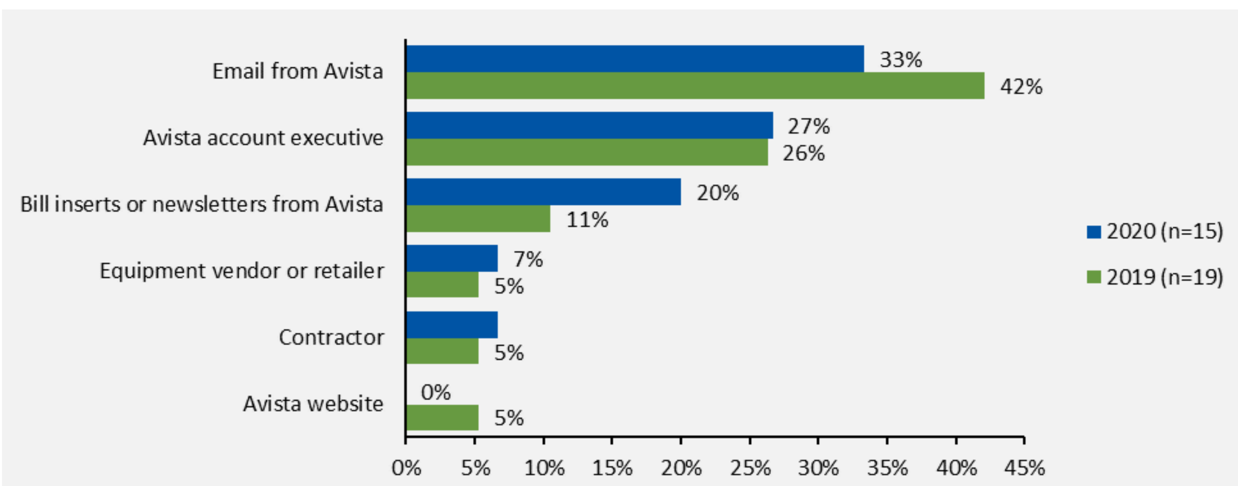
Figure 1. How Participants First Learned of Program



Source: Site Specific survey questions C2: "How did you first hear about the Site Specific program?"

When asked how they preferred to learn of rebates and incentives, PY 2020 respondents were most likely to select email, followed by their account executive. This is notably different from the actual channel through which they learned about the program, as discussed above. As shown in Figure 2, responses in PY 2020 closely matched responses in PY 2019.

Figure 2. How Participants Prefer to Learn of Programs and Offers

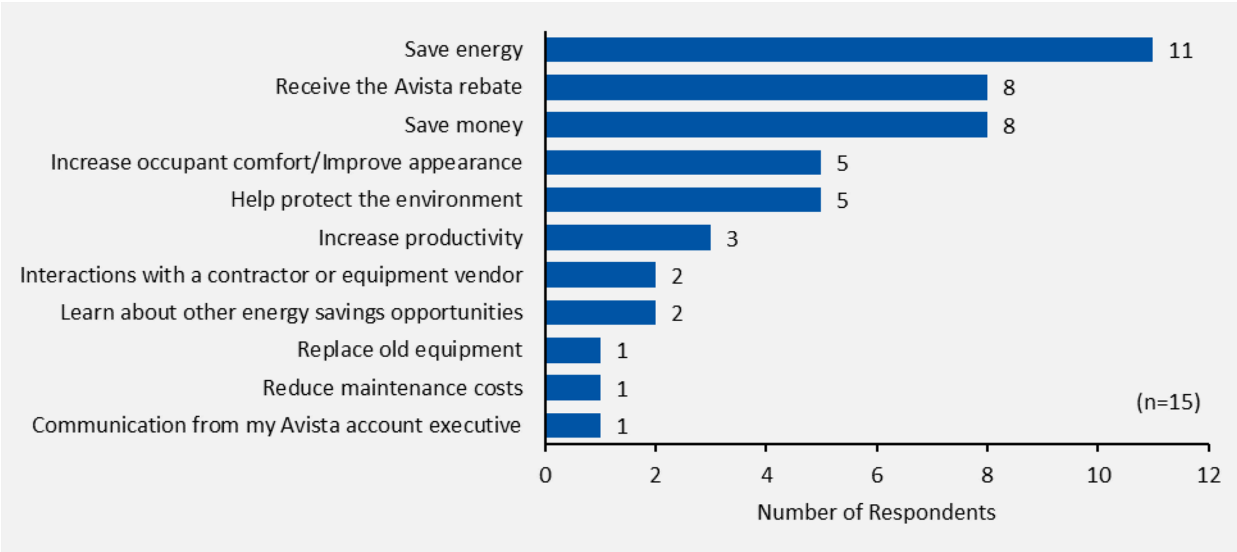


Source: Site Specific survey questions C3: "What is the best way for Avista to inform commercial customers like you about their rebates and incentives for energy efficiency improvements?"

Participation Motivations and Benefits

Figure 3 shows the distribution of motivations identified by PY 2020 Site Specific survey respondents. Participants were primarily driven by economic motivations including saving energy, taking advantage of the Avista rebate, and saving money on utility bills. Increasing occupant comfort or improving the appearance of a space and helping the environment were also frequently mentioned.

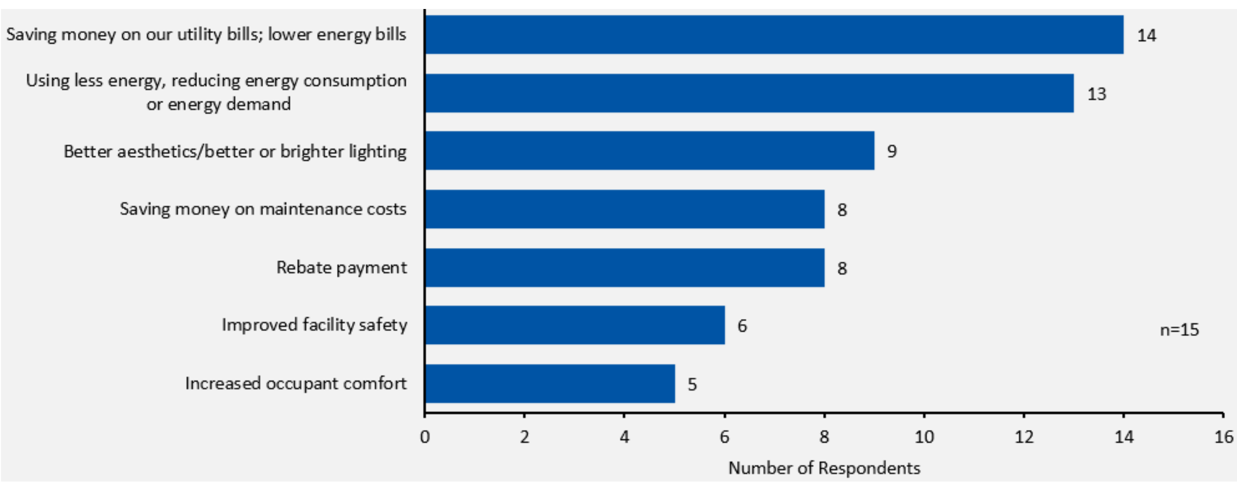
Figure 3. Site Specific Participant Motivation



Source: Site Specific survey question C4: "What motivated you to participate in the Site Specific Program?" Multiple responses allowed.

Respondents' perceived benefits aligned closely with their motivations, as shown in Figure 4. The majority of respondents cited using less energy and saving money on utility bills as benefits, over half of respondents noted better aesthetics from improved lighting, reduced maintenance costs, and the rebate payment.

Figure 4. Site Specific Participation Benefits



Source: Site Specific survey question C5: "What would you say are the main benefits your company has experienced as a result of participation?" Multiple responses allowed.

Customer Experience

Program Delivery

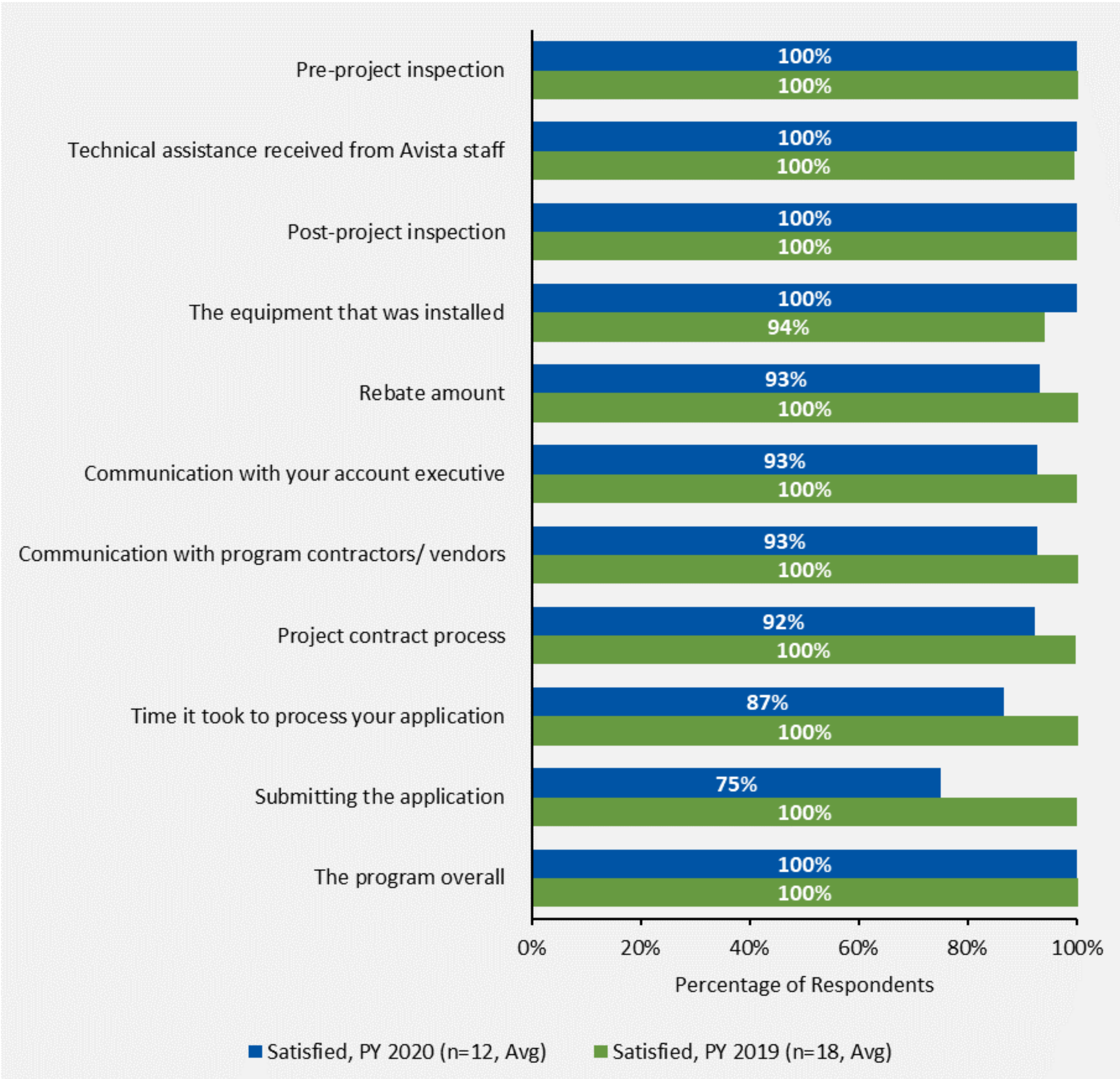
Most PY 2020 respondents (12 of 15) reported their contractor, vendor, or retailer was involved in the design or implementation of their project. Six of those respondents reported their Avista account executive was also involved. Two-thirds of those respondents (8 of 12) said the contractor, vendor, or retailer also took the lead in preparing the application, and three of those respondents received a discount from the contractor rather than receive the rebate directly.

Of the three who did not mention a contractor helping implement their project, one said their Avista account representative was involved in the design of the project, and two respondents said they completed the projects on their own.

Program Satisfaction

Figure 5 compares the percentage of PY 2020 respondents rating themselves *very satisfied* or *somewhat satisfied* with different aspects of the Site Specific program with responses from PY 2019. Respondents were less likely to be satisfied with several components in PY 2020 than in PY 2019, in particular with the process to submit the application and the time it took to process it. In comments explaining their satisfaction levels, one respondent had difficulty understanding the paperwork, another experienced delays after their Avista representative retired, and a third reported this was their first energy efficiency project, and they were unsure how to proceed.

Figure 5. Respondents Satisfied with Site Specific Program Components



Source: PY 2020 and 2019 Site Specific survey question E1: "In terms of the Site Specific program, how satisfied were you with the following aspects? Please think about each item individually as you select your answer." Showing only respondents that indicated they were *very satisfied* or *somewhat satisfied*.

Program Challenges and Successes

As shown in Table 8, 10 of 15 PY 2020 respondents reported experiencing program participation challenges. Another respondent reported having no challenges, while four others did not respond. In PY 2020, the most common challenge reported by participants was just learning about the program. Another two respondents reported internal challenges, related to getting approval to pursue the project and for the upfront capital expense.

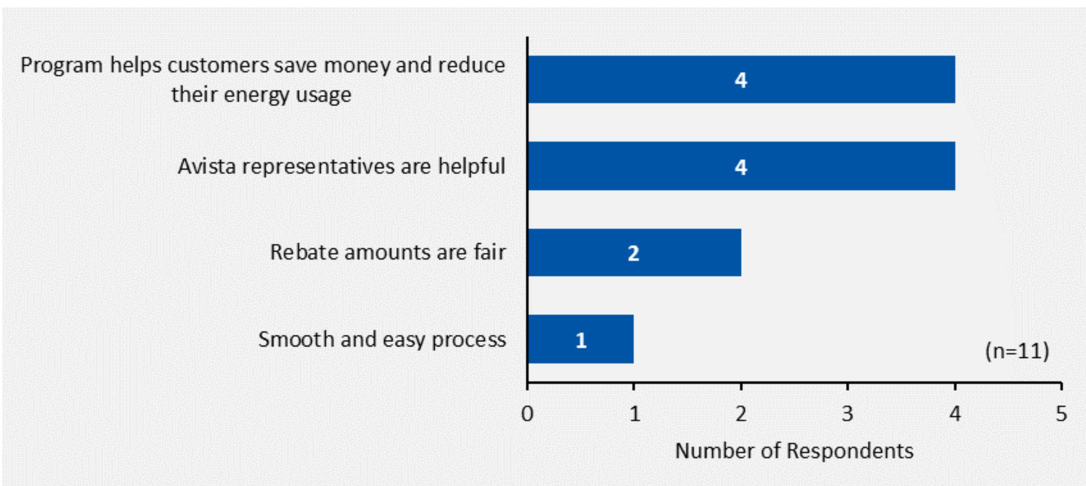
Table 8. PY 2020 Participation Challenges

Challenge	PY 2020 (n=10)
Discovering the program	3
Getting internal interest and approval	2
Finding eligible equipment	1
Understanding what equipment is eligible	1
Slow communication from Avista	1
Delay in receiving the rebate check	1
Finding a contractor willing to work with the program	1

Source: Site Specific survey question E3: "What do so see as the biggest challenges to participating in Avista's Site Specific program?"

Despite these issues, 11 PY 2020 respondents identified aspects of the program that they viewed as working well. For example, one PY 2020 Site Specific participant said, "It is great that Avista is working with business[es] and residents to reduce the electrical demand with new tech." Figure 6 shows the full break down of responses.

Figure 6. Site Specific Program Successes



Source: Site Specific survey question E5: "What would you say is working particularly well with Avista's Site Specific program?" Multiple responses allowed.

While seven PY 2020 respondents indicated they could not think of ways to improve the program, four survey respondents provided recommendations:

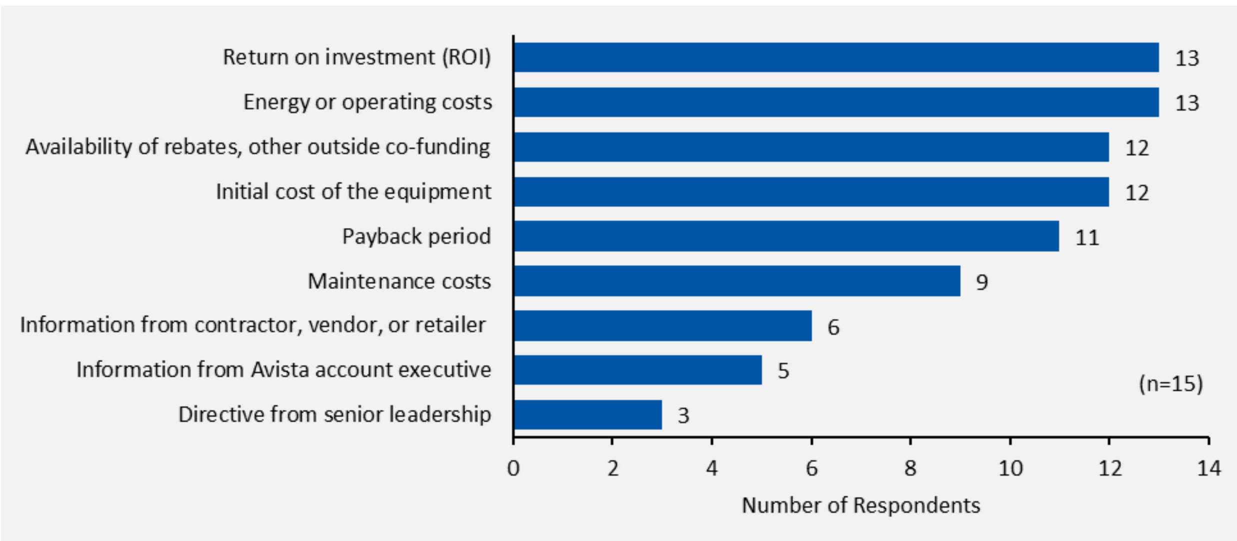
- Quicker response and interim check-ins from Avista (2 respondents)
- Increase awareness (1 respondent)
- More information about process provided upon initiating a project, including information about factors that might cause delays (1 respondent)
- Simplify the approval process (1 respondent)

Energy Efficiency Attitudes and Behaviors

Twelve of 15 PY 2020 respondents said the rebate provided by Avista was *very important* in their decision to complete their project. Another two said it was *somewhat important* and one said the rebate was *not too important* in their decision. All respondents said energy efficiency was *very* or *somewhat important* when making capital upgrades or improvements.

As shown in Figure 7, respondents most commonly selected the project's return on investment and energy or operating costs as the most important criteria in their decision to complete their project, followed closely by rebate or outside funding availability. These responses are similar to those from PY 2019.

Figure 7. Important Criteria for Making Energy Efficiency Improvements



Source: Site Specific survey question F5: "Which of the following criteria are important in deciding whether your company makes energy efficiency improvements?" Multiple responses allowed.

Since participating in the Site Specific program, four PY 2020 respondents purchased energy-efficient equipment, and two adopted new energy-efficient protocols. Three respondents who mentioned purchasing new equipment had invested in lighting upgrades, and one had purchased a new ventilation system. One respondent with new protocols had changed their refrigeration setpoints, and the second had adopted a checklist for turning off equipment.

In PY 2020, participants faced potential obstacles related to COVID-19 shut-downs. However, 10 respondents said there were no impacts to their project from the pandemic. One respondent said their project scope was impacted because it was difficult to get supplies. Two respondents said their project timeline was impacted, but the delays were minor. Going forward, nine respondents thought the COVID-19 economic impacts would not affect their organization's interest in or ability to complete other energy efficiency projects, but three respondents thought there would be less budget available and one respondent thought there would be less staff time available for such projects.

Survey Respondent Profile

The majority of PY 2020 Site Specific survey respondents (13 of 15) owned their facilities, while two leased. Employee numbers at each facility ranged from six to 330, with an average of 80 per facility (n=11). Eleven of 15 facilities used gas for heating, and four used electricity. The PY 2020 sample included a range of sectors, including industrial, commercial, public, and nonprofits.

Nonresidential Prescriptive Findings

This section describes findings from 65 online surveys completed with Prescriptive participants for PY 2020. Because 63 of the 65 respondents installed lighting projects, the results primarily represent lighting participants rather than non-lighting participants. Because the PY 2020 sample did not reflect the same mix of lighting and non-lighting as the PY 2019 survey, Cadmus did not compare PY 2020 results to prior years.

Program Changes

As shown in Table 9, Avista made several changes to the lighting program in PY 2020; the PY 2020 Avista Washington Annual Conservation Plan, Appendix A, page 12, compares the PY 2019 and PY 2020 Prescriptive lighting rebates.

Table 9. Prescriptive Lighting Rebate Changes

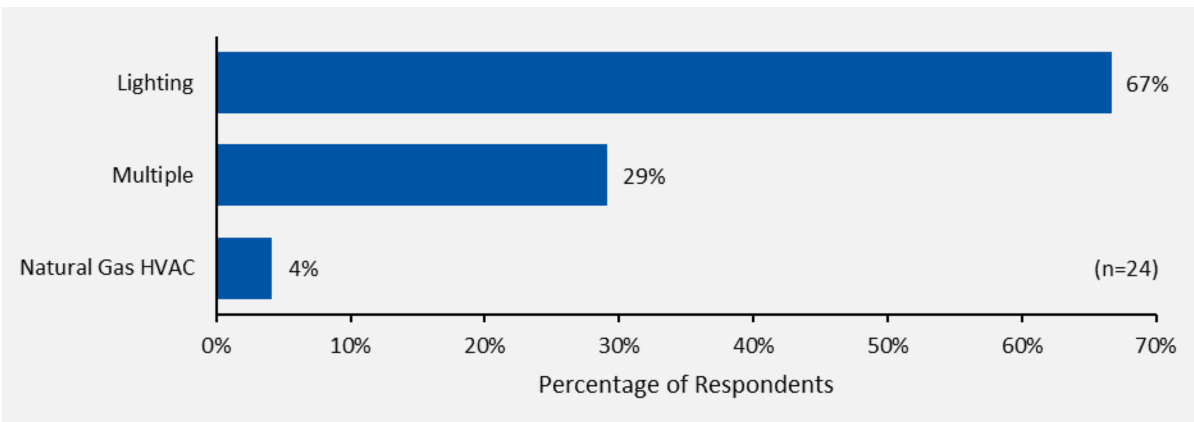
Change	PY19	PY20
Fluorescent Tubular Lamps		
T5HO four-foot TLED	$15	$12.50
T8 four-foot TLED	$6.50	$6.50
U-bend LED	$8	$10.00
T8 eight-foot TLED	$13	$11.50
Fluorescent Fixtures		
2, 3, or 4-lamp T12/T8 fixture to LED qualified 2x4 fixture	$40	$45
2-lamp T12/T8 fixture to LED qualified 2x2 fixture	$30	$20
250-watt HID fixture to ≤140-watt LED fixture or lamp	$155	$125
1,000-watt HID fixture to ≤400-watt LED fixture or lamp	$205	$185
1,000-watt HID fixture to ≤400-watt LED fixture or lamp	$460	$270
2-watt to 9-watt MR16 lamp	$10	$5.50
Occupancy sensors with built-in relays	$40	$25
70-watt to 89-watt HID fixture to ≤25-watt LED fixture, retrofit kit, or lamp	$60	$65
90-watt to 100-watt HID fixture to ≤30-watt LED fixture, retrofit kit, or lamp	$80	$85
150-watt HID fixture to ≤50-watt LED fixture, retrofit kit, or lamp	$125	$130
175-watt HID fixture to ≤100-watt LED fixture, retrofit kit, or lamp	$130	$130
250-watt HID fixture to ≤140-watt LED fixture, retrofit kit, or lamp	$140	$160
320-watt HID fixture to ≤160-watt LED fixture, retrofit kit, or lamp	$180	$195
400-watt HID fixture to ≤175-watt LED fixture, retrofit kit, or lamp	$255	$280
750-watt HID fixture to ≤300-watt LED fixture, retrofit kit, or lamp	$450	$490
1,000-watt HID fixture to ≤400-watt LED fixture, retrofit kit, or lamp	$610	$610
175-watt code HID fixture to ≤100-watt LED fixture	$130	$130
250-watt code HID fixture to ≤140-watt LED fixture	$140	$160
320-watt and 400-watt code HID fixture to ≤160-watt LED fixture	$250	$195

Change	PY19	PY20
T12 to LED sign lighting	$17/sq ft	$22/sq ft
LLLC Fixture	-	$35

Customer Awareness

Just over one-half of PY 2020 survey respondents (50%, n=60) previously participated in an Avista business energy efficiency program, for a previous participation rate about equal to the PY 2019 program year (56%, n=75). Of the 31 respondents who participated previously, 24 provided details about programs in which they participated. As shown in Figure 8, most reported installing lighting, with five respondents reporting they participated multiple times in previous years, and one respondent reporting having previously upgraded a furnace.

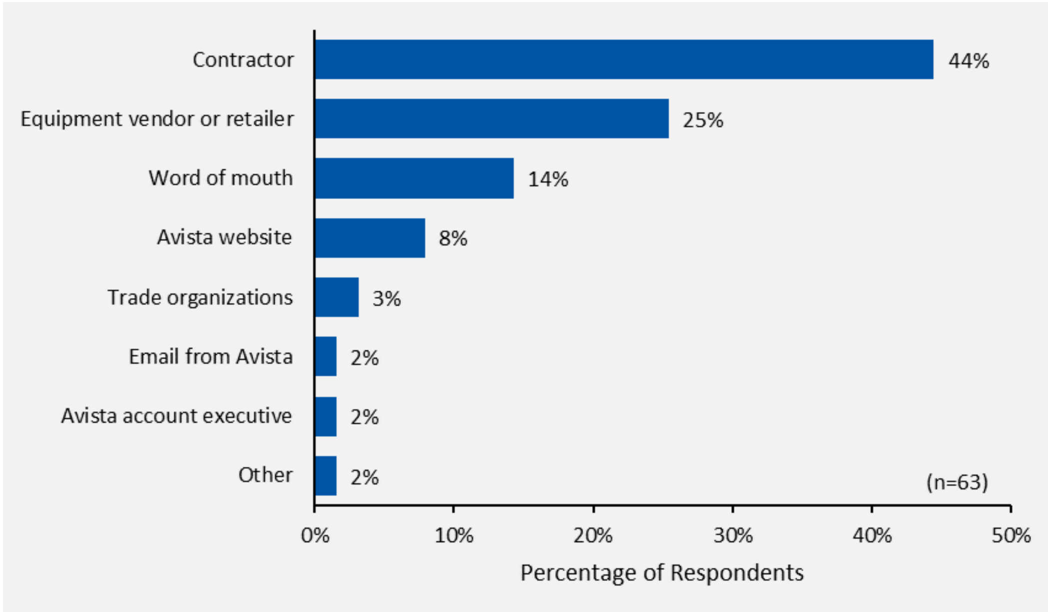
Figure 8. Equipment Installed by Previous Avista Program Participants



Source: Prescriptive survey question C1.2: "What other Avista Nonresidential energy efficiency programs has your business participated in?"

In PY 2020, respondents were most likely to say they first learned about the program from a contractor (44%, n=63), followed by a vendor or retailer (25%). Figure 9 shows the frequency that each information channel was mentioned.

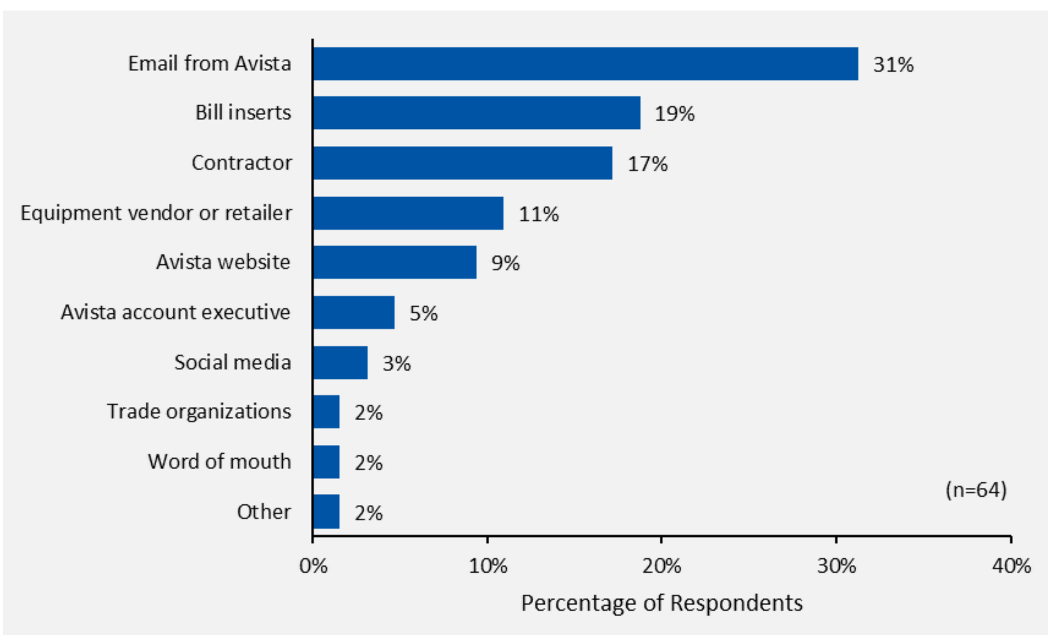
Figure 9. How Participants First Learned of Program



Source: Prescriptive survey questions C2: "How did you first hear about the program?"
Percentages may not total 100% due to rounding.

Respondents most commonly said that the best way for Avista to inform them of rebate programs was by an email from Avista (31%) or through a bill insert (19%). Figure 10 shows the distribution of preferred methods across all respondents in PY 2020.

Figure 10. How Participants Preferred to Learn of Programs and Offers

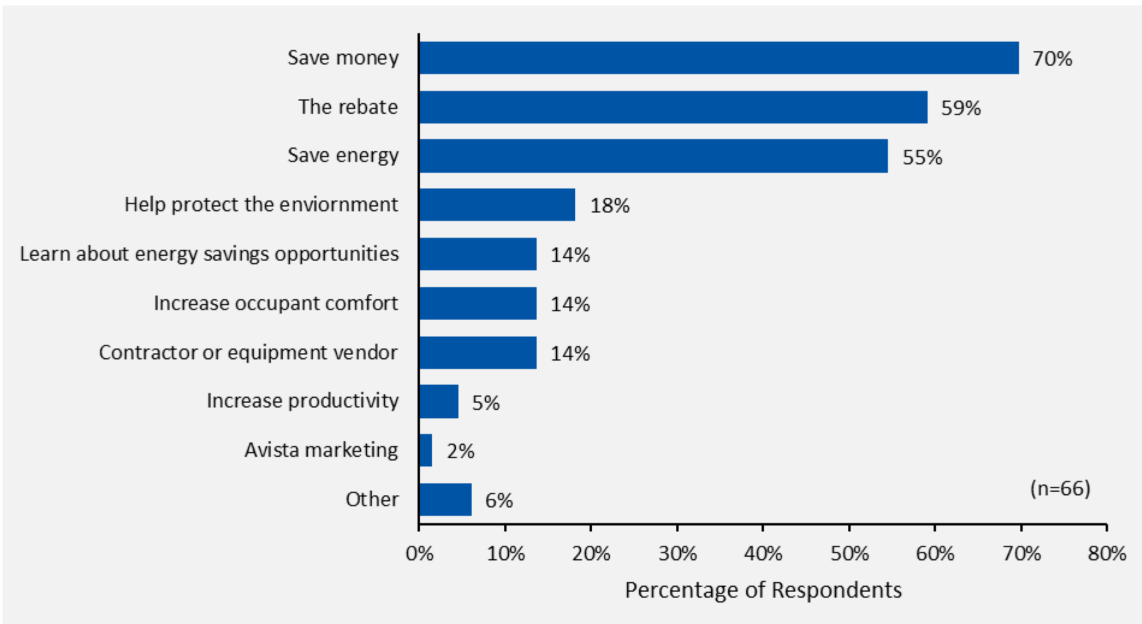


Source: Prescriptive survey question C3: "What is the best way for Avista to inform commercial customers like you about their rebates and incentives for energy efficiency improvements?"

Participation Motivations and Benefits

In PY 2020, respondents most commonly reported saving money and taking advantage of the rebate as participation motivations, followed closely by saving energy. This is similar to the PY 2019 result, except that receiving the rebate was not a survey choice in PY 2019. As shown in Figure 11, PY 2020 respondents identified several other motivations, but were less likely than PY 2019 respondents to mention wanting to increase occupant comfort, or that they were responding to a contractor or vendor recommendation. This difference is likely attributable to the lower percentage of non-lighting projects in the sample.

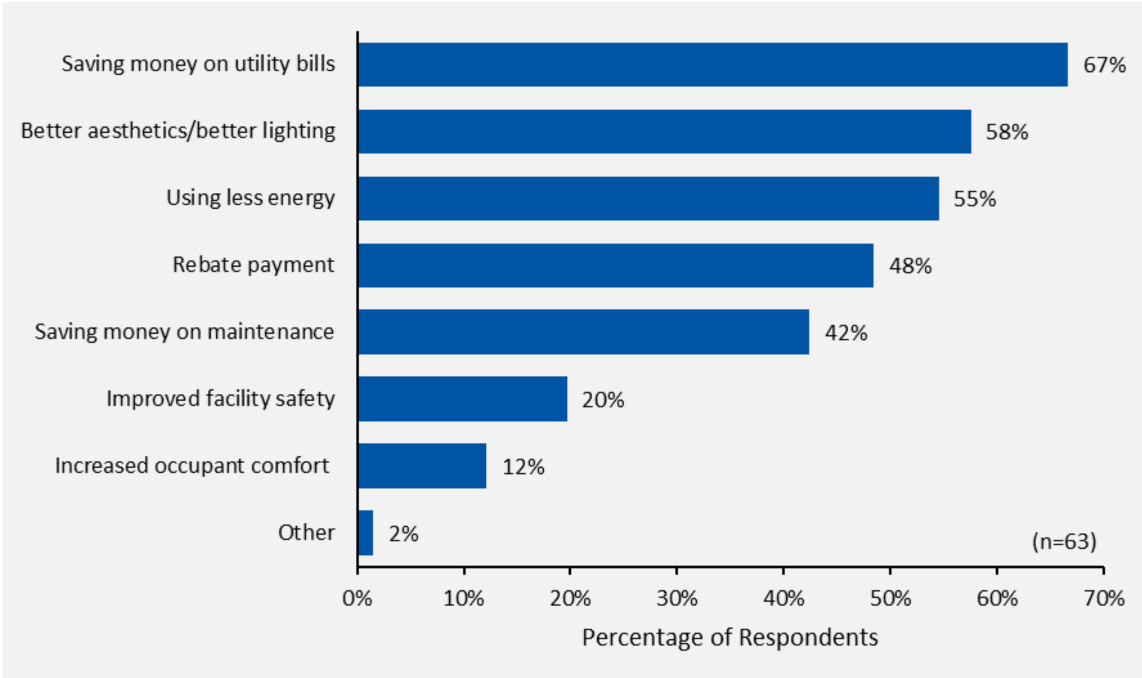
Figure 11. Prescriptive Participant Motivation



Source: Prescriptive survey question C4: "What motivated you to participate in the program?"
Multiple responses accepted.

As shown in Figure 12, PY 2020 participants' main reported benefits somewhat reflected their motivations, with saving money on utility bills being the most commonly mentioned benefit (67%, n=63), and using less energy being the third most common benefit (55%). However, while receiving the rebate was a commonly reported motivation, it was mentioned as a benefit less frequently than better aesthetics.

Figure 12. Prescriptive Participation Benefits



Source: Prescriptive survey question C5: "What would you say are the main benefits your company has experienced as a result of participation?" Multiple responses accepted.

Customer Experience

Program Delivery

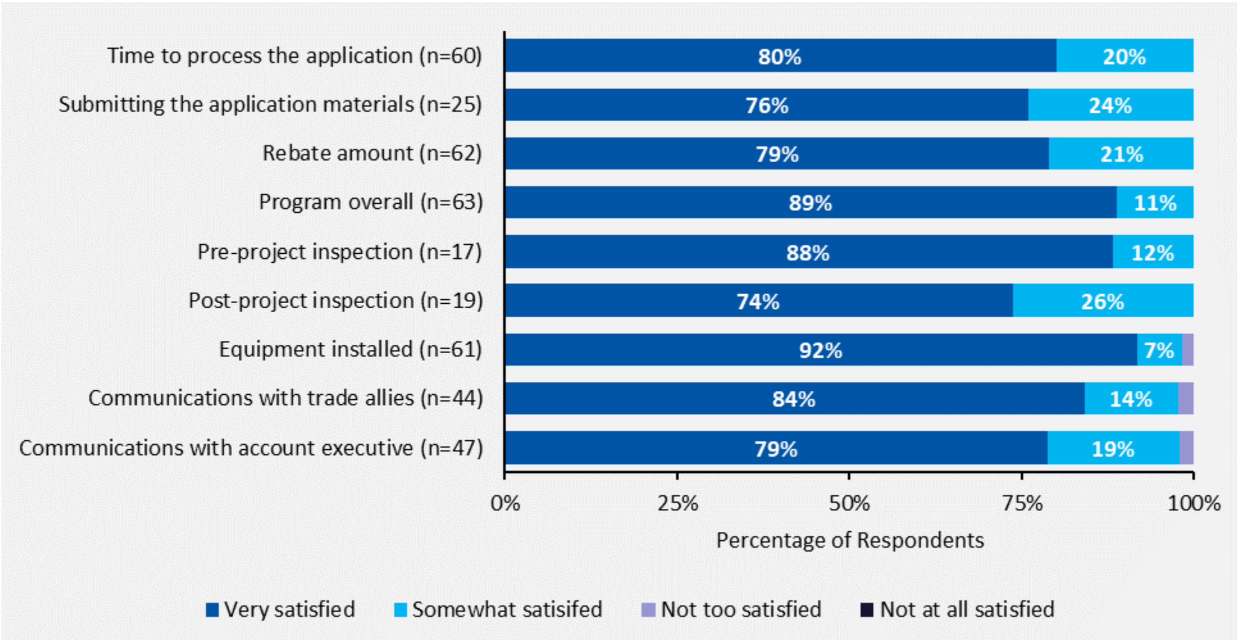
Although the majority of PY 2020 respondents reported a contractor or vendor (71%, n=66) or an Avista account executive (14%) was involved in a project's design or implementation, half of respondents (50%) took the lead on their own applications. These results are similar to PY 2019.

Most PY 2020 respondents (79%; n=47) also received their rebate checks directly, rather than as instant discounts from a contractor or vendor. Of nine PY 2020 respondents who did receive an instant discount, three said they chose the instant discount because it was easier for them, allowing them to complete projects with less cash outlay or to process less paperwork. Three other respondents chose the instant discount to reduce the amount they had to cover upfront. Another respondent wanted to avoid being responsible for any errors on the application and the last respondent wanted to reward the contractor for providing good service.

Program Satisfaction

PY 2020 respondents were nearly all *somewhat satisfied* or *very satisfied* with all aspects of the Avista program, as shown in Figure 13. Two respondents reported being *not too satisfied* with aspects of the program. One of these explained that the contractor had been difficult to work with and the process difficult to understand. The other respondent did not provide additional detail on their rating.

Figure 13. Satisfaction with Prescriptive Program Components

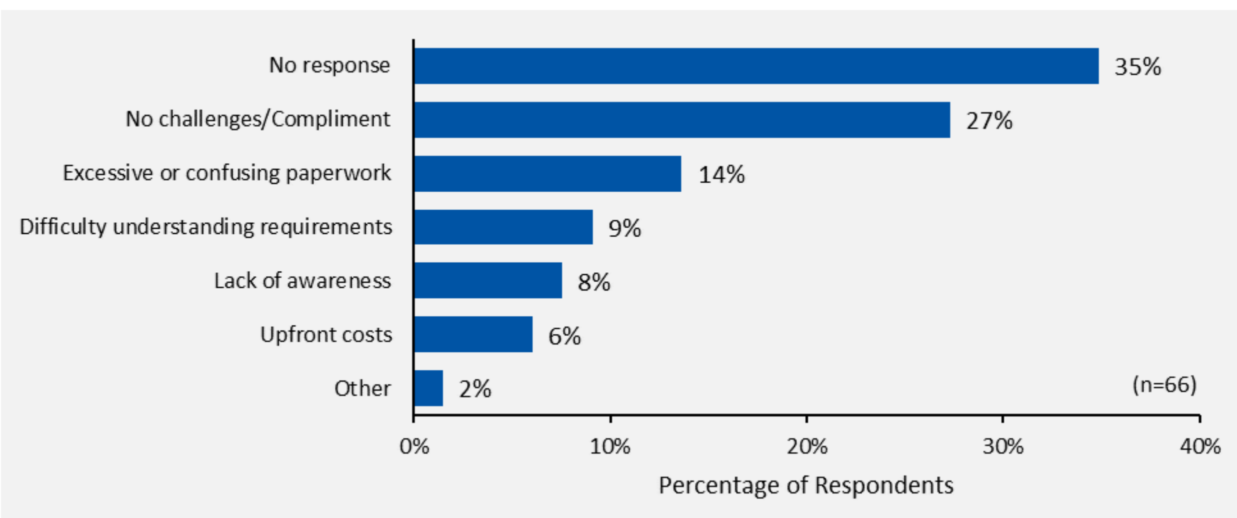


Source: Prescriptive survey questions H1: "In terms of the [PROGRAM], how satisfied were you with the following aspects? Please think about each item individually as you select your answer."

Program Challenges and Successes

When asked what challenges the program presented, 35% provided no response and 27% took the opportunity to report there were no problems, or to compliment the program. Excessive paperwork was the most common challenge reported, mentioned by 14% of respondents.

Figure 14. Participation Challenges



Source: Prescriptive survey question H9: "What do so see as the biggest challenges to participating in Avista's [PROGRAM_NAME]?"

Respondents called out several program aspects that they viewed as working well. As shown in Table 10, respondents most commonly mentioned the fast or easy application process, followed by the opportunity to save energy and money on utility bills. Several respondents who mentioned the fast process also mentioned good customer support. For example, one respondent stated, “Great customer service and fast rebate turn around.”

Table 10. Aspects of Avista Prescriptive Programs Working Well

Program Aspects	Number of Respondents
Easy/fast process	11
Saving energy and money on utility bills	10
Overall program works well	7
Access to better lighting	5
Good customer service	5
Rebate amount	5
Contractor support	2
Access to quality products	1

Source: Prescriptive survey question H11: “What would you say is working particularly well with Avista’s program?” (Multiple responses allowed; n=39)

As shown in Table 11, 16 participants provided suggestions for program improvements. The most common suggestion was to provide more information about program requirements, or better customer support. For example, one respondent suggested having a chat function for customer support, instead of just phone and email. Another person requested a searchable database for eligible products.

Table 11. Suggestions to Improve Avista Prescriptive Programs

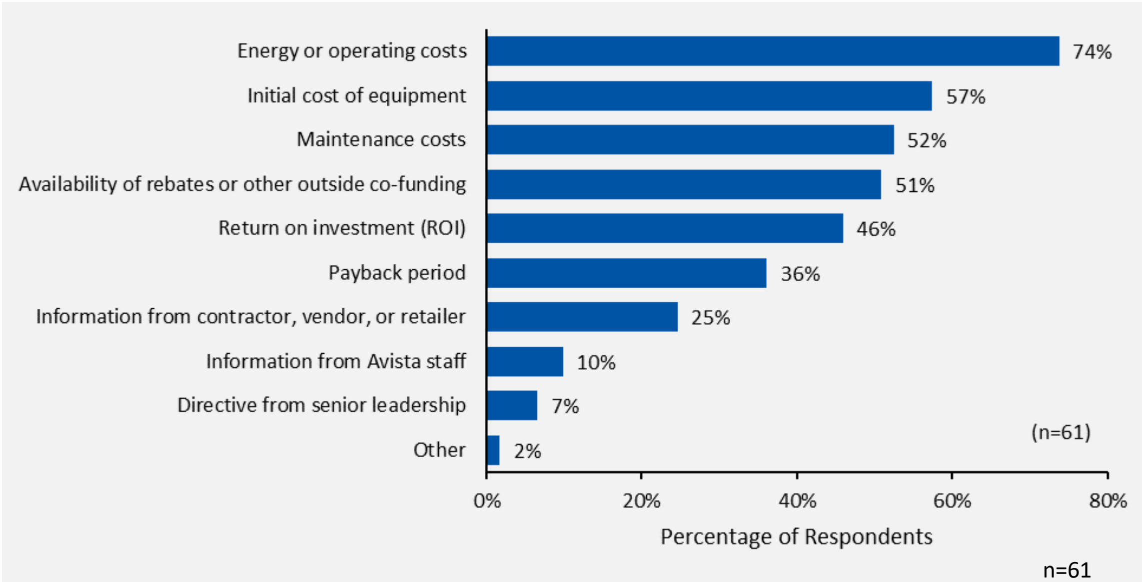
Suggestion	Number of Respondents
More information/better customer support	7
More marketing	5
Bigger rebates	3
Outreach to contractors	1

Source: Prescriptive survey question H10: “What recommendations, if any, would you make to improve the program?” (n=16)

Energy Efficiency Attitudes and Behaviors

All PY 2020 respondents (100%, n=63) considered energy efficiency either *somewhat* or *very important* to their organization when making capital upgrades or improvements. As shown in Figure 15, respondents cited energy or operating costs (74%) as the most important criteria in their decisions to undertake energy efficiency improvements, followed by initial cost of equipment (57%) and maintenance costs (52%).

Figure 15. Important Criteria for Making Energy Efficiency Improvements



Source: Prescriptive survey question I4: "Which of the following criteria are important in deciding whether your company makes energy efficiency improvements?" Multiple responses allowed.

The survey asked respondents how the COVID-19 pandemic affected their project. The majority of respondents, 88% (n=59) reported there was no impact, while 8% said the pandemic impacted the project timeline, and 3% said both the timeline and the scope were impacted. Those who reported impacts described them as due to the following factors (some respondents mentioned multiple factors):

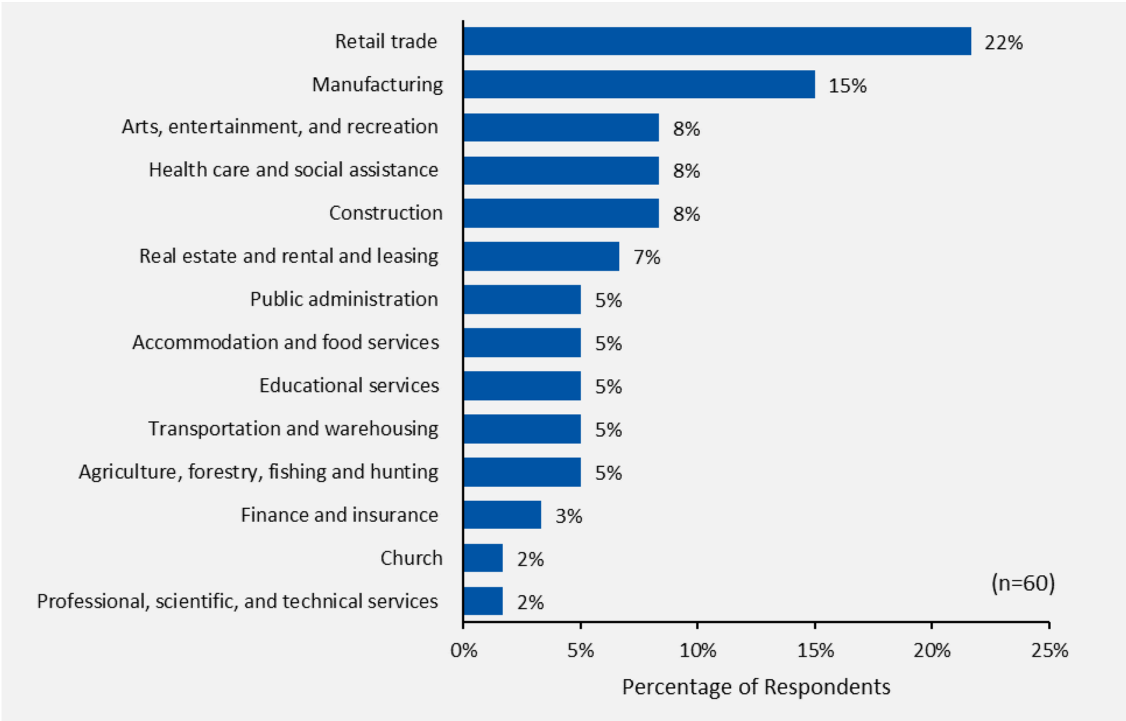
- Suspension of operations/shutdown (3 respondents)
- Shortage of materials (2 respondents)
- Additional safety requirements for contractors (1 respondent)
- Employees staying home due to illness (1 respondent)
- Short delay receiving the rebate (1 respondent)

When asked how their interest in energy efficiency projects will be impacted by COVID-19 going forward, 64% (n=55) said they expected no change relative to before the pandemic. The second most common response was that respondents expected to have less budget available to pay for projects (24%). However, 11% expected their organization to have more interest in cost-cutting projects such as energy efficiency upgrades.

Survey Respondent Profiles

Most PY 2020 survey respondents reported natural gas as their primary heating fuel (69%; n=54); 76% owned their facilities. Most respondents did not provide their facilities' square footage, but of the 28 who did respond, sizes ranged from 2,000 to 200,000 square feet, with an average of 25,500 square feet (n=28). The number of people employed at the project site ranged from 0 to 200, with an average of 28 employees (n=44). Figure 16 shows respondents' organization types. Retail trade, followed by manufacturing were the most common types.

Figure 16. PY 2020 Prescriptive Survey Sample Organization Types



Source: Prescriptive survey question J1: "What is the primary industry of your organization?"

Nonresidential Conclusions and Recommendations

Conclusions and recommendations for the Nonresidential programs are presented in this section.

Nonresidential Conclusions

- **The impact of COVID-19 on project scope was minimal, but going forward there may be slight reductions in the number or scope of energy efficiency projects due to budget or staff constraints.**
  - Ten of 13 Site Specific respondents and 88% (n=59) of Prescriptive participants said COVID-19 did not create any obstacles to their 2020 project; most respondents who reported obstacles said the obstacles were minor.
  - Four of 13 Site Specific respondents and 24% of Prescriptive respondents expected reductions to budget or staff availability to support energy efficiency upgrades in PY 2021.
- **Although contractors drive a significant portion of participation, continued Avista outreach and messaging is important to support contractor sales.**
  - Eight of 15 Site Specific participants and 70% (n=63) of Prescriptive participants reported first hearing about the Avista program from a contractor, vendor, or retailer.

- Twelve of 15 Site Specific participants and 55% (n=64) of Prescriptive participants thought the best way to learn about rebates and incentives was through Avista emails or direct mail, or communication from an Avista account representative.

- **Despite some process issues in PY 2020, participants are satisfied with the application process and the program overall.**
  - Site Specific satisfaction was lowest for process-related aspects, including submitting the rebate application (75% satisfied, n=15) and the time to process the application (87% satisfied), but 100% of respondents were satisfied with the program overall.
  - Though 14% of Prescriptive participants mentioned the application paperwork was burdensome, and 9% had some difficulty understanding requirements, 100% of participants were satisfied with the program overall, and several respondents mentioned the easy and fast process as an aspect of the program that worked well. Suggestions for process improvements were related to potential enhancements (such as a searchable database of eligible products, or chat feature for application support) rather than suggestions to correct significant problems.

Nonresidential Recommendations

Nonresidential Recommendation 1: Develop tools to help participants sort through options and scope eligible projects more quickly. For example, although the Avista website currently directs customers to search for eligible lighting on the ENERGY STAR Product Finder database or DesignLights Consortium websites, both of which have advanced search functionality, the search results can be overwhelming. A resource such as an "Energy Efficiency Buying Guide" for specific products could help customers with less technical background navigate their options or evaluate and understand proposals they receive from contractors.

Nonresidential Recommendation 2: If not already doing so, use email blasts, bill inserts, and other promotional tools that are direct from Avista to its customers, and use Avista branding to promote Nonresidential programs and incentives. Participants were more likely to want communication directly from Avista than through their contractor or vendor. These marketing efforts will enhance any contractor and vendor marketing or advertising, and give sales representatives better credibility, enabling them to make more sales through the program.

Multifamily Programs

This section focuses on two Multifamily programs: Multifamily Direct Install (MFDI) and Multifamily Market Transformation (MFMT). The MFDI program provides energy efficiency measures through a direct-install phase and an optional supplemental phase; however, due to the COVID-19 pandemic, Avista adjusted the program to a contactless delivery method midway through the year. The MFMT program provides incentives for natural gas space and water heating equipment in new multifamily developments.

Multifamily Direct Install Program Findings

The MFDI program typically consists of a direct-install phase that includes energy efficiency measures, such as faucet aerators, kitchen aerators, LEDs, Tier I smart power strips, and VendingMisers.[1] However, due to COVID-19, Avista changed the delivery mechanism midyear to a contactless model which is addressed in the next section.

An optional supplemental lighting phase typically follows, in which SBW Consulting offers lighting upgrades in facilities' common areas. Various lighting contractors perform an audit and provide SBW with the best lighting retrofit options.

Cadmus conducted stakeholder interviews with Avista program and implementation staff, in addition to five phone interviews with multifamily property managers who participated in the program in PY 2020.

Stakeholder Interviews

In January 2021, Cadmus interviewed Avista and program implementation staff about the MFDI program. Consistent with previous years, the program implementer, SBW, is responsible for recruiting and treating multifamily units and due to a robust participant pipeline no additional marketing was needed in 2020. The implementer said that, due to COVID-19 and the temporary suspension of the program, multiple properties were unable to participate. Irrespective of the pandemic and program suspension, the implementer noted participation interest from qualifying properties was high.

Program Implementation

Direct Install. As a result of the COVID-19 shutdown, Avista temporarily suspended the program in mid-March, as implementation staff were barred from entering tenant units. The program remained in a sustained critical phase through July 2020. In response to continued COVID-19 restrictions, Avista and implementer staff developed two drop-off pilot concepts. The rest of the report refers to the drop-off pilot concepts as Phase 1 and Phase 2.

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1 Devices that can be installed on beverage vending machines that use a motion sensor to determine when the machine should be powered on and off. The device measures ambient room temperatures every few hours to determine how much power to utilize.

Phase 1 targeted smaller multifamily properties in Avista's service territories. SBW provided property managers with drop-off kits that included LEDs, faucet aerators, kitchen aerators, showerheads, installation instructions and notices, a return equipment bag, and additional documentation explaining the program. SBW instructed property staff to leave drop-off kits outside of tenants' units and ask tenants to install the measures themselves. Avista and the implementer reported low uptake and difficulty recovering unused or uninstalled measures.

Phase 2 was a hybrid model that targeted three additional facilities. Avista provided property managers with drop-off kits that included LEDs, faucet aerators, kitchen aerators, installation instructions and notices, and documentation explaining the program. Property managers could install measures in tenants' units using facility staff or instruct tenants to install the drop-off kit measures themselves. The implementer reported greater uptake during Phase 2 and attributed this to better communication with facility staff. Avista changed program documentation in drop-off kits to emphasize *item exchange*, which led to an increase in recovery of unused or uninstalled measures.

Supplemental Lighting. In addition to the direct-install phases, Avista and the implementer offered a supplemental lighting phase, during which installers, hired by the implementer, revisited multifamily properties to install additional common area lighting for property managers expressing interest. Eligibility requirements included the following: the property must be an Avista electric customer, lighting must be 24/7, and supplemental lighting must be deemed cost-effective. Pre-COVID-19, while completing the direct install of measures, the implementer identified and reviewed opportunities for common area lighting with Avista and participating properties, all subject to Avista's approval. If approved by Avista, a subcontractor later returned to the property to install the lighting.

In response to COVID-19, Avista temporarily suspended the supplemental lighting phase. Avista completed eligible projects with supplemental exterior lighting and did not pursue any mixed interior and exterior supplemental lighting projects. Avista modified eligibility for the supplemental lighting phase to only include exterior common area lighting projects in 2021.

Communication. Throughout PY 2020, Avista and the implementer met monthly to discuss program progress, address program issues, and conceptualize new delivery methods in response to COVID-19. Avista noted there was an open line of communication with the implementer and both called impromptu meetings as necessary. The implementer expressed gratitude for Avista's flexibility during the pandemic and noted a strong sense of partnership.

Data tracking. The drop-off phases posed an issue for Avista and implementer staff, as implementer staff were no longer able to verify where or if measures were installed. Avista and the implementer relied on tenants to return unused or uninstalled measures to track installation. Avista reported high variability across participating properties in terms of returned measures. The implementer reported difficulty in collecting detailed measure level data and suggested low measure return rates exacerbated this issue.

Tenant installation. Avista mentioned that some tenants participating in Phase 1 and Phase 2 of the drop-off pilot were unable to, or did not have the necessary equipment to, properly install measures.

Aerators and showerheads saw the lowest uptake in PY 2020 and Avista attributed this to lack of installation knowledge and necessary tools. Due to COVID-19 restrictions, implementer staff were unable to conduct quality control checks to determine whether measures were installed correctly.

Future Plans. Avista and the implementer are considering an exchange-based delivery system for PY 2021. The exchange pilot model encourages participating tenants to return uninstalled or unused equipment and allows the implementer to track measure-level details with greater accuracy. The exchange pilot will offer LEDs only, and implementer staff will pre-audit the property to gauge compatible offerings. A facility manager or SBW staff member will be on site with an assortment of lighting products and ask tenants to remove outdated bulbs from their units and deliver them to the exchange. Upon exchange, tenants will receive LEDs compatible with their pre-existing fixtures. The process allows for social distancing, proof of exchange, enhanced data tracking, and enables staff to give tenants installation and educational guidance.

In PY 2021, showerheads will no longer be offered through the program. Avista is planning to suspend the offering of faucet and kitchen aerators in PY 2021, but will consider re-integrating these measures into the program if the pre-COVID-19 delivery model is reinstated.

Participant Interviews

In February and March of 2021, Cadmus interviewed five multifamily property managers who participated in the MFDI program to understand their awareness of and satisfaction with the program, identify the program's challenges and successes, and assess its influence on other energy-saving behaviors. The five property managers had not participated in the program in the past and attributed this to lack of awareness. Of the five property managers who participated, two were through the initial direct install phase, one was through Phase 1, and two were through Phase 2. Participating multifamily residences could have the following measures installed:

- Faucet aerators
- LEDs (indoor)
- Kitchen aerators
- Showerheads

Consistent with PY 2019, the implementer no longer offered the following in PY 2020: water heater temperature assessments, water heater blanket installs, water heater pipe wrap installs, shower valves with automatic temperature shut-offs, or smart plugs. Avista reported VendingMisers and smart power strips were offered where possible in the initial direct install phase pre-COVID-19, but both measures were not included in Phase 1 or Phase 2.

Awareness and Motivation

Two property managers said they learned about the program from the implementer, two learned about the program through fliers mailed by Avista, and one heard of the program through word of mouth.

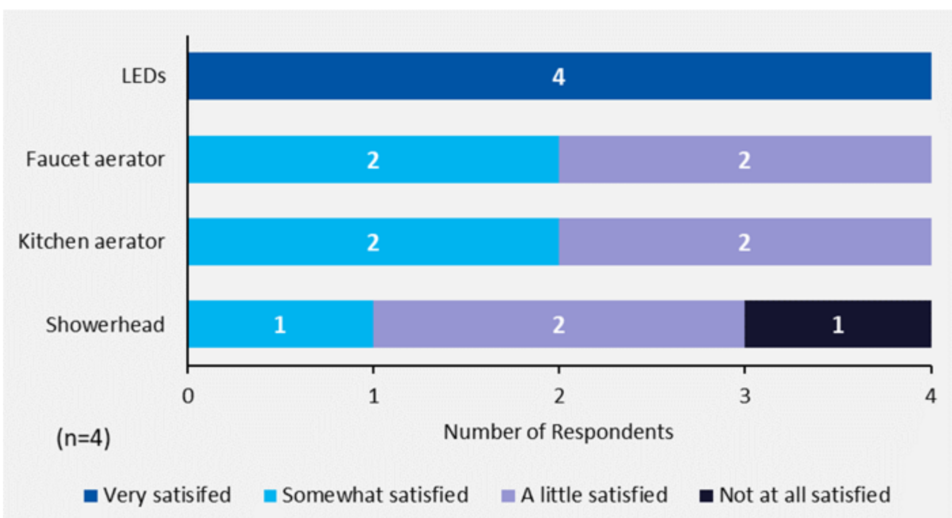
With regards to energy savings, three property managers said Avista or the implementer usually informed them of ways to save in their buildings, one property manager said he uses past experiences to inform them of ways to save energy, and the remaining property manager reported hearing little about energy-saving opportunities as a result of being recently hired. These results were similar to PY 2019 findings.

Measure Satisfaction

In terms of tenant satisfaction, all property managers reported that their tenants were *very satisfied* with the LEDs, as shown in Figure 17. One property manager reported not receiving tenant feedback about satisfaction with installed measures. Tenant satisfaction with LEDs was consistent across the 2019 and 2020 program years. Unlike PY 2019, when most tenants were *very satisfied* with program measures, in PY 2020, multiple tenants expressed dissatisfaction with the faucet aerators, kitchen aerators, and showerheads.

Two property managers reported tenants were *a little satisfied* with faucet aerators and kitchen aerators due to low water pressure and the aesthetically displeasing appearance. Three property managers reported tenants were dissatisfied with showerheads due to restricted water flow, of which two were *a little satisfied* and one was *not at all satisfied*. One property manager suggested that tenants with no obligation to pay their water bill were uninterested in installing aerators or showerheads, and instead preferred installing LEDs.

Figure 17. Satisfaction with Program Measures, PY 2020



Source: MFDI Program Participant Interview, Question C1:
"In your perspective (given your interactions with them), are your tenants very satisfied, somewhat satisfied, a little satisfied, or not at all satisfied with their new…?"

Of the four PY 2020 property managers who participated in the supplemental lighting phase, all were *very satisfied* with the new outdoor lighting. When asked about tenant feedback, three did not report tenant issues or complaints. One reported that tenants provided positive feedback, such as being able to see clearly at night.

Program Delivery

Cadmus asked property managers whether implementer staff, maintenance staff, or tenants installed program measures. Two property managers who participated in the program pre-COVID-19 reported SBW staff installed energy efficiency measures while being accompanied by maintenance staff. In addition, two property managers reported maintenance staff installed measures. Both property managers who participated in Phase 2 were *very satisfied* with the instructional materials provided by SBW and reported no issues during the installation process. The property manager who participated in Phase 1 reported tenants were uninterested in the program and *not at all satisfied* with the installation instructions and educational material. This property manager said, “Because they’re renters, many of the tenants didn’t care as much to install the measures. The educational materials and installation instructions didn’t provide enough information to show tenants how these measures will save them money and energy. I talked with one of the tenants at C*** Apartments, and he commented on how he didn’t look through the bag that Avista provided. He left the drop-off kit in the closet.”

All three property managers who participated in either Phase 1 or 2 were *very satisfied* with the unused or uninstalled equipment pick-up process.

Program Satisfaction

Consistent with PY 2019, most property managers (4 of 5) were *very satisfied* with their MFDI program experience overall. One property manager was *a little satisfied* with the additional time that resulted from tenant installation and suggested changing program delivery to maintenance staff installation only.

Four property managers who received supplemental lighting addressed questions about their satisfaction with this program phase. All supplemental lighting participants reported being *very satisfied* with the contractors’ professionalism, the time required to complete the installations, the quality of outdoor lighting, and the scheduling process.

Participation Barriers

As in previous years, property managers did not report any barriers to program participation in the direct install portion of the program.

In PY 2020, one property manager was unaware of the supplemental lighting phase and expressed interest in pursuing a common area lighting retrofit. The property manager reported the implementer reached out to the property’s improvement manager, who never relayed the information, and recommended enhanced communication. This was consistent with PY 2019 feedback.

Program Influence

Cadmus asked property managers if they took energy-saving actions after participating in the MFDI program, and, if so, how important the program was in influencing that behavior. Two property managers installed additional energy-saving items. One of these property managers reported that the program was *somewhat important* in influencing this decision while the other property manager would have installed the measures anyway and considered the program's influence *not at all important*.[2] Four respondents were *very likely* to seek out energy efficiency measures, while one said they were *somewhat likely* to do so.[3]

Multifamily Market Transformation Program Findings

The MFMT program provides incentives for natural gas space and water heating equipment in new multifamily developments in Idaho. Builders are eligible to receive incentives of up to $3,000 per unit to pay for the incremental cost of installing natural gas heat and/or water heat in new multifamily developments of five or more units per building. Water heating applications can either be individual natural gas hot water heaters in each unit or a central natural gas hot water system. Participants are required to sign a contract prior to construction and complete their project within two years. Cadmus conducted interviews with Avista staff and home builders as part of the MFMT program evaluation in PY 2020.

Avista Staff Interview

Program Changes

Avista discontinued the Washington portion of the program at the end of PY 2019 and reported that all Washington projects were required to finish by the end of the year. Avista also reported that the incentive for installing equipment through the program decreased from $3,500 to $3,000 at the beginning of PY 2020. If a project was contracted before the start of PY 2020, participants could receive $3,500 if they completed and verified their installation within two years. Avista does not expect significant changes for PY 2021.

Program Goals and Delivery

The program set and achieved an electric savings goal of 476 MWh per year for PY 2020. Avista tracks certain targets related to the number of projects completed through the program, current year-to-date pace, and kWh savings. Avista did not see a large impact from COVID-19 on program delivery aside from initial challenges with conducting final inspections on projects near the beginning of the pandemic. Avista also noted that program participants were in a slower time of the year when these challenges arose, so it did not create any long-term challenges for the program.

Aside from processing the rebate, Avista takes the role of confirming and verifying installations of equipment in new developments. While participants have up to two years after signing their contract to install their equipment, Avista confirmed the incentive is typically paid to the participant within a week of the verification. Avista also said that data tracking is different for the MFMT program than other Avista programs because the data are considered Site Specific and therefore project tracking is more

[2] Using the following scale: *not at all important*, *a little important*, *somewhat important*, *very important*.

[3] Using the following scale: *not at all likely*, *a little likely*, *somewhat likely*, *very likely*.

customized. Avista did not track any new data in PY 2020 that were not already being tracked and indicated the current data tracking and reporting systems and processes meet their needs.

Marketing and Outreach

The program is marketed primarily by Avista interacting directly with multifamily developers and builders—a strategy that Avista indicated has succeeded. Avista also lists the incentive for the program on their website. While the program previously had an informational flyer which could be distributed, staff noted this is no longer in use. Avista said there are currently no efforts to increase customer participation in hard-to-reach areas, but did note that a “gas growth team” was recently established in Idaho and that increasing participation in hard-to-reach areas may be a goal of the initiative.

Avista said that staff currently does not have a good way to monitor or assess marketing and outreach efforts for their effectiveness, but noted that the marketing department tracks activity on their website. Staff also indicated there are no current cross-promotional efforts for the MFMT program with other Avista programs. They emphasized that they have had success marketing the program through HVAC installers and would recommend targeting them more to enhance program marketing. While these HVAC installers do not act officially as trade allies for the program, some can promote the program if they have a good understanding and relationship with the program. Avista did not report any effects from COVID-19 related shutdowns on the program marketing efforts.

Stakeholder and Customer Experience

Avista reported good relationships with other groups involved in working with the MFMT program. These groups include builders, developers, HVAC installers, and development CPCs. Avista noted a good level of communication between groups, which allows program efforts to be handled relatively easily.

Avista faces two main barriers to participation among builders in the area. The first is that some regulations in Washington affect builders who operate there and in Idaho as well and that they need to limit their inventory of developments with natural gas appliances as a result. The second barrier is the price point of equipment compared to the incentive they offer. Avista said that the current incentive level, $3,000 per unit, continued to generate interest but explained if the incentive decreases further, some builders said the incentive will not offset the cost because installation is too expensive. To combat these barriers, Avista continues to work with builders and developers to bring natural gas into their developments in Idaho, despite the Washington regulations and plans to keep incentives at their current level.

Avista reported positive feedback from customers regarding their participation in the program. Staff noted that builders appreciate the incentive that allows them to install these natural gas appliances. They also said that the appliances can add value to the developments, especially in times when there is more competition for multifamily living spaces, as the natural gas appliances are more attractive and can help increase the value of units.

Home Builder Interviews

Cadmus interviewed one home builder who participated in the program in 2020 to assess their reasons for and obstacles to participation as well as measuring their overall satisfaction and experience with the program. Cadmus attempted to interview two other participating home builders but were unsuccessful after multiple attempts.

Program Experience

The participating home builder reported learning about Avista's MFMT program from family members who had previously worked for Avista and had connections to program staff. This builder said their main motivation for participating in the program was to help offset costs of heating in their buildings. They noted they were originally planning to install electric cadet heaters, but the incentive from the program made natural gas heaters more affordable and allowed them to provide a better product to their customers. This home builder claimed it was *very easy*[4] to qualify a new building for the incentive offered by the program.

When asked about their relationship with Avista, the home builder said it was "fantastic" and added "Avista is above and beyond the most flexible company to work with in our local area." This builder did not report experiencing any barriers to participation but noted there are occasional obstacles with other service providers for their buildings, though Avista has been able to assist them in those instances. The builder said they were *very satisfied*[5] with the MFMT program overall and planned to participate to a greater extent in 2021 as they have additional projects planned and will use the program.

Program Impact

The home builder was also asked what kind of impact the program has had on their operations. This builder reported that the program has greatly influenced the way they build multifamily housing because they primarily install natural gas heaters rather than electric cadet heaters. They also said the incentive is what makes this possible and would not complete any natural gas space heating projects without the incentive due to the associated costs. The home builder said in the projects they have completed through the program; they have only installed natural gas space heating and have not installed natural gas water heating. They said this was because the venting system in these buildings would have to be re-designed in order to install natural gas water heating. Although, they would have liked to install natural gas water heating they felt it was not worth the effort. The home builder did not report any effects on their participation in the program due to COVID-19 related shutdowns and/or stay-at-home orders. This builder also noted that the program has had a positive effect on their business because they are able to provide a different product than other companies in their area. They also said it is more attractive to their tenants because the natural gas appliances help keep utility costs lower than if it were electric heating.

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[4] Using the following scale: *not at all easy*, *not too easy*, *somewhat easy*, *very easy*.

[5] Using the following scale: *not at all satisfied*, *a little satisfied*, *somewhat satisfied*, *very satisfied*.

Builder Profile

Cadmus interviewed the owner of a home building company who said they primarily do field work and ensure the installations go as planned, with respect to the MFMT program. They said their company has been building multifamily housing in Idaho for 6 years and first participated in the program in 2019. They indicated they did not build any multifamily housing in Avista's service territory that did not participate in the program in 2020.

Multifamily Conclusions and Recommendations

Conclusions and recommendations for the Multifamily programs are presented in this section.

Multifamily Conclusions

- **MFDI: Collaborative relationships between Avista and the program implementer allowed new delivery methods and future implementation techniques to be conceptualized quickly in response to COVID-19. Open communication between the implementer and property managers ensured the quick dissemination of new implementation information to maintenance staff and tenants allowing the program to continue in PY 2020 despite challenges due to the pandemic.**
  - In response to continued COVID-19 restrictions, Avista and implementer staff developed a contactless delivery method.
  - Due to low uptake in the first post-COVID-19 implementation phase, Avista and the implementer adjusted the program to increase participation and measure installation by limiting measures and working with property managers.
- **MFDI: Property managers were satisfied with the program but suggested some tenants were not satisfied with all the measures included in the program. Additionally, some tenants did not install measures that were difficult to install or for which they did not have appropriate tools.**
  - Four of five property managers (4 of 5) were *very satisfied* with their MFDI program experience overall.
  - Two property managers reported tenants were not satisfied with faucet aerators and kitchen aerators due to low water pressure and appearance while three property managers reported tenants were dissatisfied with showerheads due to restricted water flow.
  - One property manager reported that tenants' participating in Phase 1 were *not at all satisfied* with installation and educational materials provided by Avista.
- **MFDI: The reliance of current data tracking on tenants' willingness to return uninstalled or unused equipment, together with low recovery rates, may be a contributing factor to minor inconsistencies in measure-level data.**
  - The drop-off delivery phases relied heavily on documentation filled out by maintenance staff and tenants detailing the location and type and quantity of both installed and removed measures. The implementer noted during the drop-off phases difficulty in tracking measure

installation locations in tenants' units without the presence of a field technician to document measure implementation.

- **MFMT: Overall, the MFMT program was successful meeting the energy savings goal and achieving high program satisfaction.**
  - The program surpassed its electric savings goal of 476 MWh per year for PY 2020.
  - Builders have told Avista staff that they appreciate the incentive because it allows them to install natural gas appliances which provides a competitive advantage, since they say natural gas appliances are more attractive and can help increase the value of units.
  - The builder who completed a survey said they were *very satisfied* with the program and planned to participate to a greater extent in 2021.

- **The MFMT program has had success working with HVAC installers to help market the program, though more can be done to increase marketing efforts and participation, as a result.**
  - Avista reported success working with HVAC installers to help promote the program. Staff said this is a beneficial relationship as the HVAC installers are provided with additional work and the program with more participants.
  - Avista reported that there used to be a flyer handed out as promotional material for the program, though it is no longer used. Staff also said there is no current way in which they monitor effectiveness of their marketing efforts and do not cross-promote the MFMT program with other Avista programs.

Multifamily Recommendations

MFDI Recommendation 1: If the MFDI program continues to request tenants install measures directly, consider offering an additional incentive such as an entry in a drawing for returning measures that are not installed and for providing information on installed measures and their location.

MFDI Recommendation 2: If the MFDI program continues to operate using the drop-off delivery method which requires tenants to install measures directly, continue focusing on simple and easy-to-install measures like LEDs. Provide easy to follow installation instructions and remind tenants of the benefits of installation in the program materials.

MFMT Recommendation 1: Develop marketing materials which can be used by HVAC contractors to help promote the MFMT program. Due to the strengthening relationships between program staff and HVAC contractors, promotional materials could be greatly beneficial to provide information about the program in instances where the contractors may encounter potential participants.

MFMT Recommendation 2: Develop strategies to evaluate the effectiveness of marketing efforts and cross-promotion with other Avista programs. In order to understand if marketing efforts are successful, evaluation standards or goals should be set to better understand what the primary forces are that drive participation to the program. Cross-promotion is also a simple and effective way to increase visibility of the program and garner interest from potential participants.

Residential Programs

The Space Heat, Water Heat, Shell, and Windows programs provide Residential households with Prescriptive rebates for installing space heat, water heat, smart thermostats, storm and standard windows, and natural gas space and water heat. The ENERGY STAR Homes program provides rebates to customers who purchase newly constructed manufactured homes that are ENERGY STAR-certified.

Residential Program Findings

For the PY 2020 process evaluation, Cadmus completed interviews with the Avista program manager for the ENERGY STAR Homes program and conducted online surveys with Space Heat, Water Heat, Shell, and Windows program participants.

Cadmus completed online surveys with 119 customers who participated in the Space Heat, Water Heat, Shell, and Windows programs in PY 2020. Respondents who participated in the Shell or Windows programs are reported together. The following sections present results and detail the findings.

ENERGY STAR Homes

Avista's program manager for the ENERGY STAR Homes program said the PY 2020 program operated similarly to how it operated in previous years. Participants purchase new homes from manufactured home dealers who ensure the new homes are ENERGY STAR-certified. The dealer provides a name certificate to the customer, who submits it to Avista with required program paperwork as proof of participation. Avista approves the paperwork and processes rebates shortly thereafter. Avista typically develops marketing campaigns to promote the program but relies primarily on dealers to drive participation by directly informing customers of the program at point of purchase.

Changes to ENERGY STAR Homes program include increased rebates for natural gas homes from $400 to $600, which Avista said has received "very positive" feedback from home dealers. Like most utility energy efficiency programs, the ENERGY STAR Homes program was affected by the COVID-19 pandemic. The pandemic forced some local businesses that sold manufactured homes to close permanently and inhibited the certification of new homes that, at the time, were in the process of becoming ENERGY STAR-certified. Additionally, a marketing campaign that Avista planned to launch the week the shutdown occurred in March 2020 was tabled, and the pandemic limited Avista's partnership with Northwest Energy Efficiency Alliance (NEEA), which in past years had helped market the program.

Primarily because of the pandemic, the ENERGY STAR Homes program came close to, but ultimately fell short of, achieving its participation and savings goals. Table 12 shows the target and achieved numbers of homes rebated in each state.

Table 12. PY 2020 Target and Achieved New Homes – ENERGY STAR Homes

State	Fuel Type	Target	Achieved
Washington	Natural Gas	5	3
	Electric or Electric/Natural Gas	50	30
Idaho	Natural Gas	5	3
	Electric or Electric/Natural Gas	2	13
Total		**62**	**49**

Avista speculated that, generally, investment in manufactured homes was dampened because customers who typically purchase manufactured homes may have experienced income insecurity induced by the pandemic.

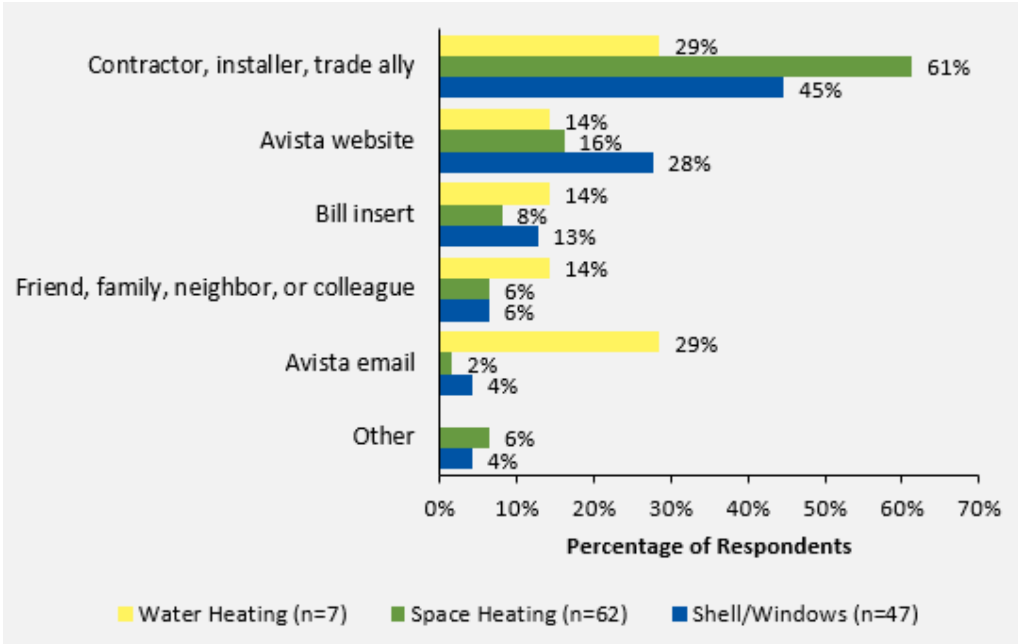
In terms of planning for PY 2021 and beyond, Avista plans to increase rebates for electric-only and combination electric/natural gas homes, continue evaluating its outreach partnership with NEEA, and explore partnerships directly with local manufactured home builders (in addition to partnerships with manufactured home dealers).

Space Heat, Water Heat, Shell, and Windows Customer Survey Results

Customer Awareness

Cadmus asked survey respondents where they learned about the program in which they participated. In PY 2020, respondents most commonly learned about Avista programs through contractors (52%), followed by Avista's website (21%) and bill inserts (9%). The share of customers who learned about programs primarily through contractors increased from PY 2019 (38%). Otherwise, respondents learned more frequently about the program through Avista's website (21% in PY 2020 compared to 19% in PY 2019), while respondents learned about the program less frequently through word of mouth (6% in PY 2020 compared to 26% in PY 2019). Figure 18 shows program-specific results.

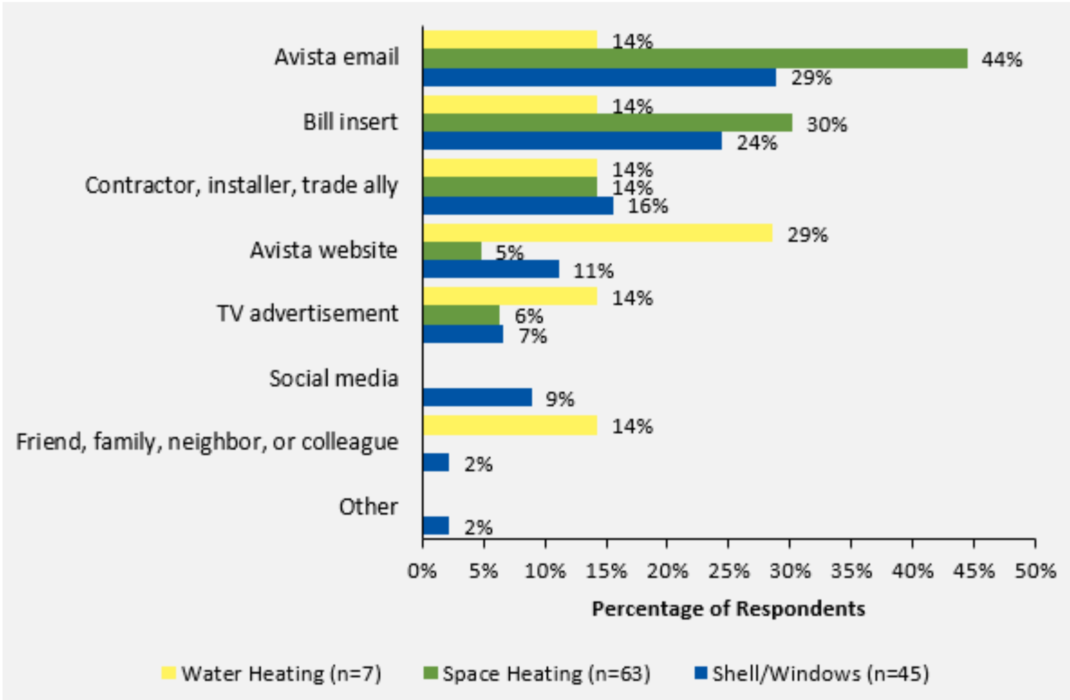
Figure 18. Awareness of Avista Energy Efficiency Programming



Source: Residential Programs Participant Survey, Question D1: "How did you first hear about Avista's Energy Efficiency Rebate program?"

Cadmus also asked respondents how they preferred to learn about Avista's energy efficiency programs. Though most PY 2020 respondents preferred Avista's emails (37%), they also cited bill inserts (27%) as an effective method for spreading information. A small portion of PY 2020 respondents preferred contractors (15%) or Avista's website (9%). From PY 2019 to PY 2020, Avista emails saw the greatest increase as an information source (from 10% to 37%), while bill inserts experienced the biggest decrease (from 43% to 27%). Figure 19 shows program-specific results.

Figure 19. Preferred Method to Learn About Programming

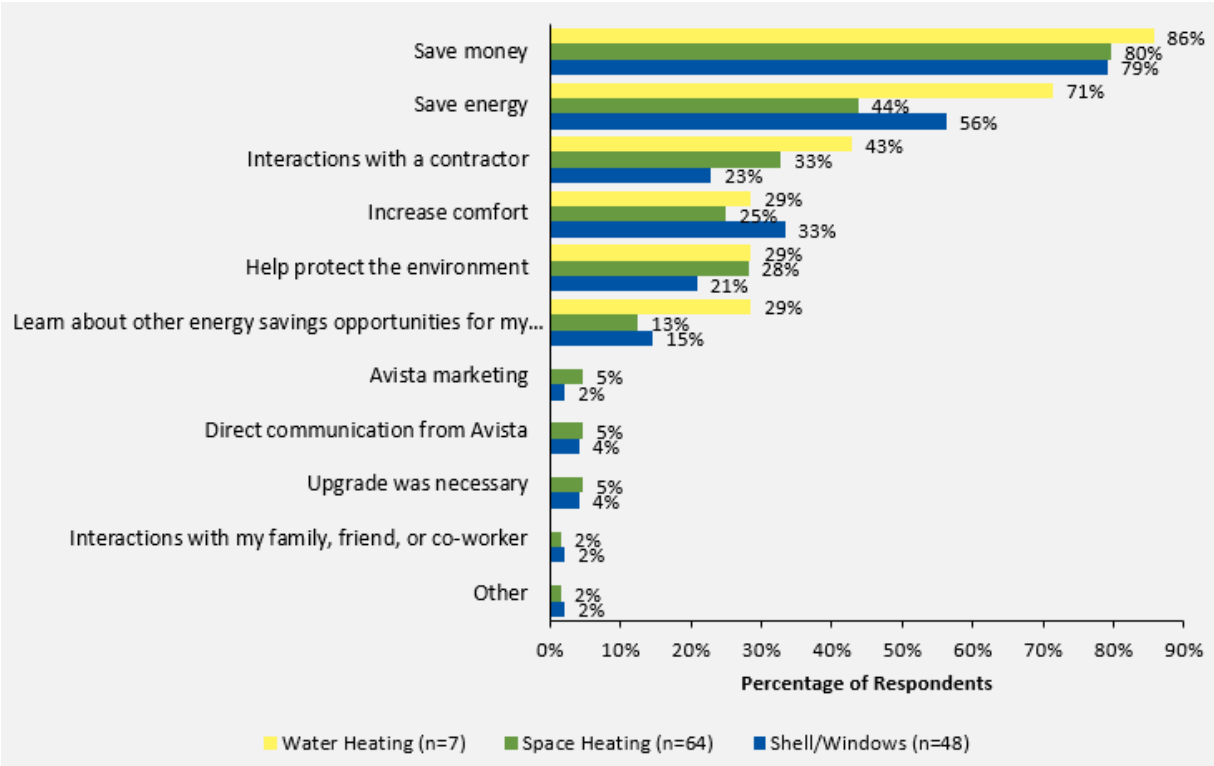


Source: Residential Programs Participant Survey, Question D2: "What is the best way for Avista to inform Residential customers like you about their energy efficiency improvement rebates?"

Motivation and Program Benefits

In PY 2020, respondents participated in Avista's programs primarily to save money (80%), save energy (50%), and/or increase their homes' comfort (33%). From PY 2019 to PY 2020, saving money provided the largest motivation increase (from 25% to 80%), followed by saving energy (from 22% to 50%). Necessary upgrades realized the largest decrease in motivation (from 31% to 4%). Figure 20 shows program-specific results.

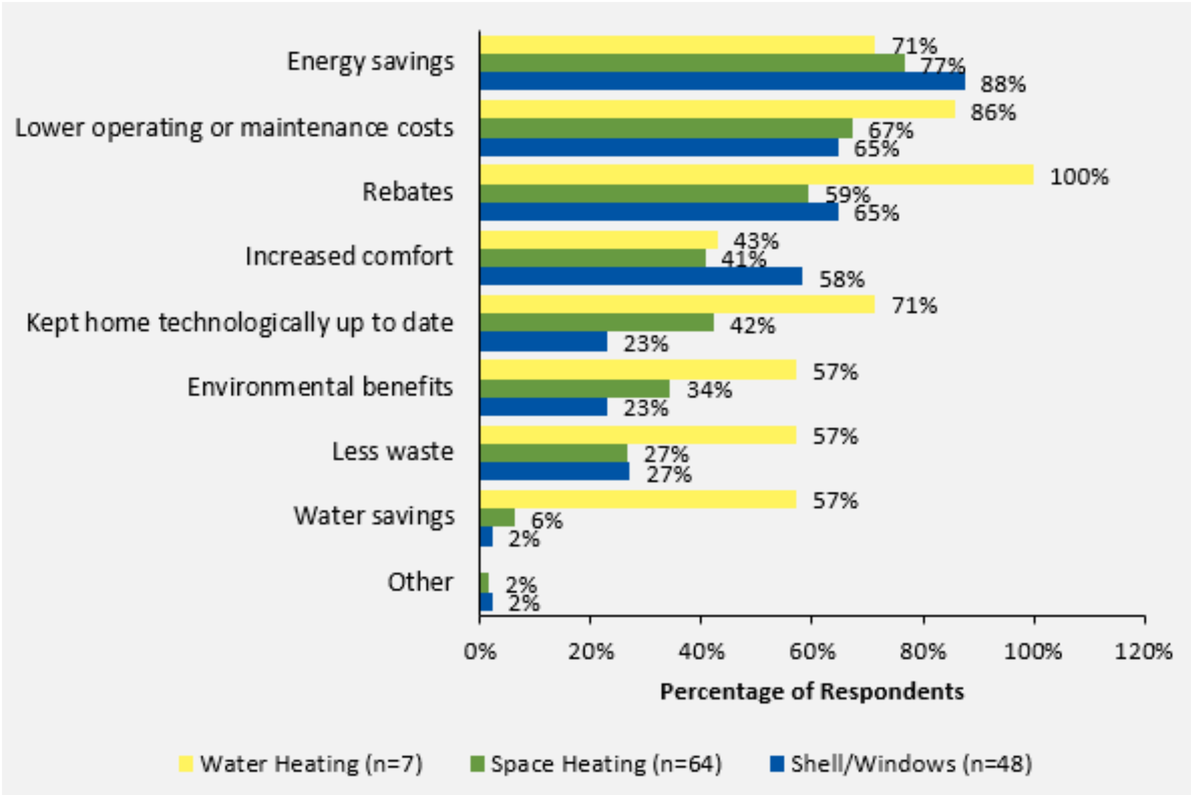
Figure 20. Motivation to Participate in Residential Programs



Source: Residential Programs Participant Survey, Question D3: "What motivated you to participate in Avista's Energy Efficiency Rebate program?" Multiple responses allowed.

Cadmus asked respondents a multiple-response question about benefits they associated with Avista's Residential programs. In PY 2020, most cited energy savings (81%), lower operating and maintenance costs (67%), rebates (64%), and increased comfort (48%). Though some respondents preferred to keep up with technological trends and to produce less waste and better environmental outcomes, the largest increase in perceived application benefits from PY 2019 to PY 2020 occurred for energy savings (from 34% to 81%). Figure 21 shows program-specific results.

Figure 21. Benefits of Participation in Residential Programs



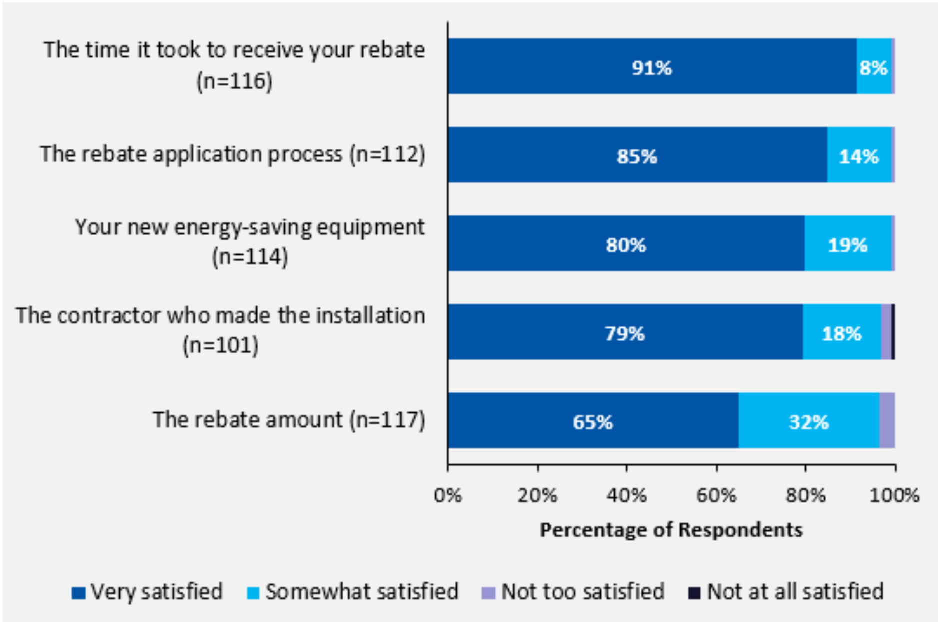
Source: Residential Programs Participant Survey, Question D4. "What benefits come to mind when thinking about your participation in Avista's Energy Efficiency Rebate program?" Multiple responses allowed.

Program Satisfaction

Cadmus asked survey respondents to indicate their satisfaction levels with various program elements associated with their rebate, new equipment, and installing contractor. Respondents' satisfaction levels with the PY 2020 program ranged from 97% to 100%[6] with the five elements shown in Figure 22. Respondents were least often *very satisfied* with the rebate amount. Lower satisfaction with rebates—as customers self-reported via the survey—occurs commonly among Prescriptive rebate programs; hence, Cadmus does not find this result unusual. From PY 2019 to PY 2020, the time it took to receive the rebate increased the most in *very satisfied* responses (from 76% to 91%). Conversely, satisfaction with the energy-saving equipment decreased the most in *very satisfied* responses (from 89% to 80%).

6 The combination of *very satisfied* and *somewhat satisfied* responses.

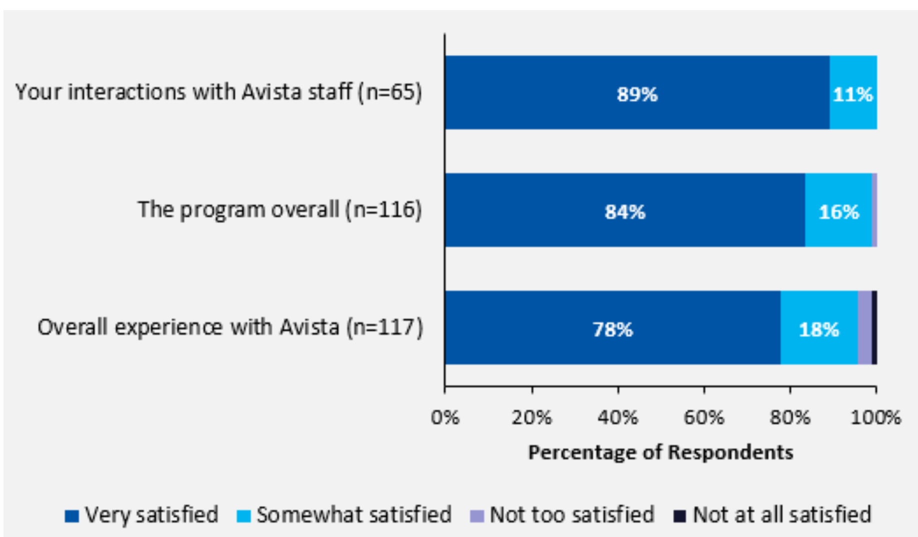
Figure 22. Satisfaction with Residential Program Elements



Source: Residential Programs Participant Survey, Question E1: "How would you rate your overall experience with..."

Respondents satisfaction levels with the PY 2020 program ranged from 96% to 100%[7] with the three elements shown in Figure 23.

Figure 23. Satisfaction with Avista and Residential Programs Overall



Source: Residential Programs Participant Survey, Questions E1, E4: "How would you rate your overall experience with..."

[7] The combination of *very satisfied* and *somewhat satisfied* responses.

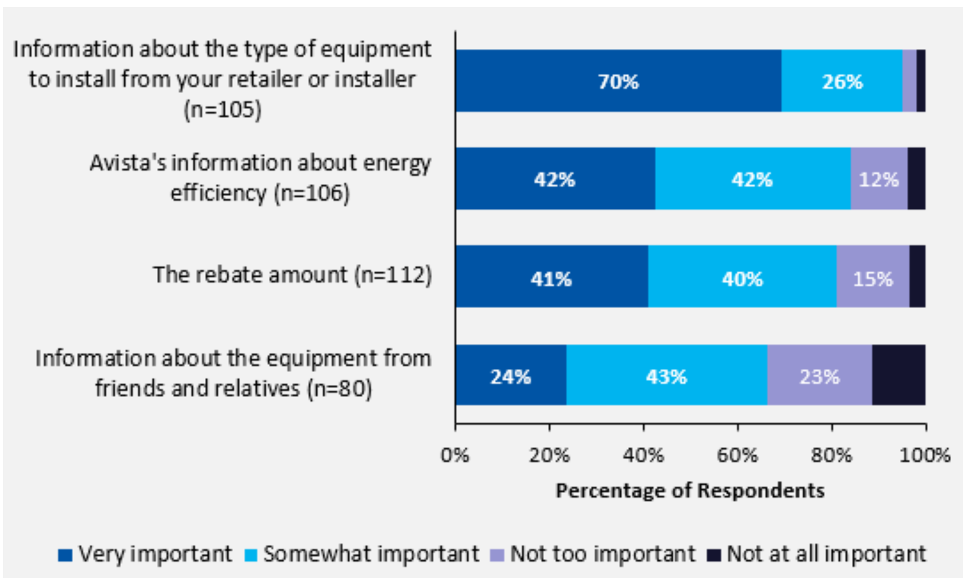
After asking respondents about their satisfaction with the PY 2020 programs and their elements, Cadmus solicited respondents' recommendations and feedback regarding possible program improvements. Nineteen percent of respondents (23 of 119) provided feedback, consisting mostly of the following recommendations:

- Increase advertising (9 of 23)
- Simplify rebate applications (4 of 23)
- Increase rebate amounts (2 of 23)

Decision Influencers

Cadmus asked respondents to rate the importance of several items on their decision to purchase and install the equipment. Respondents rated information about the equipment from retailers and installers as *very important* the most (70%), followed by Avista's information about energy efficiency (42%) and the rebate amount (41%). Respondents' reported importance of all four items is shown in Figure 28.

Figure 28. Influences on Program Participation



Source: Residential Programs Participant Survey, Question F1: "Please rate the following items on how important each item was on your decision to purchase and install the [MEASURE]."

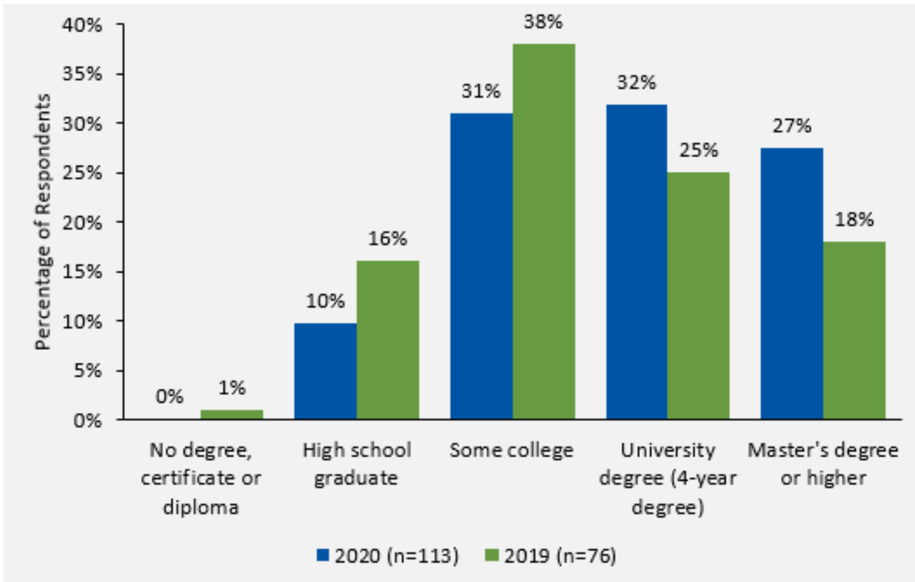
Cadmus asked respondents if anything else was *very important* in their decision to purchase and install the equipment. Forty-six percent of respondents (49 of 119) provided an answer, consisting mostly of the following reasons:

- Equipment needed to be replaced (17 of 49)
- Increased comfort (11 of 49)
- Desired to be more energy efficient (7 of 49)

Survey Respondent Profile

As shown in Figure 24, most survey respondents in PY 2020 had a two-year, four-year, or master's degree (90%), results were consistent with PY 2019.

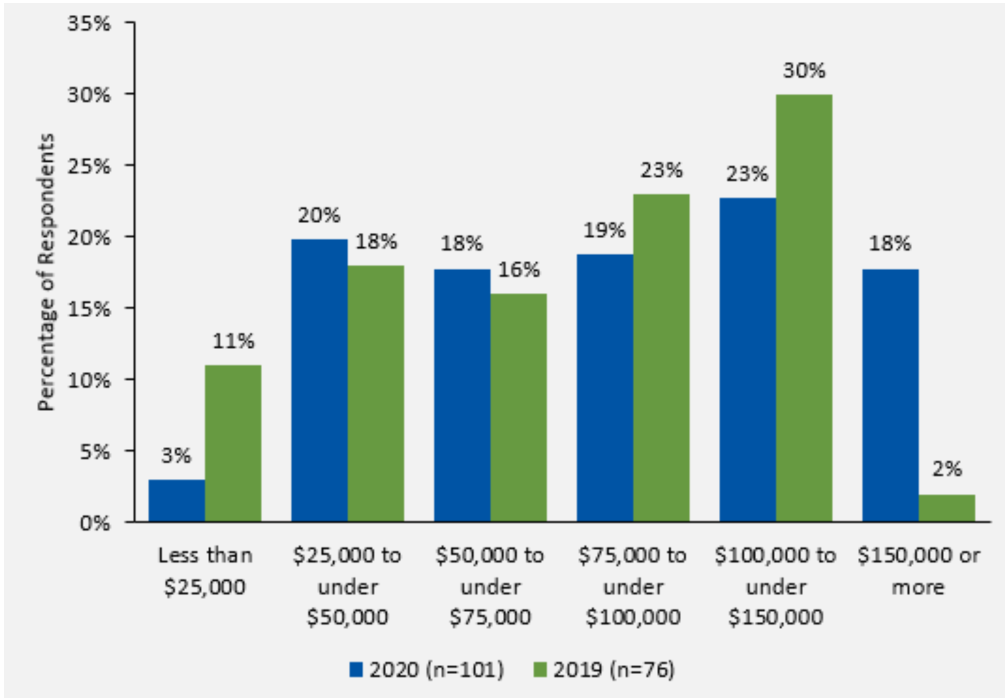
Figure 24. Residential Program Participant Education by Program Year



Source: Residential Programs Participant Survey, Question G1: "What is the highest level of education that you have completed?"

In PY 2020, 77% of respondents earned at least $50,000 annually, as shown in Figure 25.

Figure 25. Residential Program Participant Income Ranges by Program Year



Source: Residential Programs Participant Survey, Question G5: "Select the category that applies to your total household income for the year 2019."

In PY 2020, survey respondents reported an average household size of roughly 2.6 residents (n=111). Over 98% of respondents owned their homes (n=119).

Residential Conclusions and Recommendations

Conclusions and recommendations for the Residential programs are presented in this section.

Residential Conclusions

- **Like some utility energy efficiency programs, the ENERGY STAR Homes program was negatively affected by the COVID-19 pandemic.**
  - Avista achieved its target number of rebates for electric and electric/natural gas homes in Idaho but otherwise fell short of other state-specific, fuel-specific, and overall goals. The pandemic forced local manufactured homes dealers to close down, slowed the ENERGY STAR certification process for newly constructed manufactured homes, and, as was seen nationally, likely increased income insecurity among Avista's target customer base.
- **Contractors remain an important way to learn about the Residential programs but survey respondents also indicated an increased interest in learning about the programs through email from Avista.**
  - The share of respondents who learned about Avista's program through contractors increased from 38% in PY 2019 to 52% in PY 2020. Additionally, 15% of PY 2020 respondents

said that contractors would be the best way for Avista to inform them about energy efficiency, compared to 9% in PY 2019.

- The most common way PY 2020 respondents would like for Avista to inform them about energy efficiency is through email from Avista (37%). This percentage increased from 10% in PY 2019 respondents, indicating more interest in this method of communication.

- **Saving money or energy are key drivers of motivation to participate in the program.**
  - Eighty-eight percent of PY 2020 respondents said that saving money or saving energy motivated them to participate, and 96% of respondents listed energy savings, rebates, or lower operating costs as a benefit of participating in the program.
- **Participants remain highly satisfied with most aspects of the program.**
  - More than 99% of respondents were *very satisfied* or *somewhat satisfied* with their interactions with Avista staff and the program overall, as well as with the time it took to receive the rebate, the application process, and their new energy-saving equipment.
- **Information from equipment retailers or installers heavily influenced respondents' decision to participate.**
  - Ninety-six percent of respondents rated this information as *very important* or *somewhat important*, compared to information about the equipment from friends and relatives, which 67% of respondents rated as *very important* or *somewhat important.*

Residential Recommendations

Residential Recommendation 1: If not already doing so, use email blasts, bill inserts, and other promotional tools that are direct from Avista to customers, with Avista branding, to promote Residential programs and incentives. Although most participants learned about the programs from their contractor, they were more likely to want communication directly from Avista than through their contractor or vendor. These marketing efforts will enhance any contractor and vendor marketing or advertising, and give them better credibility, enabling them to make more sales through the program.

Residential Recommendation 2: Focus program outreach on home comfort to encourage participants since this was mentioned as a motivating factor for participation.

Third-Party Implementer Program

Simple Steps, Smart Savings is a midstream program that provides markdowns on specific items (such as LEDs, LED fixtures, showerheads, and clothes washers) through participating retailers. Avista administers the program and CLEAResult implements it. As part of the implementation process, CLEAResult gathers all sales data from participating retailers, occasionally sends program staff to visit each retailer, and provides marketing materials as well as any other relevant program information.

Third-Party Program Findings

For the process evaluation of Simple Steps, Smart Savings, Cadmus conducted stakeholder interviews with Avista and implementer staff.

Program Changes

Avista confirmed that most of Washington's Simple Steps, Smart Savings program terminated at the end of PY 2019, except for rebates for clothes washers. Idaho's Simple Steps, Smart Savings program operated in PY 2020 as it did in PY 2019, offering rebates on LED lamps and fixtures, showerheads, and clothes washers until the program's sunset in September 2020. Rebates did not change from PY 2019 levels.

In PY 2019, Avista considered implementing new data tracking software for the program. Avista used the software for other programs in its portfolio but did not move the Simple Steps, Smart Savings program onto the software because PY 2020 would be its last year in operation. The existing data tracking processes met Avista's needs.

Marketing and Outreach

As with past years, the implementer's field team provided marketing materials to participating retailers; Avista allows retail locations to choose if and how to use those materials in their stores. In response to the COVID-19 pandemic, the implementer provided marketing materials and conducted store visits based on both the preferences of the retail location and of its field staff. The implementer respected the individual wishes of every participating retail location; for example, some did not want any non-customers to enter for safety of their employees and customers. In those instances, the implementer did not conduct visits. Similarly, if an implementation field staff felt uncomfortable entering a store that appeared too crowded, the field staff could choose to not enter and revisit later.

Avista typically supplements point-of-purchase materials with marketing of its own materials but chose not to do so in PY 2020 in the wake of the pandemic. The implementer also scaled back online marketing in response to both the pandemic and the end of Energy Independence and Security Act (EISA) regulations.

Customer and Retailer Experiences

Because Simple Steps, Smart Savings is a third-party midstream program, Avista and the implementer cannot directly collect customer feedback or gauge satisfaction, which has always been a limitation for it and similar program models. However, feedback from retailers and the implementer suggests customers are satisfied with the program.

In past years, the implementer's field team would visit retail locations to educate customers and store associates, answer their lighting questions, and help them find the correct LED products for their needs. For health and safety reasons, implementation field staff stopped visiting stores to educate customers and store associates. Per the implementer, this left the burden of customer education on the retailers themselves; however, store associates often relied on product education as much as customers did. To overcome this barrier, the implementer arranged recurring virtual appointments between field staff and store associates to explain the program and answer any general or product-specific questions that store associates had. The implementer said its pandemic protocols, and especially its virtual visits, "worked really well." Despite the pandemic, the implementer observed sustained interest from customers in LEDs. Both Avista and the implementer speculated this could be attributed to people spending much more time at home than they normally would.

Ultimately, retailers were appreciative of their opportunity to participate in Simple Steps, Smart Savings and saddened to learn of the program's discontinuation. Per the implementer, retailers complimented the program as a "selling tool" and "a good way to get customers looking at more-efficient products."

Challenges and Successes

In addition to challenges caused by the COVID-19 pandemic described above, Avista and the implementer indicated three other challenges for the Simple Steps, Smart Savings program:

- **Goals:** When Avista set goals for PY 2020, it expected Idaho program activity to include only showerheads and clothes washers and Washington program activity to have ceased completely. Instead, Avista continued to offer rebates for LED lamps and fixtures in Idaho and for clothes washers in Washington. Accordingly, Avista did not have goals set for LEDs or clothes washers in their respective states.

  The implementer described the market as "fluid" and said, because of this fluidity, the goal of the program is to generate as much energy savings as possible using open-ended budgets. In response to the pandemic, the implementer did scale back savings program-wide in anticipation of declining activity. However, the implementer observed sustained interest in LEDs.
- **Retailer participation:** The implementer said some retail locations—especially franchises and individually owned stores such as Ace Hardware—wanted to participate in the program but could not because of unclear communication or direction from the retailer's corporate office. This resulted in unexpectedly low retailer participation.
- **EISA uncertainty:** The implementer said, for LED products, it was difficult to navigate the repeal of EISA. Because the Simple Steps, Smart Savings program is designed to be a turnkey program, the implementer faced challenges in adapting the program to the unique lighting guidelines developed by each state in response to EISA's repeal. Avista and the implementer discontinued the program in Washington largely because of the state's adoption of stricter guidelines than the federal guidelines originally imposed by EISA, a decision that rendered lighting savings in

Washington nearly obsolete. The repeal of EISA was a challenge for PY2020 that Avista and the implementer anticipated in PY 2019.

The implementer continues to maintain good relationships with utility partners, manufacturers, and retailers, and utilities find the program easy to sponsor, with current reporting systems making the program easy to maintain.

Third-Party Program Conclusions and Recommendations

Conclusions for the Simple Steps, Smart Savings program are presented in this section.

Conclusions

- **The implementer responded to the COVID-19 pandemic thoughtfully, which enabled the program to continue to perform well despite the circumstances until its termination in September 2020.**
  - The implementer let retailers permit or deny store visits from implementation field staff, allowed field staff the flexibility to reschedule store visits, and conducted virtual store visits to educate store associates about the program and products (such as LEDs) like it typically would. Avista and the implementer also scaled back marketing and outreach efforts and allowed each retail location to tailor marketing, including point-of-purchase materials provided by the implementer, to their individual needs.
- **Avista and the implementer faced uncertainty with the repeal of EISA, which led to the Simple Steps, Smart Savings program being implemented differently in Washington.**
  - The implementer offered rebates for clothes washers in Washington and for LEDs, showerheads, and clothes washers in Idaho. Avista did not set goals for clothes washers in Washington or for LEDs in Idaho.
- **Avista observed unexpectedly low throughput for clothes washers, which the implementer attributed to the challenge it faced when recruiting retail locations to participate.**
  - Despite showing a willingness to participate, some retail locations for franchised and individually owned stores like Ace Hardware could not offer program rebates because of a lack of communication/direction from their corporate offices. Thus, fewer retailers offered buy-downs for clothes washers, and fewer customers obtained clothes washer rebates.

Recommendations

Because Simple Steps, Smart Savings discontinued in PY 2020, Cadmus does not have any recommendations to make for the program.

Low-Income Program

Cadmus did not complete any process evaluation activities in PY 2020 for the Low-Income program. Cadmus will conduct a process evaluation for both Idaho and Washington for PY 2021 as indicated in the evaluation plan.

APPENDIX I – 2020–2021 EVALUATION WORK PLAN – CADMUS

CADMUS

Avista Corporation

2020-2021 Evaluation Work Plan

October 15, 2020

Prepared for:

Avista Corporation

1411 East Mission Avenue

Spokane, WA 99252

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Figures

Tables

Introduction and Goals

Avista Corporation contracted with Cadmus to evaluate its Nonresidential program portfolio for program year (PY) 2020 and PY 2021. For this engagement, the Nonresidential evaluation also includes the Multifamily Direct Install program. Cadmus will also conduct a process evaluation of Avista's entire portfolio, including Nonresidential, Residential, and Low Income programs.

The primary goals for the evaluation are these:

- Independently verify, measure, and document energy savings impacts from each electric and natural gas energy efficiency program or from program categories representing consolidated small-scale program offerings, from January 1, 2020, through December 31, 2021
- Analytically substantiate the measurement of those savings
- Calculate the cost-effectiveness of the portfolio and component programs
- Identify any program improvements
- Identify possible future programs

This evaluation work plan reflects Cadmus' understanding of the programs as described in Avista's 2020 Annual Conservation Plans as well as at the project kickoff. The work plan may change in response to program modifications or at Avista's request during PY 2020 and PY 2021. Cadmus will relay to Avista all modifications to evaluation approaches prior to proceeding.

Presently, this document offers proven methods to conduct full impact and process evaluations for Avista's Nonresidential portfolio and the Multifamily Direct Install program, as well as process evaluations for Avista's Residential and Low-Income portfolio of programs.

The following chapter summarizes the overall evaluation effort and includes an introduction to project staff, overview of the budget, and list of deliverables. Subsequent chapters present the evaluation methodologies for the impact and process evaluations, cost-effectiveness calculations, and Cadmus' quality assurance and quality control (QA/QC) processes.

Evaluation Work Plan Overview

Cadmus' highly skilled evaluators have considerable knowledge from many years of evaluating Avista's portfolio of programs and can rely on resources such as Cadmus' inventory of data monitoring equipment and Portfolio Pro+. The team has experience conducting virtual site visits, even before the limiting effects from Covid-19, and its proactive approach to project management will ensure the evaluation objectives are achieved in the most cost-effective manner. The following sections introduce the evaluation team and present the budget, timeline, and communication activities.

Evaluation Team

Cadmus' evaluation team is organized as shown in Figure 1 and features key personnel who have previous experience with Avista's evaluations.

Figure 1. Cadmus Evaluation Team Organizational Chart

Table 1 presents the projected staffing hours by state and includes current Cadmus titles and billing rates.

Table 1. Cadmus Staffing Plan

Staff	FY2021 Title	FY2021 Billing Rate	Projected Hours	
			Washington	Idaho
Jeffrey Cropp	Principal II	$310	195	132
Jerica Stacey	Associate I	$180	343	326
Nathan Hinkle	Associate II	$190	287	203
Kristie Rupper	Associate III	$205	67	64
Max Blasdel	Analyst	$125	113	60
Romio Mikhael	Associate III	$205	63	50
Evan Talan	Sr. Analyst II	$165	215	174
Brandon Kirlin	Analyst II	$135	192	181
Ian Nimmo	Engineering Tech III	$135	73	71
Aaron Huston	Engineering Tech II	$115	16	12
Nora Twichell	Engineering Tech II	$115	107	99
Mitt Jones	Sr. Associate II	$250	12	29
Kean Amidi-Abraham	Research Analyst	$115	120	108
Brian Hedman	Principal II	$310	10	10
Maggie Buffum	Associate I	$180	31	31
Taylor La Prairie	Analyst I	$125	84	52
Amanda McLeod	Analyst II	$135	116	76
Alex Chamberlain	Sr. Analyst I	$155	68	55
Alexander Opipari	Research Analyst	$115	179	160
Leslie Anderson	Technical Editor	$125	42	40

Budget

Avista awarded Cadmus $413,211.25 for the PY 2020-2021 Washington evaluation and $336,252.50 for the Idaho evaluation. This budget includes $33,169 in travel and other direct costs for site visits.

Timeline and Reporting

The overall timeline presented in Table 2 broadly depicts progress for each of the work tasks. The work plans for each program cluster include their own specific evaluation timelines. Deliverables associated with work tasks are specified after the table.

Table 2. PY 2020 and PY 2021 Task and Deliverable Schedule

Task	PY 2020		PY 2021				PY 2022	
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Kickoff Meeting								
Work Plan								
Project Management								
Advisory Group Meetings, as needed								
Verification Surveys								
On-Site or Virtual M&V and Analysis								
Cost-Effectiveness Analysis								
Document and Database Review								
Avista and Implementer Interviews								
Participant Surveys and Interviews								
Market Actor Interviews								
Electric Impact Memos								
Natural Gas Impact Memos								
Process Memo and Report								
Cost-Effectiveness Memos								

Deliverables

Impact evaluation activities

Process evaluation activities

Cadmus will provide the following deliverables by the dates listed:

- April 9, 2021
  - PY 2020 Washington Nonresidential electric impact evaluation memorandum
  - PY 2020 Washington Nonresidential natural gas impact evaluation memorandum
  - PY 2020 Washington Nonresidential electric and natural gas cost-effectiveness analysis
- April 16, 2021
  - PY 2020 Idaho Nonresidential electric impact evaluation memorandum
  - PY 2020 Idaho Nonresidential natural gas impact evaluation memorandums
  - PY 2020 Idaho Nonresidential electric and natural gas cost-effectiveness analysis
  - PY 2020 Washington and Idaho (combined) process evaluation memorandum
- April 8, 2022
  - PY 2020 – 2021 Washington Nonresidential electric impact evaluation memorandum
  - PY 2020 – 2021 Washington Nonresidential natural gas impact evaluation memorandum
  - PY 2020 – 2021 Washington Nonresidential electric and natural gas cost-effectiveness analysis

- April 15, 2022
  - PY 2021 Idaho Nonresidential electric impact evaluation memorandum
  - PY 2021 Idaho Nonresidential natural gas impact evaluation memorandum
  - PY 2021 Idaho Nonresidential electric and natural gas cost-effectiveness analysis
  - PY 2020 – 2021 Washington and Idaho (combined) process evaluation memorandum

Prior to delivery of each memorandum, Cadmus will prepare a comprehensive outline for Avista's review and approval. The memorandums will describe data collection and process methods, present results of the analysis and summarize findings, draw conclusions, and provide meaningful recommendations. Data collection instruments used for the process evaluation will be included as appendices to the final report. Cadmus will submit all supporting workpapers for the calculations, tables, graphs, and other illustrations contained in the deliverables.

Cadmus will also prepare *ad hoc* reports to document problems, urgent issues, and resolutions as they arise.

Communication

Avista expects multiple communication and reporting activities to be performed as part of this evaluation effort. Cadmus will design its project communications based on the following:

- The Avista DSM Planning and Analytics team serves as the lead contact for all evaluation aspects (impact and process) and, for contract purposes, is the client. Ryan Finesilver of the DSM Planning and Analytics team will serve as the contract manager and primary contact for the Cadmus team.
- The Avista DSM Planning and Analytics team will work with the Cadmus team to facilitate incorporation of Avista's implementation team's input into the final product. Avista may encourage the implementation team to actively participate in the evaluations, seeking to deliver the best product possible, consistent with the evaluation's independent character.
- An Avista DSM Planning and Analytics team member may be present (in person, by phone, or copied on e-mails) during any interactions between the Cadmus team and Avista's DSM implementation team.

Cadmus will hold biweekly conference calls with the Avista DSM Planning and Analytics team. These calls will provide updates about the project's status and issues. *Ad hoc* calls may be required to address specific project issues and activities. Cadmus anticipates attending and occasionally facilitating in-person, telephone, or web-based meetings in addition to regular and *ad hoc* project meetings and a final close-out meeting.

Throughout the evaluation process, Cadmus will remain engaged with Avista's regional stakeholders, participating as requested in DSM Advisory Group and Technical Committee meetings. Cadmus will provide the following support to Avista through these meetings:

- Present evaluation plans

- Present interim or final results on energy savings, realization rates, and cost-effectiveness
- Act as a technical resource to explain details of the evaluation methodologies and the rationale behind the methods employed for Avista
- Explore opportunities for new or expanded techniques to evaluate programs or inform program design

Impact Evaluation

Cadmus will apply the methods described below to develop findings that will determine the impacts of Avista's Nonresidential programs and guide the development of current and future programs.

Overview of Nonresidential Impact Evaluation Methods

Cadmus' analyses will use standard engineering approaches such as those defined by the International Performance Measurement and Verification Protocols (IPMVP) and the Uniform Methods Project (UMP). Cadmus will employ the following primary methods:

- Simple verification (desk review, phone, online, remote walk-through, or on-site)
- Energy calculation models
- Metering (IPMVP A and B)
- Whole building billing analysis (IPMVP Option C)
- Simulation modeling (IPMVP Option D)

Table 3 lists the impact evaluation data collection and analysis activities by program. Cadmus will conduct the online, phone, remote, and on-site measurement and verification activities in two waves in both 2020 and 2021 to obtain a reasonable sample from each program year.

Table 3. PY 2020–2021 Natural Gas and Electric Impact Evaluation Activities

Sector	Program	Database/ Document Review	Remote Verification/ Site Visit	Metering	Billing Analysis	Simulation Modeling
Multifamily	Multifamily Direct Install	✓				
	Multifamily Market Transformation – Fuel Efficiency (Idaho)	✓	✓			
Nonresidential	Site Specific	✓	✓	✓	✓	✓
	Interior Lighting	✓	✓			
	Exterior Lighting	✓	✓			
	Prescriptive Shell	✓	✓		✓	
	Green Motors	✓	✓			
	Motor Control HVAC (VFD)	✓	✓			
	HVAC	✓	✓		✓	
	Fleet Heat	✓	✓			
	Food Services	✓	✓			
	Compressed Air	✓	✓	✓		
	Grocer	✓	✓			

Simple Verification

Cadmus will verify some prescriptive measures (particularly those with relatively small reported savings) on site, via remote video walkthrough, by phone, by reviewing submitted documentation, or through an on-line questionnaire to confirm that measures are installed in the reported quantity and operating in a manner consistent with deemed-savings assumptions. Cadmus will also verify recorded nameplate efficiency data against manufacturer's specifications. Cadmus will accept reported savings without further investigation if it can confirm that these details match the assumptions used for unit energy savings in the Regional Technical Forum (RTF) or Avista technical reference manual (TRM). Cadmus will adjust the savings for any inconsistencies based on equipment and operating parameters found at the site.

Engineering Calculation Models

For some Nonresidential Site Specific measures, Avista uses spreadsheets to calculate the estimated energy savings for a variety of measures based on relevant inputs, such as quantity, fixture wattage, square footage, efficiency value, HVAC system details, and location details. For each spreadsheet, Cadmus will review input requirements and outputs to determine if the approach is reasonable. We will discuss any concerns about the approach with Avista's implementation team and explain why we think a different method may yield more accurate results. Where applicable, we will update calculations using on-site verification data, energy management system (EMS) trend data, spot measurements, and metering data.

Metering Analysis (IPMVP Options A and B)

To estimate the relevant operational parameters needed to inform engineering calculation models, Cadmus may perform data logging for a period of days, weeks, or months. During the site visits, we will confirm relevant information such as installation of the efficient equipment, set points, sequence of operations, operating schedules, and ambient conditions. We will also estimate the baseline energy performance, according to program documentation, on-site conditions, facility interviews, and relevant energy code requirements.

After downloading, we will clean meter data, checking key fields for missing data, correcting bad data, and removing sites with insufficient data. We will flag anomalies and send them to a senior engineer who will determine if the data should be used, corrected, or excluded from the analysis. Next, we will analyze the key variables in the metering data using spreadsheet tools or Python. We will use the resulting information to calculate savings (as input variables in an engineering model) or for comparison to consumption estimates.

Whole Building Analysis (IPMVP Option C)

Cadmus can use monthly billing or interval data to conduct regression analyses for nonresidential retrofit projects, particularly in the Site Specific and HVAC-related prescriptive programs (for example, HVAC and Shell). This analysis method is particularly useful for accurately assessing the energy savings from comprehensive retrofit projects, especially those involving custom HVAC or controls measures.

Using the pre- and post-modeling approach, Cadmus will develop retrofit-savings estimates for the sampled sites, accounting for cooling degree days (CDDs) and heating degree days (HDDs). We will match the participant-consumption data to the nearest weather station by zip code. We will then calculate the building balance-point temperature by correlating monthly energy use with monthly average temperature.

Cadmus will use the balance-point temperature to calculate the CDDs and HDDs then match these to the monthly billing data. We will use the resulting regression estimates to extrapolate average energy savings based on normalized weather conditions. (For this calculation, we will use typical meteorological year [TMY], 15-year normal weather averages from 1991–2005, obtained from the National Oceanic and Atmospheric Administration.)

For each project, Cadmus will model average daily consumption in kilowatt hours (kWh) and/or therms as a function of base load, HDDs and CDDs, and, where appropriate, daily production. For the evaluated sites, we will estimate two demand models—one for the pre-period and one for the post-period. We typically choose this methodology over a single standard-treatment-effects model to account for structural changes in demand that can occur with retrofits, such as changes in occupancy or usage patterns. We will then estimate the annual consumption based these values.

Simulation Model Analysis (IPMVP Option D)

Cadmus may review and verify the savings calculated from simulation models if this methodology is applied on projects. Our simulation approach, which is based on *in situ* observations and measurements, is calibrated to the best available energy-use indices. It entails the use of well-developed, sophisticated building-simulation tools, such as DOE-2, and follows methods described in the U.S. Department of Energy M&V Guideline and ASHRAE Guideline 14.[1,2]

We will obtain the existing as-built and baseline models, utility billing data, and any available documentation for each simulated measure project in the sample. Step one will be to conduct a side-by-side comparison of the existing baseline and as-built models. Because different versions of the same software (mainly eQuest and EnergyPlus) can return conflicting results, we will open models only in the software-build version in which they were developed.

Our goal for the site visit will be to gather all data necessary to improve and calibrate the model. Using our on-site data collection form and following our facility operator interview guide, we will verify all necessary assumptions and obtain any available EMS data needed to further inform the calibration process.

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1 U.S. Department of Energy. *M&V Guidelines: Measurement and Verification for Performance-Based Contracts (Version 4.0).* Available online at: http://energy.gov/sites/prod/files/2016/01/f28/mv_guide_4_0.pdf

2 ASHRAE. *Measurement of Energy, Demand, and Water Savings.* Atlanta, GA. 2014.

Following the site visit, Cadmus will update the model with the verified values and actual meteorological year (AMY) weather data for the appropriate location and time period then test statistical calibration, comparing model results with utility and metered data. In accordance with ASHRAE Guideline 14, we will target a monthly accuracy within a mean bias error (MBE) of ±5% and a coefficient of variation root mean square error (CVRMSE) of ±15%. We will make logical improvements, based on engineering judgment where anomalies are identified. In our analysis, we will account for fluctuations, such as those from initial building commissioning or first-year occupancy changes.

Once the adjusted as-built model has achieved the accuracy requirements, the remaining steps are straightforward. We will replace the AMY data used for calibration purposes with typical meteorological year (TMY) data. To develop the baseline model, we will back out the conservation measures based on incentive documentation, changes between existing models documented during the initial comparison, and any measure stipulations, such as code requirements. Unless instructed otherwise by Avista, we will calculate measure savings in the same order and manner suggested by the existing models and documentation (that is, first measure in, last measure out, and so on). We will determine savings by comparing results from the calibrated typical year as-built and baseline models.

Impact Sampling Plan

Cadmus' approach to developing impact evaluation sampling plans is consistent with the methods described in the UMP. Specifically, we will include these guidelines in our approach:

- **Determine confidence and precision requirements for key metrics.** Our team will use key metrics to support our gross and net energy estimates for each program. For programs with more complex or comprehensive offerings, we typically expect variation between customers to be larger than for programs with fewer variables or more streamlined installations. We will rely on our experience evaluating Avista's programs to estimate the homogeneity or heterogeneity of the population of participants and rely on coefficients of variance calculated from the previous round of evaluation to inform the variability in the expected sample population. When possible, we will design a sample for each program so that we can estimate the overall portfolio energy savings with 90% confidence and ±10% precision for each fuel type within each state.
- **Develop the sample design.** We will apply a sample design that primarily features stratified random sampling. The optimal design depends on the homogeneity or heterogeneity of the population of participants within each program as well as any targeted research we plan to perform (that is, if we are particularly interested in evaluating savings for a particular measure or collection of measures, we will stratify accordingly to ensure ample sample sizes from that population). We may select very large projects with certainty, when their expected savings are expected to differ substantially from the rest of the population. We will select at minimum the number of projects in each program as necessary to calculate confidence and precision within the program, even if participation or savings are low.

- **Calculate sample sizes.** We will calculate sample sizes based on the confidence and precision requirements, expected variation, sample design, and population size for each program. Sample sizes will be sufficient to estimate gross savings for each program and the portfolio as a whole.

For Nonresidential programs and Multifamily Market Transformation, Cadmus proposes a stratified sample design, with strata defined based on fuel type (electric and natural gas) and project savings. For each program and fuel type, we will stratify the sample into large- or small-savings projects and conduct verification on a simple random sample of the projects within each stratum. We will include dual fuel projects in the natural gas stratum for sampling purposes but will include electric savings from dual fuel measures with the electric stratum. We will evaluate the electric savings as a certainty selection for any dual fuel projects selected for random sampling. For the Multifamily Direct Install program, Cadmus will apply a simple random sample to select projects.

We will determine sample sizes for each program and fuel type separately in Washington and Idaho. Data we obtain during site visits will inform our calculation of realization rates used to estimate population savings for each program and fuel type. We will report these results and the corresponding state-specific program savings results.

After receiving program population data from Avista for January to September 2020 we determined sample sizes according to the most recent evaluation results, actual participant and project population sizes, additional stratification variables, and/or alternative sampling approaches (for example, probability proportional to size), with portfolio-level target confidence of 90% and precision of 10%. If possible, we will apply a finite correction to sample sizes to decrease the sample sizes. Table 4 shows the sample design for Washington and Idaho combined.

Table 4. Sample Design for Verification Surveys and Site Visits for Washington and Idaho Combined

Program	Fuel Type	Confidence	Precision	Washington		Idaho	
				Expected Population Size*	Sample Size	Expected Population Size*	Sample Size
Site Specific	Electric	80	20	184	34	64	30
	Natural Gas	80	20	32	6	7	4
Grocer	Electric	90	20	13	2	12	2
Interior Lighting	Electric	90	20	1084	17	516	20
Exterior Lighting	Electric	90	20	1304	17	712	20
Green Motors	Electric	90	20	16	8	16	0
Compressed Air	Electric	90	20	2	1	1	1
Fleet Heat	Electric	90	20	1	1	0	0
Motor Control HVAC (VFD)	Electric	90	20	4	7	3	1
HVAC	Natural Gas	90	20	80	10	80	6
Prescriptive Shell	Electric	90	20	16	3	1	1
	Natural Gas	90	20	16	4	4	2
Food Services	Electric	90	20	28	5	8	2
	Natural Gas	90	20	56	9	52	4
Multifamily Market Transformation	Fuel Efficiency	90	20	N/A	N/A	7	3
Total Nonresidential Site Visits/Verification Surveys				**2836**	**124**	**1483**	**96**

*** Expected population size is extrapolated from 2020 Q1-Q2 participation and 2018-2019 participation. Dual fuel measures are counted as gas for population size and sampling purposes.**

Impact Evaluation Activities by Program

Cadmus will conduct the verification activities in four waves—fall 2020, January 2021, summer 2021, and January 2021—using desk reviews, remote or physical site visits, and phone surveys to collect baseline data, operations data, and other information to inform the energy savings analyses. The following sections describe each Avista program and the proposed impact evaluation activities.

Multifamily Direct Install Program

Avista provides free gas and electric direct-install measures to multifamily residences (of five units or more) and common areas in its service territory though the Multifamily Direct Install program. Cadmus will conduct document reviews on the census of projects installed through this program to assess the quality of program tracking data (noting missing, duplicate, and out-of-range values) and will verify that values of key metrics are within expected limits.

We will provide Avista with *ex post* savings values by measure and will also calculate the program's cost-effectiveness.

Nonresidential Site Specific Program

The Nonresidential Site Specific program provides flexible opportunities to achieve energy savings for measures that do not fit a prescriptive path. In the past, these projects have been for compressed air, custom lighting, process improvement, and complex HVAC measures, among others. Multifamily Market Transformation projects for Idaho are also included in this program.

Cadmus will calculate participants' gross reductions in electricity and natural gas consumption using data collected through desk reviews, remote or on-site visits, customer billing histories (as needed), and engineering models and calculations, for the projects selected by the sample. The number of site visits will depend on actual enrollment and sample-size calculations, based on expected variability and the desired confidence and precision of evaluated savings. During the site visits, we will verify measure installations, collect baseline and equipment data, and identify addressable enrollment or installation issues.

We will analyze gross program impacts using data collected from site visits and from tracking data. We will verify reported *ex ante* savings by recalculating energy savings using Excel spreadsheet analysis tools, site-specific data, and standard engineering analysis methods. Data may include savings calculations, manufacturers' specification sheets, and commissioning reports. We may also conduct regression analyses, as needed, for measures such as comprehensive HVAC controls, whose savings impact cannot readily be evaluated through other means. Information collected during our site visits will determine if the sample projects reasonably address the measure's operating parameters and accurately reflect operating conditions.

Because we will not inspect all participant sites, we need a mechanism to extrapolate the difference between *ex ante* and *ex post* savings to the population. To resolve this, we will apply a correction factor based on the realization rates to *ex ante* savings to calculate evaluated *ex post* gross savings. We will document the reasons and impacts on savings of all adjustments and will review these with Avista's implementation team during a presentation before committing results to the draft reports.

Nonresidential Prescriptive Programs

Avista implements these ten prescriptive programs that provide incentives directly to customers for a variety of measures supported by unit energy savings in the RTF or Avista's TRM:

- Compressed Air
- Fleet Heat
- Food Services
- Green Motors
- Grocer
- HVAC
- Lighting Interior
- Lighting Exterior
- Prescriptive Shell
- Variable Frequency Drives

Cadmus will first work with Avista to prioritize and review prescriptive measures in the TRM to identify those with the most variance based on previous impact evaluation results. These measures may benefit from primary data collection and analysis during the 2020-2021 impact evaluation. This review requires in-depth knowledge and understanding about the specifics of each measure to ensure that the baseline and savings calculations reflect the best possible *ex ante* values for the region. Cadmus and Avista engineers will coordinate to ensure consistency in inputs and calculations and to ensure that the TRM uses the most up-to-date sources for Avista's engineering calculations. We may recommend measures to examine, as necessary, including references, algorithms, and inputs.

Cadmus will design a sample for verification activities to include all prescriptive programs, with primary emphasis on those that contribute the most savings or represent the highest level of uncertainty. We will apply sampling weights accordingly as part of the correction factor.

We will conduct desk reviews, remote, or on-site inspections during the initial round of impact data collection to confirm that Avista's quality-assurance processes have been maintained. This is particularly relevant for any new programs or programs with updated processes. If we find a high correlation between the *ex ante* and *ex post* results in our initial inspections, we may increase our reliance on less-intrusive data collection methods including desk reviews and phone interviews with participants.

We will review project documents, verify assumptions, adjust reported calculations, and compute *ex post* savings using Excel spreadsheet analysis tools or by approving installation rates for RTF measures with well-defined unit energy savings. We will derive baseline data from virtual/on-site visits, customer interviews, and Avista's program data. We will calculate *ex post* savings using submitted documentation, site visit data, and standard engineering analysis practices. We will also calculate a realization rate based on sampled sites and will apply this rate to the project population to estimate program total *ex post* savings.

In the Prescriptive program, as with the Site Specific program, we will document all reasons and impacts on savings for adjustments and will review these with Avista's implementation team before committing the results to the draft reports.

Remote Verification Strategy

The COVID-19 pandemic has resulted in significant and rapid changes to facility operations and caused uncertainty about future operations. This has complicated impact evaluation and especially affected on-site project verification site visits. Cadmus has developed a virtual and contactless approach that prioritizes customer comfort, preference, privacy concerns and operational policies, and is designed to minimize the burden on the customer throughout the data collection and inspection process.

Our virtual verification process involves using a web-based audio and video connection to simulate in-person customer interactions with a project-specific site contact. To verify savings, our evaluation staff may use a combination of:

- Existing submitted project documentation, including project application files, invoices, specification sheets, calculation models, and Installation Verification reports provided by Avista or available in the iEnergy web software

- Virtual site visit observations, for example a video recording, interview with the site contact, and photos taken during a virtual project tour
- Additional information provided by the site contact, for example additional trend data from the equipment, control system, or meter, more detailed photos or videos of equipment operation, or other documentation requested during the virtual site visit

Cadmus has conducted over 100 virtual site visits for 12 clients throughout the country across a wide variety of project types, and over the next 12 months we expect to have completed over 1,000 virtual site visits across the country. Our process has been designed for the long haul and we plan to keep the virtual/contactless option as a part of our evaluation offerings moving forward. In addition to the safety benefits related to the COVID-19 pandemic, our virtual site visit process saves travel costs, and allows for more flexible scheduling, particularly for geographically remote sites in rural regions of Avista's service territory.

We will review each project selected for verification to ascertain whether it is appropriate for remote verification and what level of remote verification is required to sufficiently verify the measures.

- Desk review: Lower-complexity projects which can be verified through a review of existing complete documentation.
- Desk review with interview: Projects with nearly complete documentation requiring additional photos, invoices, spec sheets, or other simple documentation. Projects with complete documentation where assumptions need to be reviewed or discussed. Interview may be conducted via email, phone call, or web video conference.
- Virtual site visit: Projects that have large savings, higher complexity, or incomplete documentation. Remote verification and interview will be conducted via video walkthrough of the project with a site contact involved in the implementation or operation of the system.
- Physical site visit: Projects that are too complex for remote verification, require on-site data collection or meter installation, projects with a large number of measures or large quantity of equipment, or where safety concerns, participant availability, or time required on site make a virtual site visit impractical or unsafe.

To be eligible for remote verification, a project must meet criteria for participant safety, data security and privacy, suitability of measures to remote verification, and site contact knowledge, availability, and technology limitations. Cadmus will provide a detailed virtual site visit protocol to Avista, and will notify the Avista account executive assigned to each project prior to initiating recruitment for remote or on-site verification. Physical site visits may be postponed until travel to the region is safe and prudent. We will review all in-person site visit plans with Avista prior to scheduling travel and will adhere to all COVID safety procedures provided by Cadmus, Avista, and the participant.

Real-Time Evaluation and Measurement

Cadmus may coordinate with Avista's implementation team to identify projects with both relatively large expected energy savings and relatively high uncertainty (for example, demand control ventilation and multi-stage compressed air retrofit). In comparison, projects such as large lighting retrofits may not require real-time EM&V because the savings should be relatively certain if the operating hours are well-characterized. Once Avista identifies the most likely projects for real-time EM&V, we will coordinate with implementation engineers and/or contractors to track project installation progress and estimate the completion date.

We will develop a site-specific EM&V plan for each project. Our metering engineer will be prepared to travel to the site to install meters during a timeframe estimated by Avista's implementation team. After removing the meter, we will follow our standard procedures for analyzing the data. We will summarize our methodology and results for further discussion with Avista before finalizing the energy savings.

EM&V for Advanced Metering Infrastructure (AMI)

Where relevant, and to support Avista's move toward advanced meter infrastructure (AMI), Cadmus will conduct EM&V for projects with AMI data. To support this type of analysis, we assume that electricity interval consumption data will be available for the pre-treatment, or ***baseline***, and treatment, or ***reporting***, periods.

The approach to calculating energy savings starts with building a predictive statistical model using baseline data, which includes baseline weather conditions and facility operating conditions as explanatory variables in the model. By applying the baseline model to the explanatory data measured during the reporting period, the model outputs represent the expected energy usage during the reporting period that would have occurred without the influence of the energy-saving measures. Therefore, subtracting the observed energy usage and predicted energy usage at each point in time results in the evaluated energy savings (adjusted for reporting period weather and facility operations).

Our proposed method has several advantages over other approaches:

- The method allows for ***flexible modeling*** of each facility's energy consumption. Because we conduct a separate analysis for each facility, it is possible to select a set of variables that are specific to that facility.
- Baseline models are ***uncontaminated*** by project treatment effects. Because the model is fit with baseline period data, the parameters of the adjusted baseline consumption reflect only baseline period operation.
- The model-building process is ***objective***. Because we rely on automated machine-learning to select the model variables, we can identify relevant variables affecting a facility's consumption from a larger set of candidate variables based on pre-determined criteria, which reduces time and the possibility for idiosyncratic choice by the analyst in building a model.

- The proposed approach is ***versatile, scalable, and cost-effective***. Much of the estimation can be automated and applied to a variety of commercial building types and samples with large numbers of facilities.

Our proposed analysis approach has four main steps—data collection and pre-processing, modeling, savings estimation, and reporting— as described in the next sections.

Data Collection and Preprocessing

Cadmus will collect the following data for the evaluation:

- Interval data of facility energy consumption
- Project implementation data including installation dates, project description, and *ex ante* savings estimate
- Building systems data from the facility's energy management system (if available)
- Interval weather data from nearest weather station

Cadmus will then conduct a quality review of the raw data. This process involves a visual inspection by a domain expert and automated checks for max and min values, consumption per square footage, rates of change, completeness of the data, etc. Once the validity of the data is established, we will define the facility's baseline and reporting periods from documentation about the project implementation.

Modeling

Cadmus will develop models using these steps:

- **Identify candidate model inputs**. Cadmus will begin by plotting energy usage against all explanatory variables and identify trends. Trends identified from visual inspection will be linear, non-linear, or periodic. These will require evaluation in the context of Cadmus' understanding of the physical systems involved and experience modeling similar facilities. We will also consider derived variables, such as day of week or degree days, and will assess correlations of these inputs and interactive effects between variables.
- **Select model type**. Cadmus has applied a range of modeling techniques and methods and knows that performance of an algorithm can depend on the dataset it is attempting to fit. Our approach is to select a class of models based on a specific use case and test performance (that is, predictive accuracy, minimization of prediction error, minimal data requirements, etc.) for the various model types within that class. Table 5 summarizes the collection of models we have used.

Table 5. Model Classes for Selection

Model Class	Model Type	Use Case
Linear	Single and multiple linear, ridge, Lasso regression	Low temporal resolution usage data, known physical relationships, observed linear trends
Time Series	Autoregressive integrated moving average (ARIMA), error term models, transfer functions	High temporal periodicity and seasonality, predicting future response
Bayesian	Decision trees, random forests, neural networks	Nonlinear relationships, complex systems, large amounts of data

Model validation and testing. Cadmus will create a set of candidate models based on prior experience and understanding of energy-savings projects and will rigorously evaluate these models against the facility-specific data and choose the best model in the energy-savings calculations. As a starting point in selecting the best model, we will apply graphical analysis of the relationship between energy usage and possible explanatory variables. We will then evaluate existing seasonality or temporal changes in selecting model types. In this initial step, we will consider using the model that is the simplest, has the fewest explanatory variables, and can be interpreted based on good engineering judgment.

Cadmus will test model prediction ability using a procedure that minimizes selection bias. This involves randomly splitting the baseline period data into training and testing sets, giving us two datasets of independent variables and measured energy consumption. Models are fit to the training data, applied to the test data, and scored on bias, model fit, and prediction accuracy metrics, such as the mean prediction error, relative root mean-squared error of prediction, mean absolute percentage error of prediction, and the median and other percentiles of prediction errors, r-square, and Akaike information criterion (AIC).

Randomly splitting the data does introduce bias and to fully understand a model we repeat this process for each model many times. These simulations build distributions of test statistics for each model that inform the selection of a final model.

Furthermore, we will identify patterns in the prediction errors by plotting or regressing the errors against variables such as hour of the day and day of the week. Also, we will investigate the evolution of errors over weeks and months to determine if there are prolonged trends that require further investigation.

Cadmus will fit the selected model to the entire set of baseline data. If, in the model validation and testing phase, we find that several models provide relatively good fit and predictions, we will calculate energy savings using several models and provide the results to Avista. For any given model that is chosen during the validation and testing phase, we will calculate the uncertainty in energy savings obtained using the entire dataset.

Cadmus expects that a variety of factors could confound the savings analysis. For example, a facility may undertake energy efficiency projects that are not funded through Avista during the reporting period. If these other projects are unaccounted for, the estimate of electricity savings could be biased upward. Table 6 lists possible confounding factors and the strategies for addressing them.

Table 6. Potential Confounding Variables

Confounding Variable	Problem	Solution Strategy
Other Energy Efficiency Projects	Unaccounted savings from other energy efficiency projects during the reporting period may bias the savings estimate.	Develop an engineering estimate of savings for the other project(s) and subtract validated savings estimates from Cadmus' regression-based estimate.
Floor Space Additions or Changes in Use of Facility Space	These changes can bias the savings estimates.	Cadmus will review project documentation and available energy management system data to identify significant changes. Cadmus may make engineering-based adjustments to the savings estimates or model energy intensity instead of consumption.

Savings Estimation

After developing a model, estimating savings is straightforward. Cadmus will fit the model to the baseline data and apply it to the conditions present during the reporting period, generating facility consumption at each interval, and subtract these estimates from the actual measured consumption. To calculate "typical year" savings, Cadmus fits a baseline model and a reporting period model, applies each of these models to TMY3 data, and takes the difference in the estimated energy consumption. Savings are provided on a per-site basis in each of these cases.

Cost-Effectiveness Analysis

Cadmus will calculate and report the program's cost-effectiveness using evaluated savings, avoided energy costs, and actual incurred implementation costs. We will use Portfolio Pro+ to provide cost-effectiveness assessments by portfolio, program, fuel type, year, measure, and state level.

We will determine the economic performance of a program from four standard perspectives—a combination of the utility and program participants, the utility, program participants, and all ratepayers (including nonparticipants). Cadmus will evaluate these perspectives using four cost-effectiveness tests—total resource cost (TRC) test, utility cost test (UCT), participant cost test (PCT), and rate impact measure (RIM) test. If requested, we may also look into applying the Resource Valuation Test (RVT).

We will populate a database with Avista's utility data common to all programs (such as discount rates, avoided costs, load shapes, and retail rates) so that we can maintain a consistent approach to cost-effectiveness valuation across all programs and portfolios.

Process Evaluation

The process evaluation approach considers past evaluation findings, insight from the kickoff meeting, and Avista's 2020 Annual Conservation Plans.

For all programs, our research methods will consider these three fundamental objectives:

- Assess participant and market actor program journey including motivation for participation, barriers to participation, and satisfaction
- Assess Avista and implementer staff experiences including organizational structure, communication, and program processes
- Document areas of success, challenge, and changes to the program

To address these research objectives, we will conduct implementation and customer research. Our implementation research will include a document and database review for each program, in-depth interviews with key Avista and implementation staff and contractor and Community Action Partner (CAP) agencies for relevant programs. Our customer research will include participant surveys and interviews, as well as builder and property manager interviews for relevant programs (Figure 2). We discuss each of these research areas and the associated tasks in more detail below.

Figure 2. Process Evaluation Research Areas and Tasks

Table 7 shows the research areas by program and year in Idaho and Table 8 shows the research areas by program and year in Washington. Cadmus will not complete a process evaluation for Simple Steps Smart Savings because the program will be discontinued soon.

Table 7. PY 2020–2021 Idaho Process Evaluation Activities

Program Name	Implementation Research		Customer Research	
	PY 2020	PY 2021	PY 2020	PY 2021
Residential Programs				
ENERGY STAR Homes	✓			
Shell		✓		✓
HVAC		✓		✓
Water Heat		✓		✓
Fuel Efficiency		✓		✓
Low-Income Programs				
Low-Income		✓		
Multifamily Programs				
Multifamily Direct Install	✓		✓	
Multifamily Market Transformation	✓		✓	
Nonresidential Programs				
Site Specific	✓		✓	
Prescriptive*		✓		✓
Grocer		✓		✓

*Nonresidential Prescriptive: Lighting, HVAC, Shell, Motor Control HVAC (VFD), Food Services, Green Motors, Compressed Air, and Fleet Heat.

Table 8. PY 2020–2021 Washington Process Evaluation Activities

Program Name	Implementation Research		Customer Research	
	PY 2020	PY 2021	PY 2020	PY 2021
Residential Programs				
ENERGY STAR Homes	✓			
Shell		✓	✓	✓
HVAC		✓	✓	✓
Water Heat		✓	✓	✓
Low-Income Programs				
Low-Income		✓		
Community Energy Efficiency Program		✓		
Multifamily Programs				
Multifamily Direct Install	✓		✓	
Nonresidential Programs				
Site Specific	✓		✓	✓
Prescriptive**		✓	✓	✓
Grocer		✓	✓	✓

*Residential prescriptive: space and water heating, smart thermostats, insulation, and windows.
**Prescriptive: Lighting, HVAC, Shell, Motor Control HVAC (VFD), Food Services, Green Motors, Compressed Air, and Fleet Heat.

The next sections describe the task methods for each research area.

Implementation Research

Cadmus will assess program processes and provide timely and actionable recommendations for continuous implementation improvement by reviewing the database and program documentation and conducting interviews with key Avista and third-party implementation staff, such as SBW Consulting, Washington State University Energy Program, 4 Sight Energy Group, the Green Motors Practices Group, contractors in the residential programs, and CAP agencies in the Low-Income program. Our reviews of key program documents and corresponding databases will inform what data we collect to meet the research objectives.

Table 9 lists the implementation research by program.

Table 9. Implementation Research by Program

<table>
<tr><th rowspan="2">Program</th><th colspan="4">Implementation Research</th></tr>
<tr><th>Document Review</th><th>Avista Interviews</th><th>Implementer Interviews</th><th>Contractor and CAP Agency Interviews</th></tr>
<tr><td colspan="5">Residential Programs</td></tr>
<tr><td>ENERGY STAR Homes</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Shell</td><td>✓</td><td>✓</td><td></td><td rowspan="3">✓*</td></tr>
<tr><td>HVAC</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Water Heat</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Fuel Efficiency</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td colspan="5">Low-Income Programs</td></tr>
<tr><td>Low-Income</td><td>✓</td><td>✓</td><td></td><td>✓</td></tr>
<tr><td>Community Energy Efficiency Program</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td colspan="5">Multifamily Programs</td></tr>
<tr><td>Multifamily Direct Install</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Multifamily Market Transformation</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td colspan="5">Nonresidential Programs</td></tr>
<tr><td>Site Specific</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Prescriptive Lighting</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>HVAC</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Prescriptive Shell</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Motor Control HVAC (VFD)</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Food Services</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Green Motors</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Compressed Air</td><td>✓</td><td>✓</td><td>✓</td><td></td></tr>
<tr><td>Fleet Heat</td><td>✓</td><td>✓</td><td></td><td></td></tr>
<tr><td>Grocer</td><td>✓</td><td>✓</td><td></td><td></td></tr>
</table>

*Contractor group to be determined after consulting with Avista.

The following sections describe the implementation research tasks. Program-level details are provided in the *Process Evaluation Activities by Program* section of this work plan.

Document and Database Review

Cadmus will review operation manuals, the program website, and the program database to gain a thorough understanding of how the program is implemented. In our database review, we will also assess the quality of program tracking data as it relates to our customer research.

We also will review Avista's most recent process and impact evaluation results to learn how Avista has incorporated earlier recommendations and to identify trends in program performance. We will apply our findings from the program document and database reviews to refine program-specific research objectives and develop data-collection instruments.

Avista Staff and Third-Party Implementer Interviews

Avista and its third-party implementers hold critical insight into program administration and delivery processes. Telephone interviews with these key stakeholders will focus on these topics:

- Program roles and responsibilities
- Program goals and objectives
- Program design and implementation
- Data tracking
- Program participation
- Marketing and outreach
- Program successes
- Market barriers
- Program impact on the market
- Future program changes including redesign

During the interview, we will be conscientious of staff members' time. Because we know they sometimes oversee multiple programs, our interview guides will avoid repetitive questions for programs with similar processes, such as data tracking, and we may cover all programs overseen by one or more staff members in one interview. We will build on our early findings from these program staff interviews to focus interviews with third-party staff about areas of interest.

For Residential and low-income programs in which contractors or agencies play a vital role, we will conduct contractor and CAP agency interviews.

Contractor Interviews

For many customers, contractors are an important source of program awareness and their involvement, cooperation, and understanding can be an indicator of program success. Cadmus proposes to conduct in-depth interviews to gain insights into contractors' motivations, experience, marketing strategies, how contractors identify customers, their standard business practices, knowledge about customer perceptions and experience, perspectives on program processes, the program's influence on business, and the opportunities for improvement.

Cadmus plans to complete up to 10 interviews with residential contractors (five per state). We will probably concentrate Residential contractor interviews on the HVAC program but will consult with Avista staff to determine if this is the best group to target. We will ask Avista program managers and account executives to identify target contactors and will coordinate communication to program contractors.

CAP Agency Interviews

Cadmus plans to complete up to five interviews with CAP Agency staff. These interviews will be focused on program experience, marketing strategies, knowledge about customer perceptions and experience, and program successes and opportunities for improvement.

Customer Research

As shown in Table 10, Cadmus will conduct online participant surveys, as well as interviews with trade allies where smaller populations exist.

Table 10. Customer Research by Program

Program Category	Customer Research	
	Participant Surveys	Trade Ally Interviews
Residential Programs		
Shell	✓	
HVAC	✓	
Water Heat	✓	
Fuel Efficiency	✓	
Multifamily Programs		
Multifamily Market Transformation (Builders)		✓
Multifamily Direct Install (Property Managers)		✓
Nonresidential Programs		
Site Specific	✓	
Prescriptive*	✓	
Grocer	✓	

*Nonresidential Prescriptive: Lighting, HVAC, Shell, Motor Control HVAC (VFD), Food Services, Green Motors, Compressed Air, and Fleet Heat.

Participant Online Surveys and Interviews

Cadmus will prepare participant survey and interview guides in each of Avista's programs. Questions will focus on topics that can help Avista understand trends in measure adoption and overall program performance and that gather critical data to inform the impact evaluation.

Our participant survey and interview guides will gather critical insights into participants' program journey, such as these aspects:

- Program awareness
- How respondents learned about the program
- General program participation
- Program delivery experience
- Overall program satisfaction
- Satisfaction with Avista

- Reasons for participation
- Program benefits
- Current energy-efficient behaviors and purchases
- Suggestions for program improvements

All participant surveys will be online and will involve emailing a link to the survey to participating customers for whom an email address is available.

We typically recommend simple random sampling when the population is sufficiently large but will finalize the sampling plan according to the target sample sizes and expected response rates and after receiving comprehensive participant tracking data. See Table 11 in the *Process Sampling Plans* section for sampling details.

For programs with unique populations (Multifamily Market Transformation and Multifamily Direct Install), we will conduct participating builder and property manager telephone interviews, respectively, to allow for a greater range of topic exploration. We will conduct up to five builders participating in the Multifamily Market Transformation program and up to five property managers in each state for the Multifamily Direct Install program.

Process Sampling Plans

For the participant surveys, Cadmus will calculate sample sizes for each program category and fuel type based on unique participant population sizes, expected variation, and confidence and precision targets. For this work plan, we have described the sample design and estimated sample sizes but will revise them according to actual participant and project population sizes.

In Table 11, we provide the anticipated survey sample sizes for each program category and fuel type, determined based on target 90% confidence and 15% precision for each program category and to far exceed 90% confidence and 10% precision for the portfolio overall with error ratios of 0.5. For programs with limited sample sizes, we will send the survey to a census of participants in the planned year and gather as many survey responses as possible.

We will conduct in-depth interviews with up to five builders participating in the Multifamily Market Transformation program and up to five property managers in each state of the Multifamily Direct Install program.

Table 11. Estimated Participant Survey Sample Design

Program Category	Fuel Type	Idaho and Washington Combined	
		Annual Participant Size*	Survey Target **
HVAC, Shell, Water Heat	Electric	~4,000	30
	Natural Gas	~12,000	40
Fuel Efficiency	Natural Gas	~500	AMAP (estimating between 10 and 20)
Residential Total		**~16,500**	**~90**
Site Specific	Both	~400	AMAP (estimating between 10 and 20)
Prescriptive Lighting	Electric	~700	30
HVAC	Natural Gas	~400	AMAP (estimating between 10 and 20)
Prescriptive Shell	Both		
Motor Control HVAC (VFD)	Electric		
Food Services	Both		
Green Motors	Electric		
Compressed Air	Electric		
Fleet Heat	Electric		
Nonresidential Total		**~1,500**	**~70**
Portfolio Total		**~18,000**	**~160**

* Participant size is the number of residential program participants and nonresidential program projects. These are estimates based on previous years.
**Final survey target will be based on actual unique participants/project by state in each program category in the year survey is scheduled. Due to small population sizes, Cadmus will send email invite to census and gather as many completed surveys as possible.

Process Evaluation Activities by Program

This section describes the process evaluation activities by program. Although many process research activities are similar, such as reviewing program documents and tracking database to assess roles and responsibilities, marketing and outreach, participation trends, and informing subsequent interview and survey questions, the following descriptions note more program-specific focus areas.

Residential HVAC, Shell, and Water Heat Programs

The process evaluation of these programs will include the following data-collection activities:

- **Review program documents and database** to assess program changes and determine if database contains all necessary fields for customer surveys.
- **Interview Avista staff** to assess differences between the implementation of the program in Idaho and Washington, assess the impact of Washington's Clean Energy Transformation Act on program design and implementation, document program changes and goals, and identify program successes and challenges.

- **Interview participating contractors (n=10)** to assess program understanding, experience, and satisfaction, how contractors identify customers, use of rebates as a sales factor, customer awareness of the program prior to engaging the contractor, standard business practices, influence of the program on business, and qualifying equipment offered.
- **Survey participating customers** to explore their experience, including application processing and influence of the contractor, continued levels of satisfaction, and marketing preferences.

ENERGY STAR Homes Program

The process evaluation of the ENERGY STAR Homes program will include the following data-collection activities:

- **Review program documents** to assess program changes.
- **Interview Avista staff** to document program changes and goals, assess differences between the implementation of the program in Idaho and Washington, identify program successes and challenges, assess regional communication and coordination with NEEA and other partnering utilities, and assess builder and dealer perceived experience and relationship.

Residential Fuel Efficiency Program (Idaho only)

The process evaluation of the Fuel Efficiency program will include the following data-collection activities:

- **Review program documents and database** to assess program changes and determine if database contains all necessary fields for customer surveys.
- **Interview Avista staff** to document program changes and goals and identify program successes and challenges.
- **Survey participating customers** to explore their experience, including application processing and influence of the contractor, continued levels of satisfaction, and marketing preferences.

Low-Income Program

The process evaluation of the Low-Income program will include the following data-collection activities:

- Review program document to assess program changes.
- Interview Avista staff to assess program changes and goals, assess differences between the implementation of the program in Idaho and Washington, identify program successes and challenges, and assess CAP agency and contractor experience and relationship.
- **Interview CAP agencies (up to n=5)** to assess program implementation, document marketing methods, assess experience with contractors, Avista staff, and customers, and identify program successes and challenges.

Community Energy Efficiency Program (Washington Only)

The process evaluation of the Community Energy Efficiency Program will include the following data-collection activities:

- **Review program documents** to document program processes, marketing efforts, and data tracking.

- **Interview Avista and implementer staff** to document program design including goal setting, delivery process, customer eligibility, incentive structure, and data tracking, as well as roles and responsibilities, and areas of success and challenge.

Multifamily Direct Install Program

The process evaluation of the Multifamily Direct Install program will include the following data collection activities:

- Review program documents to assess program changes.
- Interview Avista staff to document program changes and goals, assess differences between the implementation of the program in Idaho and Washington, identify program successes and challenges, and assess trade ally relationship.
- Interview implementer to document program understanding, including coordination of program marketing and outreach, and overall program experience, including satisfaction and suggestions for improvement.
- **Interview participating property managers (up to 5 per state)** to explore customer experience, including program awareness, satisfaction, energy efficiency actions, barriers to energy efficiency programs, and marketing preferences.

Multifamily Market Transformation (Idaho Only)

The process evaluation of the Multifamily Market Transformation program will include the following data collection activities:

- Review program documents to assess program changes.
- Interview Avista staff to document program changes and goals, identify program successes and challenges, and assess trade ally relationship.
- **Interview participating builders (up to 5)** to assess motivation and challenges, explore customer satisfaction and experience, and asses influence of the program on business practices.

Nonresidential Site Specific and Prescriptive Programs

The process evaluation of the Site Specific and Prescriptive programs (Interior and Exterior lighting, HVAC, Shell, Motor Control HVAC [VFD], Food Services, Green Motors, Compressed Air, Fleet Heat, and Grocer) will include the following data-collection activities:

- Review program documents and database to assess program changes and determine if database contains all necessary fields for customer surveys.
- Interview Avista staff to assess differences between the implementation of the program in Idaho and Washington, assess the impact of Washington's Clean Energy Transformation Act on program design and implementation, document program changes and goals, identify program successes and challenges and to assess contractor relationships.
- **Interview implementers** to document program understanding, roles and responsibilities, experience, satisfaction, and suggestions for improvement.

    - Green Motors: Green Motor Program Group
    - Compressed Air: 4Sight Energy Group, LLC
- **Survey participating customers** to explore their experience and continued levels of satisfaction, including satisfaction with and influence of the contractor or designer, assess energy-saving behavior and document marketing preferences.

APPENDIX J – 2020–2021 EVALUATION WORK PLAN – ADM

Work Plan: Evaluation, Measurement and Verification (EM&V) of Avista's 2020-2021 Energy Efficiency Programs

Prepared for:

Avista Corporation

Delivered on:

January 7, 2020

Prepared by:

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1. Technical Evaluation Plan

This Evaluation, Measurement, and Verification (EM&V) Plan details the methods by which ADM Associates, Inc. (ADM) and Cadeo will complete the impact evaluation of Avista Utility's (Avista) 2020 Programs as-specified in ADM's response to the Request for Proposals (RFP) for evaluating Avista Utility's ("Avista") 2020-2021 residential and residential low-income (collectively, "residential") energy efficiency programs in Idaho and Washington.

1.1 Summary of Avista's Residential and Low-Income Portfolio

Table 1-1 summarizes the programs offered to residential and low-income customers in the Avista service territory as well as ADM's evaluation tasks and impact methodology for each program.

Table 1-1: Impact Evaluation Activities by Program

Program	Database Review	Survey Verification	Impact Methodology
Water Heat	✓	✓	Billing analysis with comparison group
HVAC	✓	✓	Billing analysis with comparison group
Shell	✓	✓	Billing analysis with comparison group
ENERGY STAR Homes	✓	✓	Simulation modeling/Billing analysis with comparison group
Residential Small Home & Multifamily Weatherization*	✓		RTF UES/ Billing analysis with comparison group
Residential Fuel Efficiency Program	✓		Billing analysis with comparison group
Low-Income	✓		Billing analysis with comparison group
CEEP	✓		RTF UES/Billing analysis with comparison group

*This program was not deployed for the 2020 program year. Evaluation of this program will commence in 2021.

1.2 Evaluation Approach

ADM will perform an impact evaluation on each of the programs. ADM will use the following approaches to calculate energy impact defined by the International Performance Measurement and Verification Protocols (IPMVP) and the Uniform Methods Project (UMP):

- Simple verification (web-based survey)
- Deemed savings and/or Engineering Algorithms (IPMVP Options A & B)
- Whole building billing analysis (IPMVP Option C)
- Simulation modeling (IPMVP Option D)

ADM will complete and report the results of the above impact tasks for each the electric impacts and the natural gas impacts for each state separately.

The M&V methodologies are program-specific and determined by previous Avista evaluation methodologies as well as the relative contribution of a given program to the overall energy efficiency impacts. Besides drawing on IPMVP, we will also review relevant information on infrastructure, framework, and guidelines set out for EM&V work in several guidebook documents that have been published over the past several years. These include the following:

- Northwest Regional Technical Forum (RTF)
- National Renewable Energy Laboratory (NREL), United States Department of Energy (DOE) The Uniform Methods Project (UMP): Methods for Determining Energy Efficiency Savings for Specific Measures, April 2013[1]
- International Performance Measurement and Verification Protocol (IPMVP) maintained by the Efficiency Valuation Organization (EVO) with sponsorship by the U.S. Department of Energy (DOE)[2]

We will keep our data collection instruments, calculation spreadsheets, and monitored/survey data available at the request of Avista. Any component of the data collection or analysis will be made available at request. All communications (including data transfer) will be consistently performed with constant communication and data sharing protocols.

1.2.1 Impact Evaluation Approach

This section presents our general cross-cutting approach to accomplishing the scope of work outlined in the Request for Proposal (RFP) for impact evaluation of Avista's Residential and Low-Income programs listed in Table 1-1. The Evaluators start by presenting our general evaluation approach. This chapter is organized by general task due to several overlap across programs. Section 1.3 describes the Evaluators' program-specific impact evaluation methods in further detail.

ADM outlines our approach to verifying, measuring, and reporting the residential portfolio impacts as well as cost-effectiveness and summarizing potential program and portfolio improvements. The primary objective of the impact evaluation is to determine ex-post verified net energy savings. There will be no on-site verification or equipment monitoring.

Our general approach for this evaluation considers the cyclical feedback loop among program design, implementation, and impact evaluation. Our activities during the evaluation will estimate and verify annual energy savings and identify whether a program is meeting its goals. These activities are aimed to provide guidance for continuous program improvement and increased cost effectiveness for the 2020 and 2021 program years. ADM will provide the following services and objectives as deliverables to Avista for this evaluation, as specified in the RFP:

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[1] Notably, The Uniform Methods Project (UMP) includes the following chapters authored by ADM. Chapter 9 (Metering Cross-Cutting Protocols) was authored by Dan Mort and Chapter 15 (Commercial New Construction Protocol) was Authored by Steven Keates.

[2] Core Concepts: International Measurement and Verification Protocol. EVO 100000 – 1:2016, October 2016.

1. Independently verify, measure and document energy savings impacts from each of Avista's electric and natural gas energy efficiency Programs, or for Program categories representing consolidated small-scale offerings from January 1, 2020 through December 31, 2021;
2. Analytically substantiate the measurement of those savings;
3. Calculate the cost effectiveness of the Portfolio and component Programs using the Total Resource Cost Test (TRC), Utility Cost Test (UCT), Participant Cost Test (PCT), Ratepayer Impact Measure Test (RIM), and, potentially, the Resource Values Test (RVT) tests;
4. Identify Program improvements, if any; and
5. Identify possible future Programs.

In addition to the above services, we have identified the following deliverables to Avista for this evaluation:

- Two (2) separate and independent evaluation reports, one for Idaho and one for Washington, of Avista's Residential Natural Gas Impact Evaluation for each program year
- Two (2) separate and independent evaluation reports, one for Idaho and one for Washington, of Avista's Residential Electric Impact Evaluation for each program year
- An independent estimate of kWh and Therm savings for 2020 and 2021 through thorough and proper evaluation of program impacts with statistical precision and confidence at a minimum of 10%/90% for each state and fuel type
- Presentation of evaluation findings to Avista's Spokane offices or other regional locations, as required, along with additional stakeholders, as necessary
- Updates to Avista's Technical Reference Manual (TRM), annually, based on Avista's evaluation findings and secondary information
- All supporting workpapers for calculations, tables, graphs, and other documents as necessary
- State-specific reports on any project where realization rate is expected to be less than 90% as well as a complete listing of all projects where any material adjustments were made
- Summary of any deviations from historical methodology for calculating cost-effectiveness in the final report in addition to a presentation of deviations to the Advisory Group.

ADM will deliver the 2020 program year results by April 15, 2021, and the 2021 program year results by April 15, 2022. We approach evaluation with the frame of mind that the final report should not contain information that has not already been communicated with Avista. This is achieved through the following:

- **Transparency of Evaluation Effort.** In our evaluations, we will keep our data collection instruments, models, calculation spreadsheets, programming scripts, and monitored data/survey data available at the request of Avista. All components of the data collection or analysis will be made available in their native format with all formulas intact, informing Avista as to how the calculation of energy savings is performed and allowing for independent review of ADM's efforts.
- **Regular Updates on Impact Findings.** ADM approaches the evaluation effort with the frame of mind that Avista should know the realized savings of the program prior to delivery of evaluation reporting. This will be accomplished through regular updating of all involved parties as to the

findings of the impact evaluation effort. This allows for real-time feedback regarding the performance of varying measures or participant classes, feeding into a process of continuous program improvement. This also allows for Avista to conduct an independent review or quality check of ADM's analysis, if desired. ADM's analysis will be kept transparent throughout the evaluation effort.

This document contains the approach for the evaluation of Avista's 2020 and 2021 program year. It is ADM's intention to formalize this workplan in collaboration with Avista; This is a collaborative effort with Avista to ensure Idaho Public Utilities Commission (PUC) and Washington Utilities and Transportation Commission (WUTC) receives accurate and reliable program findings and that Avista receives meaningful insights to continue energy efficiency efforts and improve program results. ADM will provide comprehensive documentation and transparency for all evaluation tasks and will provide ongoing technical reviews and guidance throughout the evaluation cycle.

ADM will employ the following approach to complete impact evaluation activities for the programs. ADM defines three major approaches to determining net savings for Avista's programs:

- A *Deemed Savings* approach involves using stipulated savings for energy conservation measures for which savings values are well-known and documented. These prescriptive savings may also require an adjustment for certain measures, such as lighting measures in which site operating hours may differ from RTF values. ADM will work with Avista to identify these instances and develop a method for calculated an adjusted value. This approach aligns with the IPMVP Option A and B.
- A *Billing Analysis* approach involves estimating energy savings by applying a linear regression to measured participant energy consumption utility meter billing data. Billing analyses may also include billing data from nonparticipant customers. This approach does not require on-site data collection for model calibration. However, a sample of customers or sites may be selected and surveyed to confirm that the energy conservation measures were installed and are still operating. This approach aligns with the IPMVP Option C.
- A *Simulation Model Analysis* approach involves a whole building simulation using the program REM/Rate and a User Defined Reference Home (UDRH) to compare the efficient home and the baseline home. The UDRH is designed as an exact replica of each program participating home in terms of size, structure, and climate zone. This approach aligns with the IPMVP Option D. ADM will apply appropriate net-to-gross (NTG) values to estimate net impacts.

ADM will accomplish the following quantitative goals as part of the impact evaluation:

- Verify savings with 10% precision at the 90% confidence level by program year;
- Where appropriate, apply the RTF to verify measure impacts; and
- Where available data exists, conduct billing analysis with a suitable comparison group to estimate measure savings.

1.2.2 Database Review

At the outset of the evaluation, ADM will review the databases to ensure that each program tracking database conforms to industry standards and adequately tracks key data required for evaluation. ADM will additionally review program materials – such as program theory and logic models to identify potential issues and key barriers to end-use behavior changes that could be influenced by efforts by each program.

Measure-level gross savings will be evaluated primarily by reviewing measure algorithms and values in the tracking system to assure that they are appropriately applied using the Avista TRM. The ADM team will then aggregate and cross-check program and measure totals. The ADM team will calculate verified gross program savings by summing deemed kWh and Therm savings per project.

The ADM team will clearly identify, clarify, and substantiate any variations in the savings calculations we uncover. We will integrate all findings into the final evaluation report. In addition to reporting the total gross realization rates, we will also quantify the associated impact each adjustment had on the overall program savings.

1.2.3 Simple Verification Methods

ADM will verify a sample of participating households for detailed review of the installed measure documentation and development of verified savings. Proposed sample sizes for documentation review is detailed in Table 1-2 in the section below. ADM will work with Avista to adjust the sampling plan once program tracking data has been delivered and participation rates are finalized.

ADM will also verify tracking data by reviewing invoices and surveying a sample of participant customer households. We will coordinate as needed with Avista's process evaluation contractor in conducting participant surveys. Proposed sample sizes for documentation review are detailed in Table 1-3 in the section below. The following sections describe ADM's general methodology for conducting document-based verification and survey-based verification.

1.2.3.1 Documentation-Based Verification

ADM will first screen each rebate household to ensure the customer who received a measure did not also receive another measure that disqualifies that customer from participating in either program, such as the ENERGY STAR Homes rebate in combination with an HVAC rebate. Tracking data will be reviewed to verify each measure satisfies all program efficiency requirements.

ADM will also request rebate documentation for a subset of participating customers. These documents will include invoices, rebate applications, and additional materials required for accepting rebate applications for each of the following programs:

- Water Heat Program
- HVAC Program
- Shell Program
- ENERGY STAR Homes Program

This sample of documents will be used to cross-verify tracking data inputs. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report under each program.

ADM will develop a sampling plan that achieves a sampling precision of ±10% with 90% statistical confidence – or "90/10 precision" – to estimate the percentage of projects for which the claimed savings are verified or require some adjustment. ADM will use the following equations to estimate sample size requirements for each program and fuel type. If the population of participants is small, ADM will use the finite population size equation. Otherwise, ADM will use the infinite population size equation.

Equation 1-1 Sample Size for Infinite Sample Size

$$n = \left(\frac{Z \times CV}{d}\right)^2$$

Equation 1-2 Sample Size for Finite Population Size

$$n_0 = \frac{n}{1 + \left(\frac{n}{N}\right)}$$

Where,

n = Sample size

Z = Z-value

CV = Coefficient of variation

d = Precision level

N = Population

For a sample that provides 90/10 precision, Z = 1.645 (the critical value for 90% confidence) and d = 0.10 (or 10% precision). The remaining parameter is *CV*, or the expected coefficient of variation of measures for which the claimed savings may be accepted. The most conservative value of *CV* is 0.5, as that results in the largest sample size. Specifically, it yields a sample size of 68 for an infinite population. In cases in which the participant population is small enough that Equation 1-2 produces a smaller sample size, we will use that sample size.

Based on the above considerations, ADM proposes the following sample sizes for the above programs' document review (Table 1-2). The representative participant sample will be adjusted for each of the programs in Washington and Idaho, by fuel type.

Table 1-2: Sample Design for Document Review for Washington and Idaho Combined

Program	Fuel	Population	Sample (With Finite Population Adjustment)[1]
Water Heat	Electric	127	45
	Natural Gas	957	64
HVAC	Electric	419	59
	Natural Gas	7,401	68
Shell	Electric	379	58
	Natural Gas	1,337	65
ENERGY STAR Homes	Electric	44	27
	Natural Gas	6	6
Residential Small Home & MF Weatherization	Electric	NA	NA
	Natural Gas	NA	NA
Residential Fuel Efficiency Program	Electric	95	40
Low-Income	Electric	364	58
	Natural Gas	550	61
CEEP	Electric	21	17
	Natural Gas	0	0

*Residential and Low-Income combined

[1]Assumes sample size of 68 for an infinite population, based on *CV* (coefficient of variation) = 0.5, *d* (precision) = 10%, *Z* (critical value for 90% confidence) = 1.645.

The above values represent our preliminary sample design. ADM will work with Avista to adjust these sample sizes once program tracking data has been delivered for the program year in evaluation. ADM understands that representation of participants in each state in Avista's service territory is critical. Therefore, ADM will ensure the samples for document review includes participants in both Washington and Idaho in addition to representation of each the electric and natural gas fuel types.

1.2.3.2 Survey-Based Verification

The primary purpose of conducting a verification survey would be to confirm that the measure was installed and is still currently operational and whether the measure was early retirement or replace-on-burnout. Units found to be inoperative prior to replacement could be re-classifies as replace-on-burnout. This would aid in providing more accurate estimation of annual savings by replacement type.

ADM proposes to conduct survey-based verification for the Water Heat Program and the HVAC Program. The evaluation of these programs would benefit from additional information from the participating customer on baseline equipment and home heating and cooling type. Survey responses for these programs may be used to confirm assumptions made during the impact analysis via billing regression. ADM concluded that it is unlikely a survey would provide additional insight or adjustments to the Shell

Program or ENERGY STAR Homes Program; therefore, these programs are not included in the survey-based verification effort.

If there is reason to believe, however, that the misclassification of measures is rare, then the likely value of collecting such information must be weighed against the effort and cost of surveying customers. This is especially a concern, given that the process evaluation contactor may be fielding a survey of the same customer population at the same time or nearly the same time. One possible approach is for the process evaluation contractor to include a question about the operability of the old equipment at the time the new measure was purchased.

Therefore, we suggest holding off making a final decision on fielding a survey until ADM has been able to confer with the process evaluation contractor. Should the decision be made to proceed with a verification survey, ADM will also ask the participant questions about additional details of the installed unit, such as sizing of furnace, model number, number of light bulbs installed, etc.

ADM proposes the sample sizes shown in Table 1-3 for the Water Heat and HVAC document review. The representative participant sample will be adjusted for each of the programs in Washington and Idaho, by fuel type. ADM will develop a sampling plan that achieves a sampling precision of ±10% with 90% statistical confidence – or "90/10 precision" – for net realized savings estimates at the measure category level for all significant measures during web-based survey verification.

Table 1-3: Sample Design for Verification Survey for Washington and Idaho Combined

Program	Fuel	Survey Verification Goal
Water Heat	Electric	45
	Natural Gas	64
HVAC	Electric	59
	Natural Gas	68
Fuel Efficiency	Electric	40

The above values represent our preliminary sample design. ADM will work with Avista to adjust these sample sizes during the kickoff meeting and the formation of Avista's Electric and Natural Gas Residential EM&V Plan for Idaho and Washington.

ADM will develop the web-based verification guide for review and comment by Avista staff prior to deploying these verification surveys. ADM will employ our in-house survey research center to support all survey-based data collection efforts. In cases where the web-based survey response does not meet sampling target, ADM will use our in-house survey research center to reach out to customers via phone call.

ADM will develop a sampling plan that achieves 90/10 precision at the measure category level for all significant measures during web-based survey verification. The selected sample participants will be offered a $10 gift card incentive to participate in the verification survey. In the case the targeted number of web-based survey completes is not reached, ADM will supplement with phone interviews to reach the 90/10 precision goal.

These surveys will be designed to ensure that best practices and lessons learned from individual programs are then shared and incorporated across the entire program portfolio. In order to facilitate evaluation among and between programs, customer surveys will contain a standard set of questions to be addressed across all Avista programs.

The findings from these activities will serve to:

- Verify measure was installed
- Verify measure is functional
- Gather pre-retrofit equipment information
- Gather retrofit equipment information

1.2.4 Impact Evaluation Methods

ADM will employ the following approach to complete impact evaluation activities for the programs. ADM defines three major approaches to determining net savings for Avista's programs:

- Deemed Savings
- Billing Analysis
- Simulation Model Analysis

ADM will also estimate gross savings for all measures that require billing analyses for planning purposes at the request of Avista.

In the following sections, we summarize the general guidelines and activities ADM will follow to conduct each of the above analyses.

1.2.4.1 Deemed Savings

This section summarizes the deemed savings analysis method ADM will employ for the evaluation of a subset of measures for each program. ADM will complete the validation for specific measures across each program using the RTF unit energy savings (UES) values, where available. The goal is to ensure that the proper measure unit savings were recorded and used in the calculation of Avista's ex-ante measure savings. ADM will request and use the RTF document version Avista employed during calculation of ex-ante measure savings. The ADM team will document any cases where we recommend values differing from the specific unit energy savings workbooks used by Avista.

In cases where the RTF has existing unit energy savings ("UES") applicable to Avista's measures, ADM will verify the quantity and quality of installations and apply the RTF's UES to determine verified savings. If we find any projects that do not use the RTF values, we will complete additional investigation and review of measures with custom savings inputs through engineering algorithms. ADM understands that for measures using RTF UES, no NTG adjustments are necessary.

ADM will verify the following home specifications, as required by the RTF:

- Verify heating system type
- Verify heating and cooling zone

ADM will review program application documents for a sample of incented measures to verify the tracking data accurately represents the program documents. ADM will ensure the home installed measures that meet or exceed program efficiency standards.

1.2.4.2 Billing Analysis

This section summarizes the general billing analysis methods ADM will employ for the evaluation of a subset of measures for each program. For further details on the specific model specifications to be explored for each measure, see Section 1.3.

For the purposes of this summary, a household is considered a treatment household if it has received a program incentive. Additionally, a household is considered a control household if the household has not received a program incentive. To conduct a linear regression billing analysis for energy efficiency measures, ADM requires billing data for a control group to compare against treatment households via quasi-experimental methods. The evaluation team will request billing data for nonparticipant customers to serve as the control group. This method assumes Avista is able to provide consumption data for a group of similar non-participating customers in the service area.

ADM will attempt to create a statistically similar control group using propensity score matching (PSM), a method that allows the evaluators to find the most similar nonparticipant customer households based on a range of independent variables. ADM has extensive experience conducting propensity score matching for residential program billing analyses of similar measures and is familiar with the implications and uncertainties involved in this type of analysis. ADM will use available datasets to ensure the control households are similar to the treatment homes, using variables such household square footage, household heating type, household occupancy date, household zip code, and any other information available for the nonparticipant customers specific to the program. For example, to create a sufficient counterfactual group for the Low-Income Program, ADM will request flags for income eligibility across nonparticipant customers.

Further information on the selection of customers for a counterfactual control group is detailed below, as well as potential risks and implications. If a sufficient control group can be constructed, ADM will compare participant billing data to the control billing data, as detailed in IPMVP Option C. ADM will fit a regression model to estimate weather-dependent daily consumption differences between participating customer households and nonparticipating customer households. ADM will include independent variables such as Heating Degree Days for weather controls, square footage, and other household characteristics where applicable to improve model confidence. We will tailor our regression model specifications to each program and measure. ADM will explore the following regression models:

- Fixed effect Difference-in-Difference (D-n-D) regression model (recommended in UMP protocols)
- Random effects post-program regression model (recommended in UMP protocols)

Further details on model specifications can be found below. It is important to note that because whole household consumption is used, the savings value includes the positive or negative effects of any non-measure changes made in the household. This option is used to determine the collective savings of all measures applied to the program-participating household by the energy meter. Therefore, ADM will attempt to isolate households that have installed only the measure in evaluation. For example, in evaluating the furnace measure in billing analyses, ADM will exclude households that have also installed an incented water heater in order to effectively isolate the effects of the furnace retrofit.

The period of billing data should cover the same timeframe for both groups. To evaluate the 2020 and 2021 program years, ADM will request billing data ranging from at least one year prior to measure intervention (i.e. date measure was installed, or date household was built) through the most recent date available from each household.

The following lists the data requirements for billing analysis:

1. Monthly billing data for program participants (treatment)
2. Monthly billing data for a group of non-program participants (control)
3. Household-level data provided by Avista and public sources relevant to program requirements and targeted customers

The following steps will be taken to prepare data:

1. Gather billing data for homes that participated in the program.
2. Exclude participant homes that also participated in the other programs, if either program disqualifies the combination of any other rebate or participation.
3. Gather billing data for similar customers that did not participate in the program in evaluation
4. Create a matched control group using non-participant billing and customer and/or household characteristic data.
5. Exclude homes missing sufficient billing data.
6. Exclude bills with consumption indicated to be outliers.

ADM will report parameters necessary to portray model accuracy and significance such as coefficient p-values, adjusted *R*-squared values, and household-level and program-level kWh and Therm savings at the 90% confidence intervals for each state. Program-year savings estimates at the monthly- and annual-level will also be reported for each state and fuel type.

One major caveat of this method is that we must be able to gather a sufficiently large sample of control households that are statistically similar to the treatment households. If the nonparticipant homes are statistically different from the participant homes in the pre-treatment period, this analytical approach will not provide meaningful results and ADM will therefore validate savings via RTF or Avista TRM engineering algorithms as well as additional literature review.

Billing analysis with a valid counterfactual group can provide reliable net impact estimates at the measure-level and program-level. However, the success of a billing analysis depends on the availability of several key factors:

- A sufficient number of customers have installed the measure to isolate measure-level savings;
- A sufficient number of similar nonparticipant customers can be identified and used towards propensity score matching to create a valid counterfactual group for the measure;
- Install dates for the measure display sufficient variability; and

- Historical billing data is available for at least one year prior to customer install dates.

ADM will also conduct an additional billing analysis for these measures to estimate gross savings. This analysis is very similar to the net estimate methodology, but it will not require the use of a counterfactual control group.

ADM provides further detail on the implications of each of the components listed above.

Comparison Group

To estimate reliable net impacts through billing analysis, a similar counterfactual group must be selected. In program designs where treatment and control customers are not randomly selected at the outset, such as for downstream rebate programs, quasi-experimental designs are required. ADM proposes to construct a comparison group of nonparticipants who are similar to participants and reflect the counterfactual condition. ADM aims to achieve this by selecting customers from one of the two following options:

- Future program participants or
- Nonparticipants selected through propensity score matching (PSM)

For the prior case, ADM would isolate customers that participated later in the program year as the control group to compare against customers that participated earlier in the program year (the treatment group). ADM will then verify that the treatment and control groups display similar pre-period average daily consumption through *t*-testing and run a linear regression model to estimate the measure effect on consumption in the post-period.

In the latter case, ADM will use propensity-scoring matching (PSM) to match nonparticipants to similar participants using pre-period data, test the validity of the matches with *t*-testing, and run a linear regression to estimate the measure effect. PSM allows the evaluators to find the most similar household based on the customers' billed consumption trends in the pre-period and verified with statistical difference testing.

A propensity score is a metric that summarizes several dimensions of household characteristics into a single metric that can be used to group similar households. ADM will create a post-hoc control group by compiling billing data from a subset of nonparticipants in the Avista territory to compare against treatment households using quasi-experimental methods. This will allow ADM to select from a large group of similar households that have not installed an incented measure. With this information, ADM will attempt to create a statistically valid matched control group via seasonal pre-period usage. After matching, ADM will conduct a *t*-test for each month in the pre-period to help determine the success of PSM.

After creating a PSM control group, ADM will carry out linear regression modeling on the treatment and matched control group.

For measures that are active during the heating season only, such as the air source heat pump or furnace, ADM will include heating degree days in the model specification. For measures that are active during the heating season and cooling season, such as water heaters and thermostats, ADM will include heating degree days and cooling degree days in the model specification.

In addition, ADM will test and select the optimal temperature base for heating degree days and cooling degree days based on model *R*-squared values. ADM will select a value between 60- and 80-degrees Fahrenheit that displays the optimal model *R*-squared value. The selected base temperature therefore maximizes the total variation the model is able to explain.

Fixed Effects Difference-in-Difference Regression Model

To calculate the impacts of each measure, ADM will apply a linear fixed effects regression using participant and nonparticipant billing data with weather controls in the form of Heating Degree Days (HDD) and Cooling Degree Days (CDD). The following equation displays the model specification to estimate the average daily savings due to the measure.

Equation 1-3: Fixed Effects Difference-in-Difference (D-n-D) Model Specification

$$\begin{aligned} ADC_{it} = \alpha_0 &+ \beta_1(Post)_{it} + \beta_2(Post \times Treatment)_{it} + \beta_3(HDD)_{it} + \beta_4(CDD)_{it} \\ &+ \beta_5(Post \times HDD)_{it} + \beta_6(Post \times CDD)_{it} + \beta_7(Post \times HDD \times Treatment)_{it} \\ &+ \beta_8(Post \times CDD \times Treatment)_{it} + \beta_9(Customer\ Dummy)_i + \varepsilon_{it} \end{aligned}$$

Where,

ADC_{it} = Estimated average daily consumption (dependent variable) in home *i* during period *t*

$Post_{it}$ = A dummy variable indicating pre- or post-period designation during period *t* at home *i*

$Treatment_i$ = A dummy variable indicating treatment status of home *i*

HDD_{it} = Average heating degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*

CDD_{it} = Average cooling degree days (base with optimal Degrees Fahrenheit) during period *t* at home *i*

$Customer\ Dummy_i$= A dummy variable indicating customer-specific identifier at home *i*

ε_{it} = Customer-level random error

α_0= The model intercept for home *i*

β_{1-9} = Coefficients determined via regression

The Average Daily Consumption (ADC) is calculated as the total monthly billed usage divided by the duration of the bill month. β_2 represents the average change in daily baseload in the post-period between the treatment and control group and β_7 and β_8 represent the change in weather-related daily consumption in the post-period between the groups. Typical monthly and annual savings will then be estimated by extrapolating the β_7 and β_8 coefficients with Typical Meteorological Year (TMY) HDD and CDD data or actual weather displayed in the program year, gathered from NOAA. Note that the Treatment term is dropped from the model specification due to fixed effects. This term is not included because it would be collinear with the customer-specific dummy variable.

This option is used to determine the collective savings of all measures applied to the program-participating household by the energy meter. It is important to note that because whole household consumption is used, the savings value includes the positive or negative effects of any non-measure changes made in the household.

Random Effects Post-Program Regression Model

ADM will also explore the post-program regression model with random effects to estimate net program savings. The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the treatment and control customers; in particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between treatment and control customers will be reflected in the differences in their past energy use, which is highly correlated with their current energy use. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

Equation 1-4 Post-Program Regression (PPR) Model Specification

$$
\begin{aligned}
ADC_{it} = \alpha_0 + \beta_1(Treatment)_i \\
&+\beta_2\ (PreUsage)_i \\
&+\beta_3\ (PreUsageSummer)_i \\
&+\beta_4(PreUsageWinter)_i \\
&+\beta_5(Month)_t \\
&+\beta_6(Month \times PreUsage)_{it} \\
&+\beta_7(Month \times PreUsageSummer)_{it} \\
&+\beta_8(Month \times PreUsageWinter)_{it} \\
&+\varepsilon_{it}
\end{aligned}
$$

Where,

i = the *i*th household

t = the first, second, third, etc. month of the post-treatment period

ADC_{it} = Average daily usage for reading *t* for household *i* during the post-treatment period

$Treatment_i$ = Dummy variable indicating whether household *i* was in the treatment or control group

$Month_t$ = Dummy variable indicating month-year of month *t*

$PreUsage_i$ = Average daily usage across household *i*’s available pre-treatment billing reads

$PreUsageSummer_i$ = Average daily usage in the summer months across household *i*’s available pre-treatment billing reads

$PreUsageWinter_i$ = Average daily usage in the winter months across household *i*'s available pre-treatment billing reads

ε_{it} = Customer-level random error

α_0= The model intercept for home *i*

β_{1-8} = Coefficients determined via regression

The coefficient β_1 represents the average change in consumption between the pre-period and post-period for the treatment group.

In this specification, savings are calculated by:

Equation 1-5 Monthly Savings Estimate

$$Savings = \sum Treatment\ Coeff \times Number\ of\ recipients\ in\ month\ i \times Number\ of\ days\ in\ month\ i$$

Gross Billing Analysis

The sections above detail ADM's methodology for estimating net energy savings for each measure. The results of the above methodology report net savings due to the inclusion of the counterfactual comparison group. However, for planning purposes, it would also be useful to estimate gross savings for each measure. To estimate gross savings, ADM will employ similar regression models, but only with the participant customer billing data. This analysis will not include any control group billing data and will only model energy reductions between the pre-period and post-period for the measure participants.

To calculate the impacts of each measure, ADM will apply a linear fixed effects regression using participant billing data with weather controls in the form of Heating Degree Days (HDD) and Cooling Degree Days (CDD). The following equation displays the model specification to estimate the average daily savings due to the measure.

Equation 1-6: Treatment-Only Fixed Effects Weather Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(HDD)_{it} + \beta_3(CDD)_{it} + \beta_4(Post \times HDD)_{it} + \beta_5(Post \times CDD)_{it} + \beta_6(Customer\ Dummy)_i + \varepsilon_{it}$$

ADM also will explore the monthly regression model rather than degree days to estimate gross program savings.

Equation 1-7 Treatment-Only Fixed Effects Monthly Model Specification

$$ADC_{it} = \alpha_0 + \beta_1(Post)_{it} + \beta_2(Month)_t + \beta_3(Month \times Post)_{it} + \beta_4(Customer\ Dummy)_i + \varepsilon_{it}$$

ADM will test and select the optimal regression model and temperature base for heating degree days and cooling degree days based on model *R*-squared values.

The results of the treatment-only regression models will be gross savings estimates. The gross savings estimates will be useful to compare against the net savings estimates. However, the treatment-only models are unable to separate the effects of the COVID19 pandemic. The post-period for PY2020 and perhaps also PY2021 will be affected by the stay-at-home orders that had taken effect starting March 2020 in Idaho and Washington. The stay-at-home orders most likely will affect the post-period household usage. Because there is insufficient post-period data before the shelter-in-place orders, ADM is unable to separate the effects on consumption due to the orders and the effects on consumption due to the measure installation. Therefore, the results from this additional gross savings analysis are unable to reflect actual typical year savings.

1.2.4.3 Simulation Model Analysis

ADM provides the following method for deriving savings from the ENERGY STAR Homes Program. This method involves a whole building simulation (IPMVP Option D) in addition to a billing analysis with a counterfactual control group.

The simulation analysis results in gross savings estimates whereas a billing analysis with a control group results in net savings estimates. Therefore, ADM will use a simulation analysis with a net-to-gross (NTG) savings adjustment or a billing analysis with a counterfactual control group.

This approach involves the comparison of participating homes with a User Defined Reference Home (UDRH). The methodology detailed in this section is supported by the IPMVP Option D as a whole building simulation using calibrations. ADM will use the simulation models to compare a sample of participating homes with a User Defined Reference Home (UDRH), an agreed upon set of efficiency standards built to represent the baseline residential home in the region. The UDRH is defined in more detail in the following subsection.

ADM will use the program REM/Rate to complete whole building simulation modeling efforts. The UDRH feature in REM/Rate allows energy consumption to be calculated using energy efficiency input values for both the efficient home and the baseline home. The UDRH will be designed as an exact replica of each program participating home in terms of size, structure, and climate zone. However, instead of using the actual HERS-rated efficiency values, we use the energy codes defined in the UDRH. ADM will gather energy characteristics for the efficient, rated home by requesting HERS datafiles from the certified HERS-raters or by gathering information from the HERS certificates required by the program and provided by Avista.

To calculate the gross savings for a given home, first, the as-built home is verified using building characteristics found in supporting documentation. Once the efficient home is modeled, the energy model calculates the unadjusted gross savings by subtracting the energy use of the as-built home from the energy use of its UDRH baseline home. This method provides a reliable and supported means of verifying gross residential new construction home savings.

Energy savings will be calculated per-home with the following calculation:

Equation 1-8: Whole Building Model Energy Savings

$$Energy\ Savings = Consumption_{UDRH} - Consumption_{ENERGY\ STAR}$$

Where,

$Consumption_{UDRH}$ = Simulated energy consumption values from REMRate for a household under the UDRH efficient code standards

$Consumption_{ENERGY\ STAR}$ = Simulated energy consumption from REM/Rate for a household built referencing the HERS certification values

ADM defines the UDRH used to evaluate simulated savings in the following section.

User Defined Reference Home (UDRH)

The UDRH represents a home built to meet the state of Idaho's and Washington's current minimum energy efficiency code requirements. Idaho uses the residential 2015 International Energy Conservation Code (IECC) with amendments[3] for newly constructed residential homes until January 1, 2021. Starting in 2021, Idaho will use the residential 2018 IECC with Idaho amendments. ADM will use the residential 2015 IECC with Idaho-specific amendments efficiency values to create the UDRH when evaluating homes built in Idaho during the 2020 program year and the 2018 IECC with Idaho-specific amendments when evaluating homes built in Idaho during the 2021 program year. This comparison will provide an accurate simulation of a newly constructed minimum efficient code residential home to compare against efficiency, program-participating homes. For homes built in Avista's territory in Washington state lines, ADM will create a UDRH based on Washington residential building codes, which are modeled after International Residential Code (IRC) 2015.

Realization rates from the home-level analyses can be used to provide strategic guidance for program improvement. We will examine realization rates for commonalities among home builders or HERS raters and inform Avista if any program partner demonstrates a statistically significant increased likelihood of association with low realization rates. We will then review the home results in further detail to identify a root-cause (errors in model input, construction practice, equipment sizing, etc.)

1.2.5 Net-To-Gross

The Northwest RTF UES measures do not require NTG adjustments. In addition, billing analyses with counterfactual control groups, as proposed in our impact methodology, does not require a NTG adjustment, as the counterfactual represents the efficiency level at current market (i.e. the efficiency level the customer would have installed had they not participated in the program).

However, the simulation model analysis presented for the ENERGY STAR Homes Program results in gross savings estimates.

1.2.6 Cost-Effectiveness Tests

ADM will calculate each program's cost-effectiveness, avoided energy costs, and implementation costs. ADM will use our ADM-developed cost-effectiveness tool to provide cost-effectiveness assessments for the Residential Portfolio by program, fuel type, program year, and measure, for each state.

As specified in this solicitation, ADM will determine the economic performance with the following cost-effectiveness tests:

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[3] https://www.energycodes.gov/adoption/states/idaho

- Total Resource Cost (TRC) test;
- Utility Cost Test (UCT);
- Participant Cost Test (PCT);
- Rate Impact Measure (RIM) test; and
- Resource Valuation Test (RVT).

1.2.7 Non-Energy Benefits

ADM will use the Regional Technical Forum (RTF) to quantify non-energy benefits (NEBs) for residential measures with established RTF values where available. Measures with quantified NEBs include residential insulation, high efficiency windows, air source heat pumps, and ductless heat pumps. ADM understands the RTF provides NEB values for electric measures, but not natural gas measures.

In addition to the residential NEBs, ADM will apply the end-use non-energy benefit and health and human safety non-energy benefit to the Low-Income Program. ADM understands that the two major non-energy benefits referenced above are uniquely applicable to the Low-Income Program. ADM will apply those benefits to the program impacts as well as additional non-energy benefits associated with individual measures included in the program.

ADM will incorporate additional NEBs to the impact evaluation, as applicable and under guidance from Avista.

1.3 Program-Level EM&V Approaches

ADM presents a summary of the program-specific impact evaluation work procedures. ADM will work with Avista to adjust program-specific impact and sampling plans as additional information is received about program participation, program restrictions, measure offerings, and available data.

1.3.1 Water Heat Program

The Water Heat Program encourages customers to replace their existing electric or natural gas water heater with high efficiency equipment. Customers receive incentives after installation and after submitting a completed rebate form. Table 1-4 summarizes the measures offered under this program.

Table 1-4: Water Heat Program Measures

Measure	Impact Analysis Methodology
Electric Water Heater (0.94 EF or higher)	Billing Analysis
Natural Gas Water Heater (0.60 EF or higher)	Billing Analysis
Natural Gas Tankless Water Heater (0.82 EF or higher)	Billing Analysis

ADM summarizes the program-specific and measure-specific impact analysis activities and requirements for the Water Heat Program in the section below.

1.3.1.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the Water Heat Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

In addition, ADM will randomly select a subset of participant customers to survey for simple verification of installed measure, displayed in Table 1-3. ADM will include questions such as:

- Was this water heater a new construction, or did it replace another water heater?
- Was the previous water heater functional?
- Is the newly installed water heater still properly functioning?
- What is the efficiency and sizing of the newly installed water heater?

These questions will help ADM verify that the measure was documented accurately and that data collection activities are progressing smoothly for the program. In addition, in the event that billing analysis is infeasible, this simple verification will help ADM more accurately estimate measure-level impacts using engineering algorithms.

1.3.1.2 Impact Analysis

ADM will conduct a billing analysis regression using with a counterfactual group selected via propensity score matching on each of the water heater measures in the Water Heat Program. ADM will isolate each unique measure and verify the participant did not also participate in other programs; therefore, ADM will be able to isolate the measure effects using the customer's consumption billing data.

ADM will attempt to create a valid quasi-experimental control group using nonparticipant customer data and available household characteristics. ADM will work with Avista to identify household characteristics the Water Heat Program targets in order to identify nonparticipant customers similar to program participants. ADM will then explore the linear regressions summarized in Section 1.2.4.2 with controls for HDD and CDD to estimate weather-related impacts from each measure. ADM will summarize the measure-level impacts by extrapolating regression coefficients with TMY data or actual weather data.

1.3.1.3 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of measure install
- Filled rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if available

1.3.1.4 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis, ADM will review RTF values and Avista TRM methods along with verified tracking data to estimate net program savings.

1.3.2 HVAC Program

The HVAC program encourages installation of high efficiency HVAC equipment and smart thermostats through customer incentives. The program is available to residential electric or natural gas customers with a winter heating season usage of 4,000 or more kWh, or at least 160 Therms of space heating in the prior year. Existing or new construction homes are eligible to participate in the program. Table 1-5 summarizes the measures offered under this program.

Table 1-5: HVAC Program Measures

Measure	Impact Analysis Methodology
Variable speed motor	Billing Analysis
Electric to air source heat pump	Billing Analysis
High efficiency natural gas furnace	Billing Analysis
High efficiency natural gas boiler	Billing Analysis
Smart thermostat	RTF UES

ADM summarizes the program-specific and measure-specific impact analysis activities and requirements for the HVAC Program in the section below.

1.3.2.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the HVAC Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

In addition, ADM will randomly select a subset of participant customers to survey for simple verification of installed measure, displayed in Table 1-3. ADM will include questions such as:

- What type of thermostat did this thermostat replace?
- Is your home heating with electricity, natural gas, or another fuel?
- Was the previous equipment functional?
- Is the newly installed equipment still properly functioning?

These questions will help ADM verify that the measure was documented accurately and that data collection activities are progressing smoothly for the program. The verification for smart thermostats will allow ADM to calculate measure-level savings more accurately. In addition, in the event that billing analysis is infeasible, this simple verification will help ADM more accurately estimate measure-level impacts for the other measures using engineering algorithms.

1.3.2.2 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if necessary

1.3.2.3 Impact Analysis

ADM will conduct billing analysis regression using with a counterfactual group selected via propensity score matching on the HVAC measures in the HVAC Program listed in Table 1-5. The smart thermostat measure will be estimated using RTF UES values. ADM will apply the RTF UES values to the types and quantities of each connected thermostat, after applying adjustments from verification surveys, if found.

In order to estimate daily impacts of each measure, ADM will isolate the customers that received an isolated measure. For example, to evaluate the air source heat pump measure, ADM will select only customers that have retrofitted their air source heat pump and have not installed any additional program measures during the same program year. ADM will connect these isolated customers to billing data, provided by Avista as well as historical weather data collected from NOAA. ADM will conduct billing cleaning and estimate fixed-effects panel regression models referenced in Section 1.2.4.2 with heating season and cooling season controls to estimate the relationship between the energy consumption and weather during the pre- and post-periods, for electric or gas, as applicable to the measure.

1.3.2.4 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis, ADM will review RTF UES values and Avista TRM methods along with verified tracking data to estimate net program savings.

1.3.3 Shell Program

The Shell Program provides incentives to customers for improving the integrity of the home's envelope with upgrades to windows and storm windows. Rebates are issued after the measure has been installed for insulation and window measures. Participating homes must have electric or natural gas heating and itemized invoices including measure details such as insulation levels, window values, and square footage. In order to be eligible for incentive, the single-family households, including fourplex or less, must demonstrate an annual electricity usage of at least 8,000 kWh or an annual gas usage of at least 340 Therms. Multifamily homes have no usage requirement. This program includes free manufactured home duct sealing implemented by UCONS. Table 1-6 summarizes the measures offered under this program.

Table 1-6: Shell Program Measures

Measure	Impact Analysis Methodology
Attic insulation	RTF UES
Wall insulation	RTF UES
Floor insulation	RTF UES
Window insulation	RTF UES
Low-E Storm Windows	RTF UES
Manufactured home duct sealing	Billing Analysis

ADM will attempt to isolate the duct sealing measure in order to isolate the performance of the duct improvement measure.

1.3.3.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the Shell Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

In addition, ADM will randomly select a subset of participant customers to survey for simple verification of installed measure, displayed in Table 1-3. ADM will include questions such as:

- When did the weatherization measures get installed?
- What type of fuel is used to heat your home?
- Does your home have central air conditioning, window, or neither?
- How long did the contractors take to complete the work?

These questions will help ADM verify that the measure was documented accurately and that data collection activities are progressing smoothly for the program. The verification of heating and cooling type will allow ADM to calculate measure-level savings more accurately based on RTF value. In addition, in the event that billing analysis is infeasible, this simple verification will help ADM more accurately estimate measure-level impacts for the other measures using engineering algorithms.

1.3.3.2 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if necessary

1.3.3.3 Impact Analysis

ADM will conduct billing analysis regression using with a counterfactual group selected via propensity score matching on the duct sealing measure in the Shell Program listed in Table 1-6. The remaining measures will be estimated using RTF UES values. ADM will apply the RTF UES values to the types and quantities of each measure, after applying adjustments from database review and verification surveys, if necessary.

In order to estimate daily impacts of each measure, ADM will isolate the customers that received an isolated measure. For example, to evaluate the duct sealing measure, ADM will select only customers that have installed the duct sealing measure and have not installed any additional program measures during the same program year. ADM will connect these isolated customers to billing data, provided by Avista as well as historical weather data collected from NOAA. ADM will conduct billing cleaning and estimate fixed-effects panel regression models referenced in Section 1.2.4.2 with heating season and cooling season controls to estimate the relationship between the energy consumption and weather during the pre- and post-periods, for electric or gas, as applicable to the duct sealing measure.

1.3.3.4 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis for duct sealing, ADM will review RTF UES values and Avista TRM methods along with verified tracking data to estimate net program savings.

1.3.4 Residential Fuel Efficiency Program

The Residential Fuel Efficiency Program encourages customers to consider converting their resistive electric space and water heating equipment to natural gas. This program is offered to residential customers in the Idaho service territory. Customers must use Avista electricity for electric straight-resistance heating or water heating in order to qualify for the rebate, which is verified by evaluating their energy use. The home's electric baseboard or furnace heat consumption must indicate at least 8,000 kWh during the previous heating season. Customers receive incentives after installation and after submitting a completed rebate form. Table 1-4 summarizes the measures offered under this program.

Table 1-7: Residential Fuel Efficiency Program Measures

Measure	Impact Analysis Methodology
Electric central ducted forced air furnace to air source heat pump (9.0 HFSP or greater)	Billing Analysis
Electric baseboard or forced air furnace heat to natural gas forced air furnace	Billing Analysis
Electric to natural gas furnace and water heat combo	Billing Analysis

ADM summarizes the program-specific and measure-specific impact analysis activities and requirements for the Residential Fuel Efficiency Program in the section below.

1.3.4.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the Residential Fuel Efficiency Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

There will be no verification surveys for this program.

1.3.4.2 Impact Analysis

ADM will conduct a billing analysis regression using with a counterfactual group selected via propensity score matching on each of the water heater measures in the Residential Fuel Efficiency Program. ADM will isolate each unique measure and verify the participant did not also participate in other programs; therefore, ADM will be able to isolate the measure effects using the customer's consumption billing data.

ADM will attempt to create a valid quasi-experimental control group using nonparticipant customer data and available household characteristics. ADM will work with Avista to identify household characteristics the Residential Fuel Efficiency Program targets in order to identify nonparticipant customers similar to program participants. ADM will then explore the linear regressions summarized in Section 1.2.4.2 with controls for HDD and CDD to estimate weather-related impacts from each measure. ADM will summarize the measure-level impacts by extrapolating regression coefficients with TMY data or actual weather data.

1.3.4.3 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of measure install
- Filled rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if available

1.3.4.4 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis, ADM will review RTF values and Avista TRM methods along with verified tracking data to estimate net program savings.

1.3.5 ENERGY STAR Homes Program

The Energy Star Homes Program provides rebates for homes within Avista's service territory that attain an ENERGY STAR certification. This program incentivizes for ENERGY STAR Eco-rated homes. Table 1-8 summarizes the measures offered under this program.

Table 1-8: HVAC Program Measures

Measure	Impact Analysis Methodology
ENERGY STAR ECO-rated home	Simulation Model Analysis
ENERGY STAR-rated manufactured home	RTF UES

ADM will verify a sample of participating homes for detailed review of the home's documentation and development of a simulation model. ADM will work with Avista to make adjustments to the sampling plan summarized in Table 1-3 and create an approved sampling plan and stratification method for the measure before submitting a data request.

1.3.5.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the ENERGY STAR Homes Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report. ADM will also ensure that ENERGY STAR Homes Program participants did not also participate in another Avista program, as this would be deemed as a disqualification for the ENERGY STAR Homes Program. In the case that a customer did participate in another program, ADM will remove the rebate from claiming any savings.

In addition, ADM will randomly select a subset of participant customers to survey for simple verification of installed measure, displayed in Table 1-3. ADM will include questions such as:

- When did you purchase and move into the household?
- What type of fuel is used to heat your home?
- Does your home have central air conditioning, window, or neither?
- What appliances were present in your home during move-in?

These questions will help ADM verify that the HERS rater documented accurately and that data collection activities are progressing smoothly for the program and adjust simulation model components accordingly.

1.3.5.2 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Rebate application forms and certifications
- A sample of REM/Rate project files from HERS raters
- Monthly billed consumption data for participating customers

- Monthly billed consumption data for non-participating customers
- Program builder contact information

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if necessary

1.3.5.3 Impact Analysis

ADM will calculate verified energy savings for the ENERGY STAR Homes Program using a whole building simulation (IPMVP Option D) to estimate gross savings. In addition, ADM will explore the option for an additional billing analysis with a counterfactual control group to estimate net savings.

1.3.6 Residential Small Home & Multifamily Weatherization Program

The Residential Small Home & Multifamily Weatherization Program provides Avista multifamily residential customers with weatherization improvementsto improve home energy efficiency. Table 1-9 summarizes the measures offered under this program.

Table 1-9: Residential Small Home & Multifamily Weatherization Program Measures

Measure	Impact Analysis Methodology
Air infiltration	Billing Analysis
Attic insulation	RTF UES
Duct insulation	Billing Analysis
Duct sealing	Billing Analysis
Floor insulation	RTF UES
Wall insulation	RTF UES
Window replacements and upgrades	RTF UES
Door retrofit	RTF UES
Low-E storm windows	RTF UES

This program was not in effect for the 2020 program year but will be offered to residential customers in Avista's service territory in the 2021 program year. Therefore, ADM will not evaluate this program as part of the 2020 impact evaluation report. ADM will complete the following impact tasks for the 2021 program year evaluation.

1.3.6.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the Residential Small Home & Multifamily Weatherization Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

There will be no verification surveys for this program.

1.3.6.2 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Rebate application forms and applicable invoices

1.3.6.3 Impact Analysis

ADM will measure net savings for each measure in the program using RTF UES values. ADM will apply the RTF UES values to the types and quantities of each measure, after applying adjustments from data review, if deviations found between invoices and tracking data.

1.3.6.4 Technical Comments

ADM provides no technical comments for this program's evaluation.

1.3.7 Low-Income Program

The Low-Income Program delivers energy efficiency measures to low-income residential customers in its Washington service territory with a partnership with five network Community Action Agencies ("Agencies") and one tribal weatherization organization. The Agencies qualify income to prioritize and treat households based on several characteristics. In-house or contract crews install approved program measures. In addition, the Agencies have access to other monetary resources which allow them to weatherize a home or install additional energy efficiency measures.

Avista provides CAP agencies with the following approved measure list, which are reimbursed in full by Avista. Avista also provides a rebate list of additional energy saving measures the CAP agencies are able to utilize which are partially reimbursed. Weatherization measures under this program may also be funded by CEEP. The following table summarizes the measures offered under this program.

Table 1-10 summarizes the measures offered under this program.

Table 1-10: Low-Income Program Measures

Measure	Impact Analysis Methodology
Air Infiltration	Billing analysis
Air source heat pump	
Attic insulation	
Duct insulation	
Duct sealing	
Electric to air source heat pump	
Electric to natural gas water heater and or furnace (ID Only)	
Electric to ductless heat pump	
ENERGY STAR door	
ENERGY STAR refrigerator	
ENERGY STAR window	
Floor insulation	
Heat pump water heater	
LED lighting	
Wall insulation	
High efficiency furnace	
High efficiency tankless natural gas water heater	
Natural gas boiler	

Database Review & Verification

Before conducting the impact analysis, ADM and Cadeo will conduct a database review for the Low-Income Program. ADM and Cadeo will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2 (above). If ADM and Cadeo finds any deviations between the tracking data and application values, we will note and summarize these differences to Avista through periodic updates and the final report. There will be no verification surveys for this program.

1.3.7.1 Required Data

ADM and Cadeo will request the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Program materials
- Rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers
- Identifiers, if available, for low- to moderate-income households in both participant and nonparticipant customers in the Avista Washington territory
- Stakeholder contact information, such as CAP agencies

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if necessary

1.3.7.2 Impact Analysis

In order to estimate daily impacts of each measure, ADM will identify the customers that participated in the Low-Income program. ADM will connect these identified participants to billing data, provided by Avista as well as historical weather data collected from NOAA. ADM will conduct billing cleaning and estimate fixed-effects panel regression models referenced in Section 1.2.4.2 with heating season and cooling season controls to estimate the relationship between the energy consumption and weather during the pre- and post-periods, for electric or gas, as applicable to the measure. The team will explore the Difference-in-Difference (D-in-D) regression and Post-Program Regression (PPR) billing analysis model to estimate verified energy savings for a subset of measures.

Our approach uses either a control group made up of “future” participants from the same program (i.e., those that received measures in late 2020 and/or early 2021 for the 2020 analysis period, and those that received measures in late 2021 and/or early 2022 for the 2021 analysis period) or a control group matched via quasi-experimental methods. A control group will account for the impact of various macroeconomic factors and other influences on pre- and post-program energy consumption that are unrelated to the installation of program measures. These include economic effects, the movement of people in and out of dwelling units, fluctuations in per-unit energy costs, or, for example, shelter-in-place orders for COVID19.

The quasi-experimental method goes beyond random sampling of treatment and comparison groups and instead uses a nearest-neighbor algorithm via propensity score matching to match each participant (treatment group) customer with a specific best-match from a pool of future participants (control group) based on pre-program energy usage. This approach identifies the future participant whose energy consumption pattern over the most recent 12 pre-participation months was most similar to that of the participant.

1.3.7.3 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis, ADM and Cadeo will review RTF UES values and Avista TRM methods along with verified tracking data to estimate net program savings. It is likely that insufficient instances of isolated measure installs can be identified. In this case, ADM and Cadeo will attempt to conduct a billing analysis for the combined measures.

Unlike other programs the Avista portfolio, the responsibility of evaluating the Low-Income Program will primarily be that of Cadeo. Specifically, Cadeo will perform the database review, billing analysis and reporting portions of the Low-Income Program evaluation using the framework described above.

1.3.8 Community Energy Efficiency Program

Avista partners with the Community Energy Efficiency Program (CEEP) and community action agencies in Washington to identify hard-to-reach markets such as rental properties, homes with alternative heat (wood, oil, propane), and households that are considered low to moderate income for potential energy efficiency improvements. In addition, CEEP provides energy efficiency improvements for small businesses in rural communities. Avista matches the CEEP contribution to share the cost of the improvements. Table 1-11 and Table 1-12 summarizes the measures offered under this program.

Table 1-11: Multi-family CEEP Program Measures

Measure	Impact Analysis Methodology
Electric ductless heat pump	Billing analysis with comparison group
Line voltage control thermostats	Billing analysis with comparison group
Air infiltration	Billing Analysis
Attic insulation	RTF UES
Duct insulation	Billing Analysis
Duct sealing	Billing Analysis
Floor insulation	RTF UES
Wall insulation	RTF UES
Lighting	RTF UES

Table 1-12: Income-Qualified Single-family CEEP Program Measures

Measure	Impact Analysis Methodology
Alternative heat to ductless heat pump	Billing analysis with comparison group
Alternative heat to air source heat pump	Billing analysis with comparison group

CEEP also funds some of the weatherization measures in the Low-Income Program as well as the Small Business Initiative Program.

1.3.8.1 Database Review & Verification

Before conducting the impact analysis, ADM will conduct a database review for the CEEP Program. ADM will select a subset of rebate applications to cross-verify tracking data inputs, summarized in Table 1-2. If ADM finds any deviations between the tracking data and application values, ADM will note and summarize these differences to Avista through periodic updates and the final report.

There will be no verification surveys for this program.

1.3.8.2 Required Data

ADM requires the following data to complete the analysis for this program:

- Program tracking data, including customer identifiers, address, and date of rebate
- Rebate application forms and applicable invoices
- Monthly billed consumption data for participating customers
- Monthly billed consumption data for non-participating customers

- Identifiers for low- to moderate-income households in both participant and nonparticipant customers in the Avista Washington territory

In addition, ADM will gather the following datasets to complete the analysis:

- Historical NOAA weather data
- Typical Meteorological Year weather data
- Publicly available household characteristics from county assessor data, if necessary

ADM will review delivered tracking data for inconsistencies

1.3.8.3 Impact Analysis

ADM will conduct a billing analysis regression using with a counterfactual group selected via propensity score matching on the heat pump and thermostat measures in the CEEP Program, as displayed in Table 1-11. All other measure savings for the program will be estimated using RTF UES values. ADM will apply the RTF UES values to the types and quantities of each measure, after applying adjustments from database review, if necessary.

In order to estimate daily impacts of each measure, ADM will isolate the customers that received an isolated measure. For example, to evaluate the heat pump measure, ADM will select only customers that have installed the heat pump and have not installed any additional program measures during the same program year. ADM will connect these isolated customers to billing data, provided by Avista as well as historical weather data collected from NOAA. ADM will conduct billing cleaning and estimate fixed-effects panel regression models referenced in Section 1.2.4.2 with heating season controls for the heat pump and heating season and cooling season controls for thermostat to estimate the relationship between the energy consumption and weather during the pre- and post-periods, for electric or gas, as applicable to the measure.

1.3.8.4 Technical Comments

In the event that the required data is not available or sufficient to conduct a billing regression analysis, ADM will review RTF UES values and Avista TRM methods along with verified tracking data to estimate net program savings. There is a possibility that insufficient instances of isolated measure installs can be identified. In this case, ADM will attempt to conduct a billing analysis for both the heat pump and thermostat, combined. This will give a reliable estimate of both measures, but not individual measure savings.

1.4 Management Plan & Schedule

This section presents information on the ADM team's project management structure and the organization of the project team.

1.4.1 Team Members

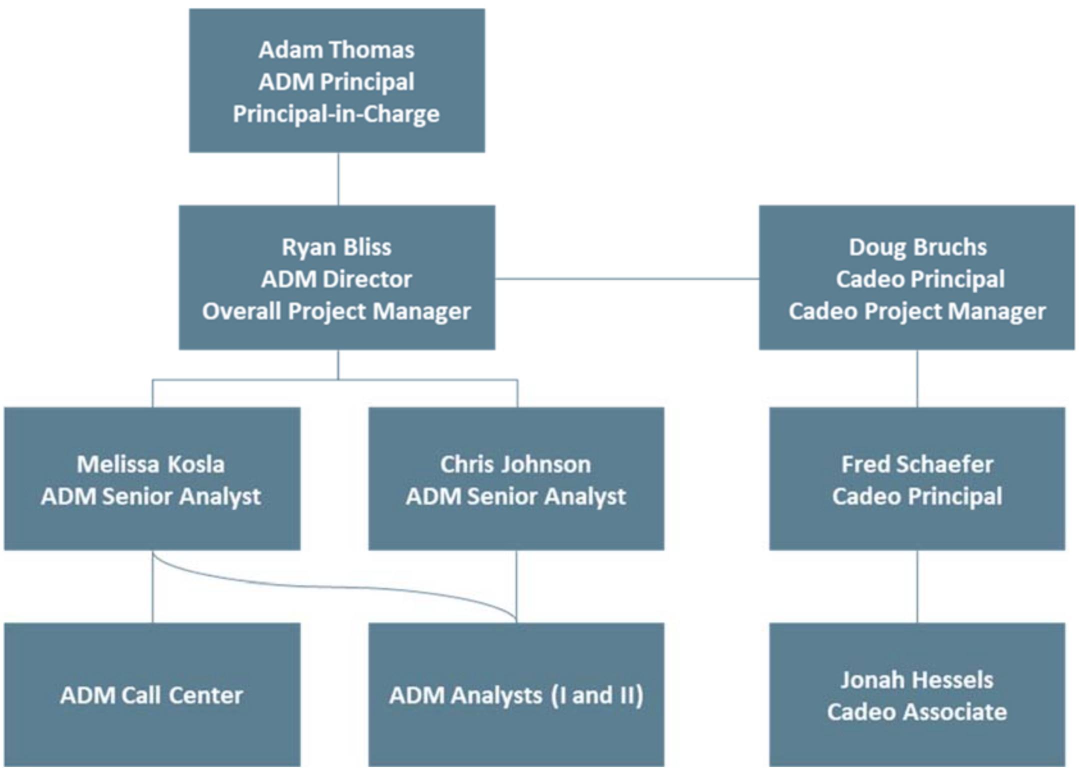
Table 1-13 summarizes the key program staff for the EM&V of Avista's programs.

Table 1-13: Project Team Members

Team Member	Role
Adam Thomas, PMP	Principal-in-charge
Ryan Bliss	Overall Project Manager
Doug Bruchs	Cadeo Project Manager
Melissa Kosla	Impact evaluation lead
Chris Johnson	Impact evaluation lead
Fred Schaefer	Cadeo Principal
Jonah Hessels	Cadeo Associate
Analyst II Staff	Supporting impact analysis
Analyst I Staff	Supporting impact analysis
Admin Staff	Call center support –surveys

Figure 1-1 shows our project organization.

Figure 1-1: Project Organization



1.4.2 Schedule

Table 1-14 presents our expected schedule for the evaluation of program year 2020. A similar project schedule will be developed for program year 2021 evaluation tasks.

Table 1-14: Schedule

Time Period	Time Period
Kickoff meeting	November 23, 2020
Submit data request	December 4, 2020
Submit evaluation plan	December 18, 2020
Avista fulfills data request	December 18, 2020
Submit participant survey instruments	December 23, 2020
Develop sampling plan	December 23, 2020
Survey data collection	January 15, 2021 – February 26, 2021
Submit billing data request	January 8, 2021
Avista fulfills billing data request	January 15, 2021
Conduct impact analysis	January 15, 2021 – February 26, 2021
Perform cost-effectiveness analysis	February 26, 2021 – March 5, 2021
Submit draft version of PY2020 final report	March 12, 2021
Submit revised version of PY2020 final report	April 9, 2021

In addition to the schedule above, ADM will meet and participate with advisory groups, subcommittees, and others as needed, in addition to presenting annual results at Avista’s convenience.

Deer Park, Washington