Appendix B:

2018 Washington Electric Impact Evaluation

CADMUS

Appendix B to the 2018 Washington Annual Conservation Report

2018 Washington Electric 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 electric demand-side management programs in Washington. This report presents our interim electric 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 Electric Program Evaluation Activities

Sector	Program Type	Document/ Database Review	Verification/ Metering Site Visit	Billing Analysis
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 electric energy efficiency portfolio achieved a 98% realization rate and acquired 46,442,467 kWh in annual interim verified 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. We used the label *interim verified savings* for our findings in the first half of the biennial evaluation. Following the end of the biennium, we 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 Electric Savings

Sector	Reported Savings (kWh)	Interim Verified Savings (kWh)	Realization Rate
Nonresidential	32,839,394	32,834,855	100%
Residential	13,978,866	13,244,864	95%
Low Income	333,482	362,748	109%
Total	**47,151,743**	**46,442,467**	**98%**

Conclusions and Recommendations

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

Nonresidential Conclusions and Recommendations

While some individual project results varied, the overall Nonresidential sector performed strongly in PY 2018. Most of the projects we sampled for evaluation were well-documented and matched what we found during site visit verification.

Cadmus has three recommendations for improving the Nonresidential sector energy 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 two 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.
- Ensure 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, Cadmus found different installed equipment sizes, quantities, or performance ratings than were used in the reported savings calculations.
- For insulation measures, require additional supporting information about existing HVAC systems and their fuel sources to more accurately calculate potential energy savings. Supporting information could be in the form of electric and natural gas utility bills, equipment nameplate information, or on-site photos of HVAC equipment.

Residential Conclusions and Recommendations

Lighting measures account for a high percentage of Residential program path savings. Simple Steps, Smart Savings provides 73% of Residential interim verified savings, mostly through lighting measures, and Multifamily Direct Install (MFDI) provides 16% of savings, also mostly through lighting measures. The HVAC program accounts for 9% of savings, with Shell and ENERGY STAR Homes accounting for a combined 2% of Residential savings.

During the evaluation, Avista confirmed that the unit energy savings (UES) used to calculate reported savings for numerous Residential measures had not been updated to match 2018 TRM UES values. This was especially pronounced in the Residential HVAC program, where reported savings under-represented savings for heat pump measures. Under the direction of Avista, Cadmus adjusted reported savings for these measures to match the 2018 TRM UES values.

Cadmus offers three recommendations regarding Avista's Residential electric programs:

- Ensure that reported savings for all Prescriptive measures are calculated using current technical reference manual (TRM) or Regional Technical Forum (RTF) UES values.
- Continue to encourage adoption of efficient lighting through the Simple Steps, Smart Savings program. The Northwest Energy Efficiency Alliance *Residential Building Stock Assessment II* shows that roughly 40% of installed lamps in single-family homes in Washington and Idaho are based either on incandescent or halogen technology.
- The MFDI program has proven to be an efficient, effective mechanism for installing high-efficiency lighting and aerators in multifamily units. The Northwest Energy Efficiency Alliance *Residential Building Stock Assessment II* "Multifamily Buildings Report" estimated that 44% of lighting in multifamily units use incandescent or halogen technology. Cadmus recommends focusing on replacement of high-use, low-efficiency lamps where practical, to maximize program cost effectiveness while keeping savings high.

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 incented 1,267 Nonresidential electric measures in Washington in PY 2018 and reported total electric energy savings of 32,839,394 kWh. Through the Nonresidential sector, Avista offers incentives for high-efficiency equipment and controls through three program paths: Prescriptive, Site Specific, and Multifamily Market Transformation. 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 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).

Multifamily Market Transformation is a site-specific program intended to prompt building owners and developers to consider natural gas as the fuel of choice when constructing multi-family housing. The 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 Nonresidential Fuel Efficiency 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 electric 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 Electric Savings (PY 2018)

Program Type	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Interior Lighting	7,302,627	10,613,699	145%
Exterior Lighting	2,517,897	7,596,871	302%
Shell Measure	7,853	35,877	457%
Green Motors	78,975	23,925	30%
Motor Control (VFD)	452,171	488,368	108%
Fleet Heat	32,000	188,000	588%
Food Service Equipment	109,611	37,350	34%
AirGuardian	42,000	0	0%
Energy Smart Grocer	1,438,175[a]	222,861	15%
Total	**11,981,309**	**19,206,951**	**160%**

[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	Planned Participation
Interior Lighting	42,400
Exterior Lighting	8,806
Shell Measure[a]	92,500
Green Motors	18
Motor Control (VFD)	330
Fleet Heat	4
Food Service Equipment	17
AirGuardian	7
Energy Smart Grocer[b]	4,890

[a] The shell measure participation goal includes participants with natural gas 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	471
Exterior Lighting	552
Shell Measure	4
Green Motors	12
Motor Control (VFD)	8
Fleet Heat	1
Food Service Equipment	14
AirGuardian	0
Energy Smart Grocer	7
Total	**1,069**

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

Nonresidential Site Specific Program

Table 6 shows electric 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 electric savings for the Fuel Efficiency sector, such as those associated with the Multifamily Market Transformation program.

Table 6. Nonresidential Site Specific Electric Savings (PY 2018)

Program Path	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Site Specific	9,000,000	13,632,443	151%

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 collected on-site data (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 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 sector 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, or 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 evaluation sample. Cadmus sampled 40 Prescriptive applications at 34 unique sites overall. Of the sampled applications, we selected 21 for certainty review based on scale of savings, measure type, or location, and selected the remaining 19 applications randomly. There was no participation in the AirGuardian program in PY 2018 and only one participant in the Fleet Heat program. Cadmus did not sample the one Fleet Heat program measure due to low participation and did not sample any Prescriptive Energy Smart Grocer measures in Washington. Cadmus performed sample selection across measures in Washington and Idaho and included Prescriptive Energy Smart Grocer measures in the Idaho sample.

Table 7. Washington Nonresidential Prescriptive Electric Evaluation Sample

Program Type	Applications Sampled	Sampled Savings (kWh)	Percentage of Reported Savings
Interior Lighting	7	2,164,634	20%
Exterior Lighting	3	168,845	2%
Shell Measure	2	5,727	16%
Green Motors	3	8,903	37%
Motor Control (VFD)	5	370,327	76%
Fleet Heat	0	0	0%
Food Service Equipment	4	14,243	38%
AirGuardian	0	0	N/A
Energy Smart Grocer	0	0	0%
Nonresidential Prescriptive	**24**	**2,732,679**	**14%**

Table 8 summarizes the Washington Nonresidential Site Specific program path evaluation sample. Cadmus sampled 18 Site Specific applications at 15 unique sites overall. Of the sampled applications, we selected 12 for certainty review based on the scale of savings, measure type, or location, and selected the remaining six applications randomly.

Table 8. Washington Nonresidential Site Specific Electric Evaluation Sample

Program Path	Applications Sampled	Sampled Savings (kWh)	Percentage of Reported Savings
Site Specific	11	2,976,300	22%

Document Review

Cadmus requested and reviewed project documentation for each sampled application and prepared M&V plans to guide its site visits. Project documentation typically included incentive applications, calculation tools (usually based on the 2017 RTF),[1] invoices, equipment specification sheets, and post-inspection reports.

On-Site Verification

Cadmus performed site visits at 46 unique Nonresidential locations to assess electric savings for 58 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. We did not consider it necessary to conduct power metering or light logging for PY 2018 site visits. We used the project documentation review and on-site findings to adjust the reported savings calculations where necessary.

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

Nonresidential Impact Evaluation Results

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

Nonresidential Prescriptive Programs

Table 9 shows reported and interim verified electric 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 electric realization rate was 99%.

Table 9. Nonresidential Prescriptive Electric Impact Findings

Program Type	Reported Savings (kWh)	Interim Verified Savings (kWh)	Realization Rate
Interior Lighting	10,613,699	10,503,819	99%
Exterior Lighting	7,596,871	7,596,871	100%
Shell Measure	35,877	30,644	85%
Green Motors	23,925	24,197	101%
Motor Control (VFD)	488,368	491,062	101%
Fleet Heat	188,000	188,000	100%
Food Service Equipment	37,350	37,340	100%
AirGuardian	0	0	100%
Energy Smart Grocer	222,861	222,861	100%
Nonresidential Prescriptive	**19,206,951**	**19,094,795**	**99%**

Of the evaluated applications, Cadmus identified discrepancies for seven 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
Interior Lighting	3	↓	• Cadmus reduced the annual operating hours for lighting fixtures on the sales floor from 8,760 hours reported, since 50% of sales floor lights automatically turn off from 12 a.m. to 6 a.m. (two projects). • Cadmus reduced the lighting fixture in-service-rate to account for 24 lamps that were on the site but in storage (one project).
Motor Control (VFD)	1	↓	• Cadmus reduced the reported quantity of 2.5 HP return air fans with VFDs from three to one and added two 3 HP return air fans with VFDs.
Shell Measure	1	↓	• Cadmus determined there was no space cooling and space was heated with natural gas. As a result, we removed electric savings from ceiling/wall insulation.

Project Type	Number of Occurrences	Savings Impact	Reason(s) for Discrepancy
Food Service Equipment	1	↓	• Cadmus reduced the pounds of food cooked per day for the oven measure and increased operating hours based on the site manager interview. • Cadmus reduced the pounds of food cooked per day for the fryer measure and increased operating hours based on the site manager interview. • Cadmus reduced the operating time per day for the pre-rinse spray valve measure based on the site manager interview.
Green Motor Rewind	1	↑	• Reported savings reference 2017 Regional Technical Forum. Cadmus applied deemed motor savings from 2018 TRM workbook.

Nonresidential Site Specific Program

Table 11 shows reported and interim verified electric 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 electric realization rate was 101%. Note that the table does not include reported and interim verified electric savings for measures in the Fuel Efficiency path.

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

Program Path	Reported Savings (kWh)	Interim Verified Savings (kWh)	Realization Rate
Site Specific	13,632,443	13,740,060	101%

Of the evaluated applications, Cadmus identified discrepancies in five applications 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
Interior Lighting	1	↑	• Cadmus included the calculated cooling load electric energy savings in the interim verified savings. These savings were calculated in the project documentation but not included in the reported savings.
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.
Shell Measure	1	↑	• Cadmus' on-site review of installed triple-pane windows confirmed that some windows had lower U-values than reported and all windows had a higher solar heat gain coefficient than reported.
Exterior Lighting	1	↓	• Site installed a higher quantity of exterior LED fixtures. • The Cadmus team found that the reported savings in database did not match the implementer's submitted calculation workbook.
	1	↓	• Site installed fewer LED pole lighting fixtures and more LED wall pack fixtures than reported.

Nonresidential Conclusions and Recommendations

The Nonresidential sector achieved total interim verified electric energy savings of 32,835 MWh in PY 2018 with a combined realization rate of 100%. The Nonresidential sector also exceeded the combined Prescriptive and Site Specific program paths' electric savings goal of 20,981 MWh by 56%.

Although some individual project results varied, the overall Nonresidential sector performed strongly in PY 2018. Most of the projects Cadmus sampled for evaluation were well-documented and matched those found during site visit verification.

Cadmus has three recommendations for improving the Nonresidential sector energy 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 two 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.
- Ensure 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, Cadmus found different installed equipment sizes, quantities, or performance ratings than used in the reported savings calculations.
- For insulation measures, require additional supporting information about existing HVAC systems and their fuel sources to more accurately calculate potential energy savings. Supporting information could be in the form of electric and natural gas utility bills, equipment nameplate information, or on-site photos of HVAC equipment.

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

In PY 2018, Avista completed and provided incentives for 743,775 Residential electric measures or units in Washington and reported total electric energy savings of 13,978,866 kWh. 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-quality LEDs, light fixtures, and energy-efficient showerheads; 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.

Table 13. Residential Prescriptive Reported Electric Savings (PY 2018)

Program	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Simple Steps, Smart Savings	11,929,925	10,344,675	87%
HVAC	1,117,034	1,205,966	108%
Shell	51,340	258,416	503%
ENERGY STAR Homes	26,368	78,296	297%
Residential Prescriptive Total	**13,124,667**	**11,887,353**	**91%**

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	Percentage of Goal
Simple Steps, Smart Savings[a]	805,153	715,976	89%
HVAC[b]	948	1,237	131%
Shell[c]	4,400	21,586	491%
ENERGY STAR Homes[b]	8	15	188%
Residential Prescriptive Total	**810,509**	**738,814**	**91%**

[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. Avista then moved it from a pilot to an ongoing study in September 2018.

Table 15. Multifamily Direct Install Program Reported Electric Savings

Program Path	Savings Reported (kWh)	Participation Reported
Multifamily Direct Install	2,091,514	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

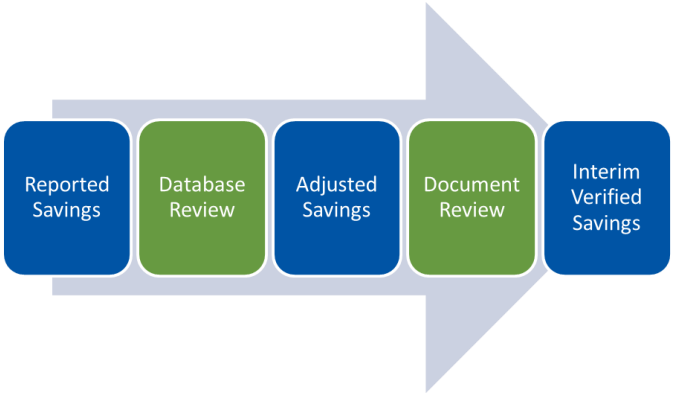
To determine the Residential sector interim verified savings for PY 2018, Cadmus employed two impact evaluation methods for most residential programs:[2]

- Database review
- Document review

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

[2] 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 our review of all projects, we calculated a realization rate for the 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 Electric 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 both 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. 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, we 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 Electric Impact Findings

Program	Reported Electric Savings (kWh)	Adjusted Electric Savings (kWh)	Percentage Change
Simple Steps, Smart Savings	10,344,675	9,676,030	(6%)
HVAC	1,205,966	1,242,787	3%
Shell	258,416	271,262	5%
ENERGY STAR Homes	78,296	52,736	(33%)
Residential Prescriptive Total	**11,887,353**	**11,242,815**	**(5%)**

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 96% electric realization rate and the Shell program had an 85% electric realization rate.

Table 18. Residential Prescriptive Electric Impact Document Review Realization Rates

Program	PY 2018-PY 2019 Target Document Audit Count	Document Audit Count Achieved to Date	Sample Reported Savings (kWh)	Sample Interim Verified Savings (kWh)	Interim Document Audit Realization Rate
HVAC	68	34	32,997	31,691	96%
Shell	68	34	49,224	41,915	85%

Cadmus identified several discrepancies during its document review through PY 2018:

- For two window measures, documentation showed a square footage for installed windows that differed from that reported. In both cases, the documented square footage was lower than that reported and resulted in lower interim verified savings based on the corrected area.
- For four window measures reported for sites with electric heating, project documents identified heating fuels other than electricity. Cadmus added natural gas savings and removed electricity savings at two sites identified as using natural gas heating. Documentation for the other two sites identified the heating fuel as liquid propane for one site and wood pellets for the other, so Cadmus removed electricity savings for these sites.
- One heat pump water heater measure had a tank capacity of 80 gallons per the documentation. To qualify for the measure, however, the heat pump water heater had to have a tank size below 55 gallons, so Cadmus removed savings for this measure.

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.

Table 19. Residential Prescriptive Interim Electric Impact Findings

Program	Reported Electric Savings (kWh)	Adjusted Electric Savings (kWh)	Interim Verified Electric Savings (kWh)[a]	Realization Rates
Simple Steps, Smart Savings	10,344,675	9,676,030	9,676,030	94%
HVAC	1,205,966	1,242,787	1,193,598	99%
Shell	258,416	271,262	230,986	89%
ENERGY STAR Homes	78,296	52,736	52,736	67%
Residential Prescriptive Total	**11,887,353**	**11,242,815**	**11,153,350**	**94%**

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

Residential Conclusions and Recommendations

Interim verified electricity savings show a realization rate of 94% on realized savings of 11,153,350 kWh for Residential Prescriptive programs, which is 85% of the savings goal for the year. Reported savings for the MFDI program add 2,091,514 kWh savings, for a total acquired savings of 13,244,864 kWh.

Lighting measures account for a high percentage of Residential program path savings: Simple Steps, Smart Savings provides 73% of Residential savings, mostly through lighting measures, and MFDI provides 16% of savings, also mostly through lighting measures. The HVAC program accounts for 9% of savings, with Shell and ENERGY STAR Homes accounting for a combined 2% of Residential savings.

During the evaluation, Avista confirmed that the UES values used to calculate reported savings for numerous Residential measures had not been updated to match 2018 TRM UES values. This was especially pronounced in the Residential HVAC program, where reported savings under-represented savings for heat pump measures. Under the direction of Avista, Cadmus adjusted reported savings for these measures to match the 2018 TRM UES values.

Cadmus offers three recommendations regarding Avista's Residential electric programs:

- Ensure that reported savings for all Prescriptive measures are calculated using current TRM or RTF UES values.
- Continue to encourage adoption of efficient lighting through the Simple Steps, Smart Savings program. The Northwest Energy Efficiency Alliance *Residential Building Stock Assessment II* shows that roughly 40% of installed lamps in single-family homes in Washington and Idaho are based either on incandescent or halogen technology.
- The MFDI program has proven to be an efficient, effective mechanism for installing high-efficiency lighting and aerators in multifamily units. The Northwest Energy Efficiency Alliance *Residential Building Stock Assessment II* "Multifamily Buildings Report" estimated that 44% of lighting in multifamily units use incandescent or halogen technology. Cadmus recommends focusing on replacement of high-use, low-efficiency lamps where practical, to maximize program cost effectiveness while keeping savings high.

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 333,482 kWh of reported electric 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 (kWh)	Reported Savings (kWh)[a]	Percentage of Goal
Low Income	731,368	333,482	46%

[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]	Percentage of Goal
Low Income	81,591	92,104	113%

[a] Participation numbers do not include Low Income Fuel Efficiency participation, shown in the *Fuel Efficiency Impact Evaluation* section, or recipients of LED bulbs at giveaway events. 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 a 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 consisted of 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 electric 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 Electric Impact Findings

Program	Reported Electric Savings (kWh)	Adjusted Electric Savings (kWh)	Interim Verified Electric Savings (kWh)	Realization Rate
Low Income	333,482	362,748	362,748	109%

Low Income Conclusions and Recommendations

With a realization rate of 109% for electricity savings, the Low Income program achieved savings of 362,748 kWh in PY 2018, or about 50% of goal. The reported savings did not match the UES values listed in the Avista TRM, resulting in higher adjusted and interim verified savings. Reported program participation reached 113% of the participation goal. Cadmus recommends that Avista adjust its Low Income electric savings goals moving forward to better align with PY 2018 performance.

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, as well as 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, Avista reported Fuel Efficiency participation of 1,213 in PY 2018 and electric energy savings of 11,740,451 kWh.

Fuel Efficiency measures provide positive electricity savings and negative natural gas savings, reflecting negative avoided costs. Cadmus incorporated these negative avoided costs in the electric cost-effectiveness calculations. We report the negative natural gas savings in the *PY 2018 Washington Natural Gas 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
- Multifamily Market Transformation

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

Table 23. Nonresidential Site Specific Fuel Efficiency Electric Savings (PY 2018)

Fuel Efficiency Measure	Savings Goals (kWh)	Savings Reported (kWh)	Percentage of Goal
Nonresidential Site Specific	N/A	126,404	N/A
Multifamily Market Transformation	3,183,708	1,298,347	41%

Residential Prescriptive Programs

Table 24 shows Avista PY 2018 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 Electric Savings (PY 2018)

Fuel Efficiency Measure	Savings Goals (kWh)	Reported Savings (kWh)	Percentage of Goal
Residential Prescriptive Fuel Efficiency	12,511,038	9,998,231	80%

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 PY 2018.

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

Fuel Efficiency Measure	Participation Goals[a]	Participation Reported[a]	Percentage of 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 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 Electric Savings (PY 2018)

Fuel Efficiency Measure	Savings Goals (kWh)	Reported Savings (kWh)	Percentage of Goal
Low Income Fuel Efficiency	116,562	317,469	272%

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)

Fuel Efficiency Measure	Participation Goals[a]	Participation Reported[a]	Percentage of 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 (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 outlined 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 (kWh)	Percentage of Reported Savings
Nonresidential Site Specific	0	0	0%
Multifamily Market Transformation	6	1,005,215	77%
Total	**6**	**1,005,215**	**64%**

Cadmus performed site visits at five unique Nonresidential locations to assess electric savings 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 the 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 also report these negative savings in the *PY 2018 Washington Natural Gas Impact Evaluation Report*.

Nonresidential Fuel Efficiency Impact Findings

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

Table 30. Nonresidential Fuel Efficiency Electric Impact Findings

Fuel Efficiency Measure	Reported Savings (kWh)	Interim Verified Savings (kWh)	Realization Rate
Nonresidential Site Specific	126,404	126,404	100%
Multifamily Market Transformation	1,298,347	1,280,182	99%
Total	**1,424,751**	**1,406,586**	**99%**

Of the six Fuel Efficiency applications evaluated, Cadmus identified discrepancies in two Multifamily Market Transformation program measures, both of which were installed at the same site, based on the evaluation site visit and project documentation review. The site installed more efficient furnaces than reported, which resulted in lower natural gas energy consumption of the installed units versus baseline efficiency units, meaning that less electricity was offset for this measure than reported.

Residential Prescriptive Fuel Efficiency Impact Findings

Table 31 shows reported, adjusted, and interim verified electric energy savings for the Residential Prescriptive Fuel Efficiency measures. Database review yielded higher savings than reported because of discrepancies in the UES values used.

Table 31. Residential Prescriptive Fuel Efficiency Interim Electric Impact Findings

Fuel Efficiency Measure	Reported Electric Savings (kWh)	Adjusted Electric Savings (kWh)	Interim Verified Electric Savings (kWh)	Realization Rate
Residential Prescriptive Fuel Efficiency	9,998,231	10,423,880	9,969,704	100%

In reviewing documentation for 34 Residential Fuel Efficiency measures, Cadmus found an issue with two measures: both were natural gas furnaces installed at sites where the furnace replaced an oil-fired heating system. We eliminated the electricity savings for the natural gas furnaces, because the replaced system did not heat using electricity. These adjustments led to a document review realization rate of 96%, as shown in Table 32.

Table 32. Residential Prescriptive Fuel Efficiency Electric Impact Document Review Realization Rate

Fuel Efficiency Measure	2018-2019 Target Document Audit Count	Document Audit Count Achieved to Date	Sample Reported Savings (kWh)	Sample Interim Verified Savings (kWh)	Interim Document Audit Realization Rate
Residential Prescriptive Fuel Efficiency	68	34	343,579	328,609	96%

Low Income Fuel Efficiency Impact Findings

Table 33 shows reported and adjusted electric energy savings for Low Income Fuel Efficiency measures.

Table 33. Low Income Fuel Efficiency Program Interim Electric Impact Findings

Fuel Efficiency Measure	Reported Electric Savings (kWh)	Adjusted Electric Savings (kWh)	Interim Verified Electric Savings (kWh)	Realization Rate
Low Income Fuel Efficiency	317,469	293,170	293,170	92%

Fuel Efficiency Conclusions and Recommendations

Nonresidential Site Specific and Multifamily Market Transformation Fuel Efficiency measures achieved interim verified savings of 1,406,586 kWh, yielding a 99% realization rate. The Multifamily Market Transformation Fuel Efficiency measures achieved only 41% of the electric energy savings goal of 3,183,708 kWh. Avista sent out an advertorial featuring multifamily developers operating in Washington and Idaho who were building apartments with lower heating costs through the direct use of natural gas. This advertorial ran from June through October 2018 in 12 publications. All but one of the multifamily participants started their project before this advertorial was released, so it will likely lead to higher Multifamily Market Transformation program participation in PY 2019.

As stated in the *Nonresidential Conclusions and Recommendations* section, 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 savings of 9,969,704 kWh, yielding a 100% realization rate and achieving 80% of savings goal. Cadmus recommends that Avista update reported savings to use current TRM UES values, particularly for measures where the differences are especially notable, such as conversions to natural gas water heaters and conversions to natural gas wall furnaces.

For Low Income Fuel Efficiency measures, interim verified savings easily exceeded Avista's savings goals, achieving more than 250% of the savings target.