Appendix C:

2018 Washington Natural Gas Impact Evaluation

CADMUS

Appendix C to the 2018 Washington Annual Conservation Report

2018 Washington Natural Gas Impact Evaluation Report

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Portfolio Executive Summary

For several decades, Avista Corporation has been administering demand-side management programs to reduce electricity and natural gas energy use for its portfolio of customers. Most of these programs have been implemented in house, but a few have external implementers. Avista contracted with Cadmus to complete process and impact evaluations of its PY 2018 and PY 2019 natural gas demand-side management programs in Washington. This report presents our interim natural gas impact evaluation findings for PY 2018. Cadmus did not apply net-to-gross adjustments to savings values, except in cases where deemed energy savings values already incorporate net-to-gross as a function of the market baseline.

Evaluation Methodology and Activities

Cadmus conducted the Washington portfolio evaluation using a variety of methods and activities, shown in Table 1.

Table 1. PY 2018 Natural Gas Program Evaluation Activities

Sector	Program	Document/ Database Review	Verification/ Metering Site Visit	Billing Analysis	Modeling
Nonresidential	Prescriptive (multiple)	✓	✓	--	--
	Site Specific	✓	✓	✓	--
Residential	Simple Steps, Smart Savings™	✓	--	--	--
	HVAC	✓	--	--	--
	Shell	✓	--	--	--
	ENERGY STAR® Homes	✓	--	--	--
	Multifamily Direct Install	✓	--	--	--
Low Income	Low Income	✓	--	--	--
Fuel Efficiency	Site Specific (Nonresidential)	✓	✓	--	--
	Prescriptive (Residential)	✓	--	--	--
	Low Income	✓	--	--	--

Summary of Impact Evaluation Results

Overall, the Washington portfolio achieved a 100% realization rate on savings from natural gas measures and acquired 736,986 therms in annual gross savings (Table 2).

Cadmus collected the Avista reported savings through database extracts from Avista's Customer Care and Billing (residential) and InforCRM (nonresidential) databases and data provided by third-party implementers. Cadmus used the label *interim verified savings* for its findings in the first half of the biennial evaluation. Following the end of the biennium, Cadmus will conduct utility billing regression analyses to evaluate the most accurate energy savings for most residential programs. We will also determine nonresidential evaluated savings using combined realization rates from both 2018 and 2019. The results of these final analyses will be labeled *evaluated savings* for the biennial evaluation report.

Table 2. PY 2018 Reported and Interim Verified Energy Efficiency Natural Gas Savings

Sector	Reported Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Nonresidential	110,853	100,205	90%
Residential	606,963	621,381	102%
Low Income	16,258	15,400	95%
Total[1]	**734,074**	**736,986**	**100%**

Conclusions and Recommendations

During the course of the PY 2018 evaluation, Cadmus identified the following areas for improvement by sector.

Nonresidential Conclusions and Recommendations

The Nonresidential sector achieved total interim verified natural gas energy savings of 100,205 therms in PY 2018 with a combined realization rate of 90%. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' natural gas savings goal of 137,381 therms by 27%.

Cadmus has two recommendations for improving the Nonresidential sector natural gas savings:

- Revisit the Prescriptive ENERGY STAR® food service equipment calculator workbook and review the default assumptions for hours of use and pounds of food cooked per day. During five food service project verifications, the feedback provided by site contacts for these calculator inputs differed significantly from the calculator default values. We also recommend adjusting future rebate application forms to ask for site-specific hours of use and load estimates. Cadmus will review the Regional Technical Forum (RTF) calculation methods to determine whether the deemed RTF values are more appropriate for these measures. RTF savings values will be more consistent with regional savings estimates.
- Confirm the time periods used for pre- and post-installation analysis periods when using utility billing regression analysis. Misaligning the billing periods can result in variance—sometimes a significant amount of variance—between reported and interim verified savings.

Residential Conclusions and Recommendations

Interim verified natural gas savings show a realization rate of 102% on acquired savings of 621,381 therms for Residential Prescriptive programs, which is 104% of the savings goal for the year. Reported savings for the Multifamily Direct Install (MFDI) program add 5,392 therms of savings.

The HVAC program accounts for most interim verified Residential natural gas savings—74%—followed by the Shell program with 24% of natural gas savings. Simple Steps, Smart Savings, MFDI, and ENERGY STAR Homes account for a combined 2% of savings, primarily through water-saving measures.

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[1] Fuel Efficiency measures result in a negative therm savings impact and are not included in this total. The impacts of fuel conversion measures can be found in the Fuel Efficiency section.

Avista confirmed during the evaluation that natural gas unit energy savings (UES) values for several measures throughout the portfolio mistakenly had not been updated to 2018 technical reference manual (TRM) values. Initially, the Shell natural gas program grossly underreported savings, which were based on 2017 TRM values. Under Avista direction, Cadmus adjusted reported savings for the Shell windows measures to use 2018 TRM values.

Cadmus offers three recommendations regarding Avista's Residential natural gas programs:

- Ensure that reported savings on Prescriptive measures are calculated using current TRM UES values or RTF methods. For Simple Steps, Smart Savings showerhead measures, Avista has moved to an RTF methodology for PY 2019, which Cadmus will also adopt for its evaluation.
- Continue to encourage installations of high-efficiency natural gas equipment through the HVAC program, which provides nearly three-quarters of natural gas savings for residential programs. The Northwest Energy Efficiency Alliance *Residential Building Stock Analysis II* estimates that roughly 70% of natural gas furnaces in Washington single-family homes and 50% in Idaho single-family homes have an annual fuel utilization efficiency (AFUE) under 90%, indicating plenty of remaining opportunity for savings.
- Continue to emphasize windows measures through the Shell program, given their contribution of 24% of Residential program path natural gas savings.

Nonresidential Impact Evaluation

Through its Nonresidential portfolio of programs, Avista promotes the purchase of high-efficiency equipment for commercial and industrial utility customers. Avista provides rebates to partially offset the difference in cost between high-efficiency equipment and standard equipment.

Program Summary

Avista completed and offered incentives for 108 Nonresidential natural gas measures in Washington in PY 2018 and reported total natural gas energy savings of 110,853 therms. Through the Nonresidential sector, Avista offers incentives for high-efficiency equipment and controls through three program paths: Prescriptive, Site Specific, and Fuel Efficiency. The Prescriptive program path is selected for smaller, straightforward equipment installations that generally have similar operating characteristics (such as simple HVAC systems, food service equipment, and envelope upgrades). The Site Specific program path is reserved for 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 HVAC retrofits).

Multifamily Market Transformation measures involve a combination of electric savings and natural gas penalties. These measures typically involve replacing electric space heating or water heating systems with natural gas equipment. Please refer to the *Fuel Efficiency Impact Evaluation* section for evaluation methodology and results discussion of the Multifamily Market Transformation measures.

Program Participation Summary

This section summarizes Nonresidential sector participation and progress toward PY 2018 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 2018 as well as reported savings and a comparison between reported savings and goals.

Table 3. Nonresidential Prescriptive Natural Gas Savings (PY 2018)

Program Type	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Interior Lighting	-79,702	0	0%
HVAC	32,142	21,471	67%
Shell	20,800	36,455	175%
Food Service Equipment	49,563	34,139	69%
Energy Smart Grocer[a]	14,578	0	0%
Total	**37,381**	**92,065**	**246%**

[a] The Energy Smart Grocer savings goal includes Site Specific Energy Smart Grocer measures. The Site Specific portion constitutes approximately 10% of the overall goal.

Table 4 shows participation goals by rebated equipment quantity, as provided by Avista. The PY 2018 Nonresidential tracking database extract listed individual projects but did not include rebated equipment quantity. For reference, Table 5 provides participation by unique application numbers.

Table 4. Nonresidential Prescriptive Participation Goals by Equipment Rebated

Program Type	Participation Goal
Interior Lighting	N/A
HVAC	10,058
Shell[a]	92,500
Food Service Equipment	93
Energy Smart Grocer[b]	4,890

[a] The shell participation goal includes participants with electric savings.

[b] The Energy Smart Grocer goal includes Site Specific Energy Smart Grocer participants.

Table 5. Nonresidential Prescriptive Participation by Project (PY 2018)

Program Type	Participation Reported[a]
Interior Lighting	0
HVAC	33
Shell	7
Food Service Equipment	54
Energy Smart Grocer	0
Total	**94**

[a] participant is defined as a unique application number.

Nonresidential Site Specific Program

Table 6 shows natural gas savings goals assigned to the Site Specific program path in Avista's Nonresidential sector for PY 2018, as well as reported savings. Note that the table does not include reported natural gas penalties for the Fuel Efficiency sector, such as those associated with the Multifamily Market Transformation program.

Table 6. Nonresidential Site Specific Natural Gas Savings (PY 2018)

Program	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Site Specific	100,000	18,788	19%

Evaluation Goals and Objectives

For quarterly and semiannual reports in PY 2018 and PY 2019, Cadmus will conduct Nonresidential impact activities to determine interim verified savings for most programs. This will provide an estimate of achieved savings until we can conduct measurement and verification (M&V) on the full biennial sample at the end of the two-year evaluation cycle.

Nonresidential Impact Evaluation Methodology

To evaluate impact evaluation savings for the PY 2018 Nonresidential sector, Cadmus performed several activities in two waves:

- Selected evaluation sample and requested project documentation from Avista
- Performed project documentation review
- Prepared on-site M&V plans
- Performed site visits and on-site data collection (such as trend data, photos, and operating schedules)
- Used site visit findings to calculate interim verified savings by measure
- Applied realization rates to total reported savings population to determine overall interim verified savings

The program context, along with Cadmus' sample design, document review, and on-site verification activities, is described in more detail below.

Program Context

As the first step of Cadmus' evaluation activities, we gained an understanding of the programs and measures being evaluated. Specifically, Cadmus explored these documents and data records:

- Avista's annual business plans, which detail processes and energy savings justifications
- Project documents from external sources such as documents from customers, program consultants, or implementation contractors

Based on the initial review, Cadmus checked the distribution of program contributions with the overall portfolio of programs. In addition, the review allowed us to understand the sources for UES for each measure offered in the programs, along with the sources for energy-savings algorithms and the internal quality assurance and quality control processes for large Nonresidential program projects.

Following this review, Cadmus designed the sample strategy for the impact evaluation activities, as discussed in the following section.

Sample Design

Cadmus based the first evaluation sample on program data from January 2018 to April 2018 and based the second evaluation sample on program data from May 2018 through December 2018. As a guideline, Cadmus used the proposed, overall PY 2018 and PY 2019 Nonresidential sample sizes by subprogram in the M&V plan, seeking to complete approximately one-quarter of the sample during the first wave and another one-quarter during the second wave.

For each activity wave, we organized submitted program applications by path and measure (such as Site Specific Shell Measure, Prescriptive Lighting, Prescriptive Motor Controls), allowing us to select the highest-savings applications in each category with certainty. For applications with reported savings greater than 1% of total savings by category, we assigned random numbers and sampled randomly. We

removed applications with less than 1% of total savings by category from the sample consideration, except where another application at the same location or facility was previously selected (and where we could assess both applications with one site visit, which is a cost-effective verification strategy even if the second application represents minimal claimed savings).

Cadmus sampled randomly selected sites across both Washington and Idaho since Avista's programs are implemented similarly in both states. We pooled the results from the randomly selected sites to calculate a realization rate by stratum and applied that realization rate to projects in both states. We applied verified savings for sites selected with certainty only to the state in which they had been implemented.

Table 7 summarizes the Washington Nonresidential Prescriptive program path natural gas evaluation sample. Cadmus sampled 21 Prescriptive applications at 19 unique sites overall. Of the sampled applications, we selected five for certainty review based on scale of savings, measure type, or location, and selected the remaining 16 applications randomly.

Table 7. Washington Nonresidential Prescriptive Natural Gas Evaluation Sample

Program Type	Applications Sampled	Sampled Savings (therms)	Percentage of Reported Savings
HVAC	5	3,762	18%
Shell	3	6,946	19%
Food Service Equipment	6	5,983	18%
Nonresidential Prescriptive	**14**	**16,691**	**18%**

Table 8 summarizes the Washington Nonresidential Site Specific program path natural gas evaluation sample. Cadmus sampled five Site Specific applications at five unique sites overall. Of the sampled applications, we selected four for certainty review based on scale of savings, measure type, or location, and selected the remaining application randomly.

Table 8. Washington Nonresidential Site Specific Natural Gas Evaluation Sample

Program	Applications Sampled	Sampled Savings (therms)	Percentage of Reported Savings
Site Specific	2	5,223	28%

Document Review

Cadmus requested and reviewed project documentation for each sampled application and prepared M&V plans to guide the site visits. Project documentation typically included incentive applications, calculation tools (usually based on the 2017 Regional Technical Forum [RTF]),[2] invoices, equipment specification sheets, and post-inspection reports.

[2] Regional Technical Forum. 2017. "Standard Protocols." https://rtf.nwcouncil.org/standard-protocols

On-Site Verification

Cadmus performed site visits at 23 unique Nonresidential locations to assess natural gas energy savings for 26 unique Prescriptive and Site Specific measures (not including Fuel Efficiency measures). Site visits involved verifying installed equipment type, make and model numbers, operating schedules, and set points, as applicable. Cadmus used the project documentation review and on-site findings to adjust the reported savings calculations where necessary.

Nonresidential Evaluation Results

This section summarizes the Nonresidential sector Prescriptive and Site Specific program paths' natural gas impact evaluation results for PY 2018.

Nonresidential Prescriptive Programs

Table 9 shows reported and interim verified natural gas energy savings for Avista's Nonresidential sector Prescriptive program path and the realization rates between interim verified and reported savings for PY 2018. The overall Nonresidential sector Prescriptive program path natural gas realization rate was 90%.

Table 9. Nonresidential Prescriptive Natural Gas Impact Findings

Program Type	Reported Savings (therms)	Interim Verified Savings (therms)	Realization Rate
HVAC	21,471	21,471	100%
Shell	36,455	36,455	100%
Food Service Equipment	34,139	24,912	73%
Nonresidential Prescriptive	**92,065**	**82,838**	**90%**

Of the evaluated applications, Cadmus identified discrepancies for six (with one discrepancy common to four applications) based on the site visit and project documentation review. Table 10 summarizes the reasons for discrepancies between reported and interim verified savings.

Table 10. Nonresidential Prescriptive Evaluation Summary of Discrepancies

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
Food Service Equipment	4	↓	• Cadmus reduced the pounds of food cooked per day for four fryer measures from the value in the savings calculator based on the site manager interview.
	2	↓	• Cadmus decreased operating hours for two fryer measures from the value in the savings calculator based on the site manager interviews.
	1	↓	• Cadmus reduced the pounds of food cooked per day for an oven measure from the value in the savings calculator based on the site manager interview. • Cadmus increased operating hours for oven and fryer measures from the value in the savings calculator based on the site manager interview. • Cadmus decreased operating time per day for a pre-rinse spray valve measure from the value in the savings calculator based on the site manager interview.
	1	↓	• Cadmus reduced the pounds of food cooked per day and operating hours for a steam cooker measure from the value in the savings calculator based on the site manager interview.

Nonresidential Site Specific Program

Table 11 shows reported and interim verified natural gas energy savings for Avista's Nonresidential sector Site Specific program path for PY 2018, as well as a comparison between interim verified and reported savings for PY 2018. The overall Site Specific program path natural gas realization rate was 92%. Note that the table does not include reported and interim verified natural gas penalties for measures in the Fuel Efficiency path.

Table 11. Nonresidential Site Specific Natural Gas Impact Findings (PY 2018)

Program	Reported Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Site Specific	18,788	17,366	92%

Of the evaluated applications, Cadmus identified discrepancies in two based on the site visit and project documentation review. Table 12 summarizes the reasons for discrepancies between reported and interim verified savings.

Table 12. Nonresidential Site Specific Evaluation Summary of Discrepancies

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
HVAC	1	↓	• This project involved implementing demand controlled ventilation and fan motor variable frequency drives for department store air handling units. During document review, Cadmus found that reported savings were calculated using natural gas utility data for an incorrect post-installation period and included some baseline system data. For the interim verified savings calculation, Cadmus only used utility data for the installed and fully operational system.
Appliance	1	↑	• Cadmus decreased the pounds of food cooked per day (from that shown in the calculator workbook, "PGE broiler testing report calculator.xlsx") for the broiler measure based on the site interview.

Nonresidential Conclusions and Recommendations

The Nonresidential sector achieved total interim verified natural gas energy savings of 100,205 therms in PY 2018 with a combined realization rate of 90%. The Nonresidential sector did not meet the combined Prescriptive and Site Specific program paths' natural gas savings goal of 137,381 therms by 27%.

Cadmus has two recommendations for improving the Nonresidential sector natural gas savings:

- Revisit the Prescriptive ENERGY STAR food service equipment calculator workbook and review the default assumptions for hours of use and pound of food cooked per day. During five food service project verifications, the feedback provided by site contacts for these calculator inputs differed significantly from the calculator default values. We also recommend adjusting future rebate application forms to ask for site-specific hours of use and load estimates. Cadmus will review the RTF calculation methods to determine whether the deemed RTF values are more appropriate for these measures. RTF savings values will be more consistent with regional savings estimates.
- Confirm the time periods used for pre- and post-installation analysis periods when using utility billing regression analysis. Misaligning the billing periods can result in variance—sometimes a significant amount of variance—between reported and interim verified savings.

Residential Impact Evaluation

Cadmus designed the Residential sector impact evaluation to verify reported program participation and energy savings. We used data collected and reported in the tracking database, online application forms, Avista TRM and RTF savings review, and applicable updated deemed savings values.

Program Summary

Avista completed and offered incentives for 88,815 Residential natural gas measures in Washington in PY 2018 and reported total natural gas energy savings of 606,963 therms. The Residential program path comprises two primary paths—Prescriptive and Multifamily Direct Install (MFDI). The Prescriptive path includes Simple Steps, Smart Savings, which encourages consumers to purchase and install high-efficiency showerheads and other equipment, such as LEDs and clothes washers; the Residential HVAC program, which offers incentives for high-efficiency heating and cooling equipment; the Residential Shell program, which provides rebates to encourage customers to install high-efficiency windows and storm windows; and the ENERGY STAR Homes program, which offers 15% to 25% energy savings relative to state energy code. Through the MFDI program, Avista provides free direct-install measures to multifamily residences (of five units or more) and common areas.

Program Participation Summary

This section summarizes Residential sector program path participation and progress toward PY 2018 goals by Residential Prescriptive and Residential MFDI paths.

Residential Prescriptive Programs

Table 13 shows savings goals assigned to Avista's Residential sector Prescriptive programs for PY 2018, as well as reported savings and the goal portion achieved in PY 2018. Reported savings for the Simple Steps, Smart Savings program achieved a fairly small percentage of goal, but an extremely high realization rate for the program (see Table 19) brings natural gas savings much closer to goal.

Table 13. Residential Prescriptive Reported Natural Gas Savings (PY 2018)

Program	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Simple Steps, Smart Savings	9,541	1,381	15%
HVAC	317,700	456,474	144%
Shell	146,150	143,229	98%
ENERGY STAR Homes	3,654	487	13%
Residential Prescriptive Total	**477,045**	**601,571**	**126%**

Table 14 summarizes participation goals and reported participation in Avista's Residential sector Prescriptive programs for PY 2018, along with the percentage of goal achieved.

Table 14. Residential Prescriptive Participation (PY 2018)

Program	Participation Goals	Participation Reported	Portion Achieved
Simple Steps, Smart Savings[a]	4,725	2,743	58%
HVAC[b]	3,850	6,087	158%
Shell[c]	87,500	75,022	86%
ENERGY STAR Homes[b]	18	2	11%
Residential Prescriptive Total	**96,093**	**83,854**	**87%**

[a] Participation is defined as the number of purchased units.

[b] Participation is defined as the number of rebates.

[c] Participation is defined as square feet of installed windows or storm windows.

Multifamily Direct Install Program

Table 15 shows reported savings and participation for the MFDI program in PY 2018. Avista launched this program as a pilot in PY 2018 and did not set annual program goals, then changed this from a pilot to an ongoing study in September 2018.

Table 15. Multifamily Direct Install Program Reported Natural Gas Savings

Program	Savings Reported (therms)	Participation Reported
Multifamily Direct Install	5,392	4,961

Evaluation Goals and Objectives

For quarterly and semiannual reports in PY 2018 and PY 2019, Cadmus will determine interim verified savings for most programs through a combination of database review and document review, which are described in the *Residential Impact Evaluation Methodology* section below. This approach will provide a strong estimate of achieved savings until Cadmus can perform billing analysis at the end of the two-year evaluation cycle.

Residential Impact Evaluation Methodology

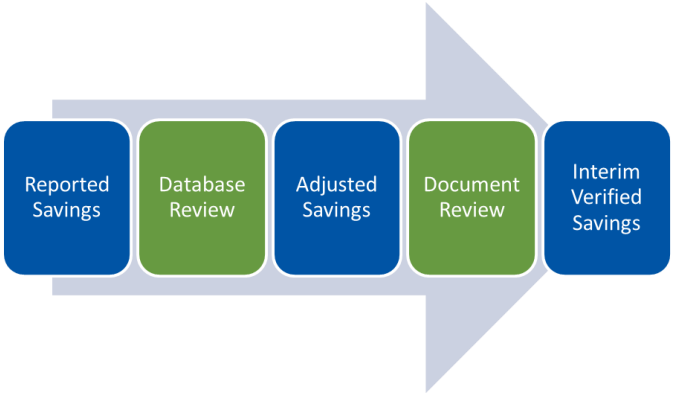
To determine the Residential sector interim verified savings for PY 2018, Cadmus employed two impact evaluation methods for most residential programs:[3]

- Database review
- Document review

Similar to previous practice, Cadmus calculated adjusted savings based on results of the database review and applied realization rates for document reviews. Interim verified savings represented adjusted savings multiplied by the document review realization rates, as shown in Figure 1.

[3] With approval from Avista, Cadmus ceased performing a third impact activity—verification surveys—in Q3 PY 2018 to eliminate redundancy between verification surveys and document review.

Figure 1. Residential Impact Process



Database Review

For the impact evaluation database review, Cadmus used UES values, provided in the TRM, to calculate savings for measures reported in the measure tracking database. This impact activity may help identify incorrect UES values used to calculate reported savings. Savings calculated during the database review are defined as *adjusted savings*.

Document Review

For the document review, Cadmus compared information from rebate forms and other supporting documents to measure tracking data for a random sample of projects. This impact activity may identify installed measures that did not meet eligibility requirements, quantities not matching the measure tracking database, and other discrepancies. Following the review of all projects, Cadmus calculated a realization rate for document review by dividing savings calculated for the sample (using the revised information) by reported savings for the sample. We then multiplied this realization rate by adjusted savings for the entire program to determine interim verified savings.

Cadmus conducted document reviews for the programs shown in Table 16, drawing roughly equal samples from participants in each quarter.

Table 16. Residential Prescriptive Natural Gas Impact Document Review

Program	PY 2018-PY 2019 Target	Complete through PY 2018
HVAC	68	34
Shell	68	34

Residential Impact Evaluation Results

The following sections summarize findings for each of Cadmus' impact evaluation methodologies and provide interim verified savings. The database review resulted in the largest number of adjustments to reported savings.

Database Review

Table 17 shows database review findings, with adjusted savings higher than reported savings for some programs and lower for others. Adjusted savings differed from reported savings because reported UES values differed from TRM values for several measures. In most cases, Avista determined that the reported savings for these measures used values from an older customer database that did not align with those in the current TRM. (Under Avista direction, Cadmus updated reported savings for the Shell windows measures to use 2018 TRM values to avoid an extremely high realization for those measures.) For measures with reported savings based on measure-specific parameters, Cadmus could not confirm the reported savings calculations, which depended on inputs that were not included in the tracking data (such as air infiltration and duct sealing).

Table 17. Residential Prescriptive Database Review Natural Gas Impact Findings

Program	Reported Savings (therms)	Adjusted Savings (therms)	Percentage Change
Simple Steps, Smart Savings	1,381	6,279	355%
HVAC	456,474	456,482	0%
Shell	143,229	143,229	0%
ENERGY STAR Homes	487	406	(17%)
Residential Prescriptive Total	**601,571**	**606,396**	**1%**

Document Review

Table 18 summarizes document review findings to date. With 50% of the document reviews complete for the two-year evaluation, the HVAC program had a 100% natural gas document review realization rate and the Shell program had a 107% natural gas document review realization rate.

Table 18. Residential Prescriptive Natural Gas Impact Document Review Realization Rates

Program	PY 2018-PY 2019 Target Document Audit Count	Document Audit Count Achieved to Date	Sample Reported Savings (therms)	Sample Interim Verified Savings (therms)	Interim Document Audit Realization Rate
HVAC	68	34	5,791	5,791	100%
Shell	68	34	1,928	2,057	107%

Cadmus identified several discrepancies during our document review through Q4 PY 2018:

- For two window measures, documentation showed a square footage for installed windows that differed from that reported. In one case the documented square footage was higher than the reported, and in the other case it was lower. Cadmus adjusted savings based on the corrected area for both measures.
- For two window measures reported for sites with electric heating, project documents identified the heating fuel as natural gas. Cadmus added natural gas savings and removed electricity savings at the sites.

Table 19 shows interim verified savings, which apply the realization rates shown in Table 18 to the adjusted savings calculated based on the database review. The interim verified savings represent Cadmus' best estimate of savings to date. With its high realization rate, the Simple Steps, Smart Savings program achieved 66% of goal based on interim verified savings, despite achieving reported savings of only 15% of goal.

Table 19. Residential Prescriptive Interim Natural Gas Impact Findings

Program	Reported Savings (therms)	Adjusted Savings (therms)	Interim Verified Savings (therms)[a]	Realization Rates
Simple Steps, Smart Savings	1,381	6,279	6,279	455%
HVAC	456,474	456,482	456,482	100%
Shell	143,229	143,229	152,822	107%
ENERGY STAR Homes	487	406	406	83%
Residential Prescriptive Total	**601,571**	**606,396**	**615,989**	**102%**

[a] Interim verified savings represents adjusted savings only for Simple Steps, Smart Savings and ENERGY STAR Homes.

Residential Conclusions and Recommendations

Interim verified natural gas savings show a realization of 102% on realized savings of 615,989 therms for Residential Prescriptive programs, which is 129% of the savings goal for the year. Reported savings for the MFDI program add 5,392 therms of savings, for a total of 621,381 therms in acquired savings.

The HVAC program accounts for most interim verified Residential natural gas savings—73%—followed by the Shell program with 25% of natural gas savings. Simple Steps, Smart Savings, MFDI, and ENERGY STAR Homes account for a combined 2% of savings, primarily through water-saving measures.

Avista confirmed during evaluation that natural gas UES values for several measures throughout the portfolio mistakenly had not been updated to 2018 TRM values. Initially, the Shell natural gas program grossly unreported savings, which were based on 2017 TRM values. Under Avista direction, Cadmus adjusted reported savings for the Shell windows measures to use 2018 TRM values.

Cadmus offers three recommendations regarding Avista's Residential natural gas programs:

- Ensure that reported savings on Prescriptive measures are calculated using current TRM UES values or RTF methods. For Simple Steps, Smart Savings showerhead measures, Avista has moved to an RTF methodology for PY 2019, which Cadmus will also adopt for its evaluation.
- Continue to encourage installations of high-efficiency natural gas equipment through the HVAC program, which provides nearly three-quarters of natural gas savings for residential programs. The Northwest Energy Efficiency Alliance *Residential Building Stock Analysis II* estimates that roughly 70% of natural gas furnaces in Washington single-family homes and 50% in Idaho single-family homes have an AFUE under 90%, indicating plenty of remaining opportunity for savings.
- Continue to emphasize windows measures through the Shell program, given their contribution of 25% of Residential program path natural gas savings.

Low Income Impact Evaluation

Cadmus designed the Low Income programs' impact evaluation to verify reported program participation and energy savings. We used data collected and reported in the tracking database and conducted a TRM savings review.

Program Summary

A group of five Community Action Program agencies and one tribal weatherization organization deliver energy efficiency programs to Avista's low-income residential customers in the Washington service territory. With annual funding of $2,350,000, these Community Action Program agencies qualify low-income customers, generate referrals through energy assistance efforts, and make funding resources available to meet customers' home energy needs. For PY 2018, the program achieved 16,258 therms reported natural gas savings in Washington.

Program Participation Summary

Table 20 shows Avista savings goals for the Low Income sector for PY 2018 as well as reported savings and goal portions achieved in PY 2018.

Table 20. Low Income Reported Savings (PY 2018)

Program	Savings Goals (therms)	Reported Savings (therms)[a]	Portion Reported
Low Income	15,323	16,258	106%

[a] Reported savings do not include Low Income Fuel Efficiency savings, shown in the *Fuel Efficiency Impact Evaluation* section.

Table 21 summarizes participation goals for the Low Income programs, along with participation reported and achieved in PY 2018.

Table 21. Low Income Participation (PY 2018)

Program	Participation Goals[a]	Participation Reported[a]	Portion Achieved
Low Income	206,198	169,075	82%

[a] Participation numbers do not include Low Income Fuel Efficiency participation, shown in the *Fuel Efficiency Impact Evaluation* section. Participation is defined as the number of installed units or square feet of installed insulation or windows.

Evaluation Goals and Objectives

For quarterly and semiannual reports in PY 2018 and PY 2019, Cadmus will determine interim verified savings for the Low Income programs through database review (described above in the *Database Review* section). This approach will provide a strong estimate of achieved savings until Cadmus can perform billing analysis at the end of the two-year evaluation cycle.

Low Income Impact Evaluation Methodology

Cadmus' impact evaluation for the Low Income programs' measures included a database review (described above in the *Database Review* section). We used UES values provided in the TRM to calculate

savings for measures reported in the measure tracking database. Cadmus labeled savings calculated during the database review as *adjusted savings*.

Low Income Impact Evaluation Results

Table 22 shows reported and adjusted natural gas savings for Low Income conservation measures. The table does not include savings for Low Income programs Fuel Efficiency path measures (shown in the *Low Income Fuel Efficiency Impact Findings* section below).

Table 22. Low Income Interim Natural Gas Impact Findings

Program	Reported Savings (therms)	Adjusted Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Low Income	16,258	15,400	15,400	95%

Low Income Conclusions and Recommendations

With a realization rate of 95% for natural gas savings, the Low Income programs achieved savings of 15,400 therms in PY 2018, or about 101% of goal. The reported savings did not match the UES values listed in the Avista TRM, resulting in a lower adjusted and interim verified savings. Reported program participation reached 82% of the participation goal.

Cadmus understands that Avista relies on Community Action Program agencies and a tribal weatherization organization to deliver Low Income savings. Cadmus' PY 2019 evaluation activities will include a process review of the Low Income programs, which may help identify opportunities to improve program performance.

Fuel Efficiency Impact Evaluation

Cadmus designed the Fuel Efficiency sector impact evaluation to verify reported program participation and energy savings. We used data collected and reported in the tracking database and details from online application forms and also reviewed TRM and RTF savings and applicable updated deemed savings values.

Program Summary

Fuel Efficiency measures replace electric space heating or water heating systems with equipment using natural gas. These measures are offered within the Nonresidential Site Specific path, Residential Prescriptive programs, and Low Income programs. Across these programs, the Fuel Efficiency measures achieved reported participation of 1,213 in PY 2018 and a natural gas energy penalty of 568,061 therms.

Fuel Efficiency measures provide positive electricity savings and negative natural gas savings, reflecting negative avoided costs. We report the electric energy savings in the *PY 2018 Washington Electric Impact Evaluation Report*.

Program Participation Summary

This section summarizes Fuel Efficiency sector participation and progress toward PY 2018 goals for the Nonresidential Site Specific path, Residential Prescriptive programs, and Low Income programs.

Nonresidential Site Specific Path

The Nonresidential sector Site Specific program path includes Fuel Efficiency measures that replace electric space heating or water heating systems with natural gas equipment. Fuel Efficiency measures provide positive electricity savings and negative natural gas savings, reflecting negative avoided costs. Three types of measures are considered Fuel Efficiency in the PY 2018 Nonresidential sector database:

- Site Specific HVAC combined
- Energy Smart Grocer Site Specific case doors
- Site Specific multifamily

Table 23 shows natural gas savings goals and reported natural gas penalties for the Nonresidential sector Fuel Efficiency measures. Avista confirmed that it did not set participation goals outside the Multifamily Market Transformation program.

Table 23. Nonresidential Site Specific Fuel Efficiency Natural Gas Penalties (PY 2018)

Fuel Efficiency Measure	Savings Goals (therms)	Savings Reported (therms)	Percentage of Goal
Nonresidential Site Specific	N/A	(710)	N/A
Multifamily Market Transformation	(139,836)	(61,341)	44%

Residential Prescriptive Programs

Table 24 shows Avista PY 2018 natural gas savings goals for Residential Prescriptive Fuel Efficiency measures as well as reported savings and percentage of goal through PY 2018.

Table 24. Residential Prescriptive Fuel Efficiency Reported Natural Gas Savings (PY 2018)

Program	Savings Goals (therms)	Reported Savings (therms)	Percentage to Goal
Residential Prescriptive Fuel Efficiency	N/A	(428,434)	N/A

Table 25 shows the Avista PY 2018 participation goal and reported participation for Residential Prescriptive Fuel Efficiency measures, as well as the participation percentage of goal through Q4 PY 2018.

Table 25. Residential Prescriptive Fuel Efficiency Reported Participation (PY 2018)

Program	Participation Goals[a]	Participation Reported[a]	Percentage to Goal
Residential Prescriptive Fuel Efficiency	1,255	1,137	91%

[a] Participation is defined as the number of rebates.

Low Income Programs

Table 26 shows Avista PY 2018 natural gas savings goals for Low Income Fuel Efficiency measures, as well as reported savings and percentage of goal through PY 2018.

Table 26. Low Income Fuel Efficiency Reported Natural Gas Savings (PY 2018)

Program	Savings Goals (therms)	Reported Savings (therms)	Percentage to Goal
Low Income Fuel Efficiency	N/A	(13,474)	N/A

Table 27 summarizes participation goals for Low Income Fuel Efficiency measures, as well as participation reported and achieved through PY 2018.

Table 27. Low Income Fuel Efficiency Participation (PY 2018)

Program	Participation Goals[a]	Participation Reported[a]	Percentage to Goal
Low Income Fuel Efficiency	47	64	136%

[a] Participation is defined as the number of rebates.

Evaluation Goals and Objectives

For quarterly and semiannual reports in PY 2018 and PY 2019, Cadmus will determine interim verified savings for Nonresidential Site Specific and Residential Prescriptive Fuel Efficiency measures through database review (described above in the *Database Review* section) and document review (also described above in the *Document Review* section). For Low Income Fuel Efficiency measures, Cadmus will determine adjusted savings through database review. These approaches will provide strong estimates of achieved savings until Cadmus can perform billing analysis at the end of the two-year evaluation cycle.

Fuel Efficiency Impact Evaluation Methodology

The impact methodology for Fuel Efficiency measures is described below for the Nonresidential Site Specific path, Residential Prescriptive programs, and Low Income programs.

Nonresidential Site Specific Fuel Efficiency Impact Methodology

Cadmus followed the same impact evaluation methodology for Fuel Efficiency measures as described in the *Nonresidential Impact Evaluation Methodology* section. We sampled six Multifamily Market Transformation program projects for our evaluation of the Nonresidential sector Fuel Efficiency measures, shown in Table 28.

Table 28. Nonresidential Fuel Efficiency Evaluation Sample

Fuel Efficiency Measure	Applications Sampled	Sampled Savings (therms)	Percentage of Reported Savings (therms)
Nonresidential Site Specific	0	0	0%
Multifamily Market Transformation	6	(48,200)	79%
Total	**6**	**(48,200)**	**78%**

Cadmus performed site visits at five unique Nonresidential locations to assess natural gas penalties for the six unique Multifamily Market Transformation program measures. Site visits involved verifying installed equipment type, make and model numbers, operating schedules, and set points, as applicable.

Residential Prescriptive Fuel Efficiency Impact Methodology

For our impact evaluation of Residential Prescriptive Fuel Efficiency measures, Cadmus followed the methodology described in the *Residential Impact Evaluation Methodology* section and conducted database review and document review. As shown in Table 29, we completed document reviews for 34 of 68 planned Fuel Efficiency participants through PY 2018.

Table 29. Residential Prescriptive Fuel Efficiency Impact Document Review

Fuel Efficiency Measure	PY 2018-PY 2019 Target	Complete through PY 2018
Residential Prescriptive Fuel Efficiency	68	34

Low Income Fuel Efficiency Impact Methodology

For the impact evaluation of Low Income Fuel Efficiency measures, Cadmus focused on a database review (described above in the *Database Review* section). We used unit savings values provided in the TRM to calculate savings for measures reported in the measure tracking database. Savings calculated during the database review are *adjusted savings*. For Low Income programs' measures in general (including Low Income Fuel Efficiency measures), these savings are also considered *interim verified savings*.

Fuel Efficiency Impact Evaluation Results

The following sections summarize findings for the Nonresidential Site Specific path, Residential Prescriptive programs, and Low Income programs Fuel Efficiency measures. All Fuel Efficiency measures provide positive electricity savings and negative natural gas savings because these measures replace electric space heating or water heating systems with equipment that uses natural gas. Negative savings, reflecting negative avoided costs, are incorporated in the electric cost-effectiveness calculations. We report the positive electric savings in the *PY 2018 Washington Electric Impact Evaluation Report*.

Nonresidential Site Specific Fuel Efficiency Impact Findings

Table 30 shows reported and interim verified natural gas penalties for Avista's Nonresidential sector Fuel Efficiency measures—along with realization rates—through PY 2018.

Table 30. Nonresidential Fuel Efficiency Natural Gas Impact Findings

Fuel Efficiency Measure	Reported Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Nonresidential Site Specific	(710)	(710)	100%
Multifamily Market Transformation	(61,341)	(55,074)	90%
Total	**(62,051)**	**(55,784)**	**90%**

Of the six Fuel Efficiency applications we evaluated, Cadmus identified discrepancies in three applications (two of which were installed at the same site) based on the evaluation site visit and project documentation review. Table 31 summarizes the reasons for discrepancies between reported and interim verified natural gas penalties.

Table 31. Nonresident Fuel Efficiency Summary of Discrepancies

Program	Number of Occurrences	Penalty Impact	Reason(s) for Discrepancy
Multifamily Market Transformation	2	↓	• The site installed more efficient furnaces than reported, resulting in lower natural gas energy consumption of the installed units versus baseline efficiency units and a reduced natural gas energy penalty.
	1	↑	• The site installed natural gas-fired furnaces with a higher heating capacity (Btu/hr) and a lower AFUE than reported. Based on Cadmus' review of the project documentation, the post-inspection did not confirm installed unit model numbers. Though this update did not affect reported electric savings, it increased the natural gas penalty.

Residential Prescriptive Fuel Efficiency Impact Findings

Table 32 shows reported, adjusted, and interim verified natural gas energy savings for the Residential Prescriptive Fuel Efficiency measures.

Table 32. Residential Prescriptive Fuel Efficiency Interim Natural Gas Impact Findings

Fuel Efficiency Measure	Reported Savings (therms)	Adjusted Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Residential Prescriptive Fuel Efficiency	(428,434)	(499,746)	(499,746)	117%

In reviewing documentation for 34 Residential Fuel Efficiency measures, Cadmus found no issues that affected natural gas savings. This led to a document review realization rate of 100% for natural gas energy savings. Table 33 shows the natural gas results of our impact document review for Residential Prescriptive Fuel Efficiency measures.

Table 33. Residential Prescriptive Fuel Efficiency Natural Gas Document Review Realization Rates

Fuel Efficiency Measure	PY 2018-PY 2019 Target Document Audit Count	Document Audit Count Achieved to Date	Sample Reported Savings (therms)	Sample Interim Verified Savings (therms)	Interim Document Audit Realization Rate
Residential Prescriptive Fuel Efficiency	68	34	(14,630)	(14,630)	100%

Low Income Fuel Efficiency Impact Findings

Table 34 shows reported and adjusted natural gas energy savings for Low Income Fuel Efficiency measures.

Table 34. Low Income Fuel Efficiency Program Interim Natural Gas Impact Findings

Fuel Efficiency Measure	Reported Savings (therms)	Adjusted Savings (therms)	Interim Verified Savings (therms)	Realization Rate
Low Income Fuel Efficiency	(13,474)	(12,531)	(12,531)	93%

Fuel Efficiency Conclusions

Nonresidential Site Specific and Multifamily Market Transformation Fuel Efficiency measures achieved interim verified natural gas penalties of 55,784 therms, yielding a 90% realization rate. The Multifamily Market Transformation Fuel Efficiency measures achieved only 44% of the natural gas penalty goal of -139,836 therms.

Cadmus recommends ensuring that the final reported savings calculations reflect the most up-to-date project details, including post-installation verification photos, equipment submittals, and invoices. During two project verifications, we found different installed equipment performances than those used in the reported savings calculations.

Residential Prescriptive Fuel Efficiency measures achieved interim verified natural gas penalties of 499,746 therms, yielding a 117% realization rate. Low Income Fuel Efficiency measures contributed natural gas penalties of 12,531 therms, with a realization rate of 93%.

Residential Prescriptive natural gas measures more than offset the natural gas penalty of Residential Prescriptive Fuel Efficiency measures, with interim verified natural gas savings of 615,989 therms. Similarly, Low Income natural gas measures also more than offset of Low Income Fuel Efficiency natural gas penalties, with interim verified savings of 15,400 therms.