Appendix B:

2019 Evaluation, Measurement and Verification Plan

Avista Utilities

2019 Energy Efficiency Evaluation, Measurement and Verification Annual Plan

I. Contents

2019 Energy Efficiency Evaluation, Measurement and Verification Annual Plan

II. Background

The Company's 2019 Energy Efficiency Evaluation Measurement and Verification (EM&V) Annual Plan, in combination with the Avista EM&V Framework, is intended to identify the evaluation, measurement and verification activities planned to be performed in 2019 in order to adequately inform and assess energy efficiency programs provided by Avista for its customers in Washington and Idaho. This evaluation effort is not only to verify savings estimates of the 2018 program year, but is to be used to enhance program design and improve the marketing and delivery of future programs. This document also provides the projected 2019 EM&V budget.

III. Overview

The EM&V Annual Plan identifies evaluation activities intended to be performed during 2019 on the 2018 energy efficiency portfolio. For Washington, the evaluation of 2018 acquisition will be consolidated with results from the 2019 evaluation to satisfy biennial reporting requirements associated with Washington's Energy Independence Act (EIA), also known as I-937. The scope of this Plan is consistent with prior evaluation plans as presented to Avista's Energy Efficiency Advisory Group ("Advisory Group"). A comprehensive EM&V overview and definitions are included in Avista's EM&V Framework, a companion document to this plan.

A key consideration integrated into this plan is the role of the independent third-party evaluator that will perform the majority of evaluation planning, tasks, analysis, and external reporting as coordinated by Avista Energy Efficiency Staff.

The following details the key aspects of this Plan:

- The Company continues to pursue a portfolio approach for Impact Analysis, insuring a comprehensive annual review of all programs, to the degree necessary, based on the magnitude of savings and uncertainty of the related unit energy savings (UES) values and magnitude of claimed energy efficiency acquisition relative to the portfolio.

- Inherent in the impact analysis for 2017, a locked UES list identifying a significant number of UES values is available to leverage through verification rather than fundamental impact analysis, however this list of UES will be reevaluated for 2019 once the impact analysis from Cadmus is provided. Measures will also be updated to reflect "best science" from other sources as well, primarily the RTF.
- Portfolio impact evaluations will be conducted for all electric and natural gas programs in Washington and Idaho. For programs with a majority of savings or particular aspects of interest, such as a high level of uncertainty, detailed impact evaluations using protocols from the Uniform Methods Project, International Performance Measurement and Verification Protocol (IPMVP) and other industry-standard techniques for determining program-level impacts will be used. Billing analyses will be incorporated as appropriate.
- Electric energy efficiency acquisition achieved during 2018 will contribute to the biennial savings acquisition for EIA compliance, which will complete its fifth biennium at the end of 2019.[1]
- A final evaluation of the electric programs deployed during 2018 and 2019 will be initiated prior to the end of 2019 in order to meet the June 1, 2020, filing deadline in Washington.
- The evaluation will provide energy efficiency acquisition results with 90% precision with a 10% confidence interval. Discrete measures may be represented by reduced precision and wider confidence, such as 80% with a 20% confidence interval, but must support the required portfolio criteria of 90%/10%.
- This planning document will not be construed as pre-approval by the Washington or Idaho Commissions.
- Evaluation resources will be identified through the development of the 2018-2019 evaluation work plan in conjunction with the independent, third-party evaluator. Primary segments will include:
    - Residential
        - The impact analysis will consider the portfolio of measures provided to residential customers during the program year. Evaluation effort will be focused on measures that contribute significant portfolio savings and allow consolidation and grouping of similar measures to facilitate the evaluation.
    - Low Income
        - For the impact analysis, billing analysis on the census of measures will be conducted. In addition, a comparison group, possibly consisting of Low Income Home Energy Assistance Program (LIHEAP) or Low Income Rate Assistance Program (LIRAP) participants, may be incorporated into the analysis if possible.

[1] Washington Initiative 937 was approved by voters on November 7, 2006. Codified as RCW 19.285 and WAC 480-109, the energy efficiency aspects of this law became effective on January 1, 2010.

- Non-Residential
  - Interviews of Avista staff and third-party implementers will be conducted, along with customer surveys, tracking databases, marketing materials and quality assurance documents.
- Consideration will be made recognizing most of Avista's current portfolio of electric energy efficiency offerings has been in place since 1995 and natural gas programs available since 2001.
- A Process Evaluation report will be delivered as part of the 2019 Annual Conservation Report which addresses program considerations for that program year.

IV. External EM&V Budget for Evaluations

For 2019, the total budget for external evaluation is estimated to be $971,762 on a total system basis. The following table identifies evaluation activities and allocations that are anticipated for 2019. The Washington and Idaho expenses include evaluation activities for both electric and natural gas fuel types.

Individual Evaluations	Evaluation Type	Contractor	Budget (System)	WA expense	ID expense
2018-2019 Electric and Natural Gas Portfolio	Impact	Cadmus	$522,147	$365,503	$156,644
2019 Electric and Natural Gas Portfolio	Impact and Process	Cadmus	$261,074	$182,751	$78,322
Electric and Natural Gas DSM Operations (or components of)[2]	Process	Cadmus	$188,541	$131,979	$56,562
Total Budget for Individual Evaluations			**$971,762**	**$680,233**	**$291,529**

V. Overall 2019 EM&V Budget

The table below captures the individual evaluations specifically identified in the previous table in aggregate and augments them with the associated expenses necessary to manage EM&V activities, perform internal EM&V evaluations, acquire physical EM&V equipment and actively participate in and fund the activities of the Regional Technical Forum (RTF).

[2] Process evaluation efforts may be directed to a further investigate past process evaluation findings rather than perform a new portfolio evaluation.

Activity	Budget (WA/ID system)	Internal budget	External budget	WA expense	ID expense
Individual evaluations previously specified	$886,762	$10,000	$876,762	$613,733	$263,029
Regional Technical Forum dues	85,000	-	85,000	59,500	25,500
Total	**971,762**	**$10,000**	**$981,762**	**673,233**	**288,529**
Expected total DSM budget	$22,150,852			$14,223,833	$7,927,019
EM&V as a % of total DSM budget[3]	**4.39%**			**4.73%**	**3.64%**

VI. Summary of Individual Evaluations

Provided below is a summary of each of the external evaluation activities anticipated to occur in 2019. All savings estimates, calculations, assumptions and recommendations will be the work product of the independent evaluator in conjunction with the respective portfolio impact, process, or market evaluation component. The final evaluation plan provided by Cadmus will also be included in this plan as an appendix.

2018-2019 Electric and Natural Gas Portfolio Impact Evaluation

The electric and natural gas portfolio impact evaluation will be performed by Cadmus, an independent third party evaluator that was selected through a competitive bidding process. Based on the evaluator's work plan, performance data and supporting information may be derived from primary consumption data collected in the field, site audits, phone surveys, billing analysis, and other methods identified to effectively quantify the energy performance of the energy efficiency measure.

Similar to prior evaluations, billing analyses is to be conducted to identify the electric and natural gas impacts of the Low Income Program based on a census of program participants to estimate savings by state, fuel type, and overall program levels. For this evaluation cycle, savings estimates

[3] While EM&V expenditures will be directly assigned where appropriate, this illustrates the anticipated allocation of estimated EM&V expenditures.

will be evaluated through a combined approach of billing and engineering analysis, as well as developing net savings estimates by measuring the effects of a comparison group.

If possible, a Low Income comparison group study may be used to evaluate this specific program activity. There are two feasible approaches for selecting this comparison group. One method would be to identify nonparticipants from data on Avista customers that receive energy assistance payments such as LIHEAP or LIRAP, who have not participated in the Low Income Program. A second method would be to consider using future program participants. The best approach will be identified as the timeline and available data are considered.

Additional participant phone surveys may be conducted to provide a better understanding of certain topics, such as primary and secondary heating sources, equipment functionality prior to replacement, customer behaviors and take-back effects, participant non-energy benefits and other building or equipment characteristics.

For nonresidential, site and metering visits on prescriptive and site specific projects will support project verification and gather necessary data to validate energy savings and engineering calculations. Sample sizes for each type of fuel will be based on the combined two-year (2018-2019) projected project count. Prior evaluations may inform sampling rates to effectively reduce the sample size in measure categories with less uncertainty, and increase the sampling for those measures with greater variation.

2018 Portfolio Process Evaluation

To identify program changes and areas of interest, brief interviews will be employed to gather relevant information. Key participants in the interview process will include Avista staff, and as appropriate, third-party implementation staff and trade allies.

The independent third-party evaluator will review communication and participant materials for critical program documents that have new or updated materials, including program tracking databases, marketing materials and trade ally materials. The program materials will be evaluated against industry best practices for their adequacy, clarity, and effectiveness. Where appropriate, feedback will be provided to support the development of new or enhancement of existing program materials.

Participant and nonparticipant surveys will be conducted in 2018 and 2019 for both residential and nonresidential segments and be used to assess differences in customer experiences, effectiveness of programs and materials available for customers and trade allies. Participant and nonparticipant surveys will focus on the decisions, attitudes, barriers, and behaviors regarding Avista's programs and efficient equipment/measure installations as well as supplement past spillover research.

Cadmus Evaluation Plan

As part of Cadmus' contractual requirements they provided an overall detailed evaluation work plan for 2018-2019. That plan will be attached to this EM&V plan.

Avista Utilities 2018–2019 Evaluation Work Plan

March 30, 2018

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CADMUS

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CADMUS

Introduction and Goals

Avista Utilities contracted with Cadmus to evaluate its portfolios of residential, non-residential, and low-income demand-side management (DSM) programs during the 2018–2019 cycle. As identified in Avista's Request for Proposals (RFP), primary goals for the evaluation are these:

- Independently verify, measure and document energy savings impacts from each of electric and natural gas energy efficiency programs, or for program categories representing consolidated small-scale program offerings, from January 1, 2018, through December 31, 2019
- Analytically substantiate the measurement of those savings
- Calculate the cost-effectiveness of the portfolio and component programs
- Identify program improvements, if any
- Identify possible future programs

Evaluation, measurement, and verification (EM&V) research will also support the following:

- Avista's development of a best-of-class evaluation infrastructure for its DSM programs
- Communicate with and provide timely information to the stakeholder group (particularly the Avista Energy-Efficiency Advisory Group and Technical Committee)

In its original proposal to Avista, Cadmus presented a general approach to conducting the overall evaluation. We have prepared this evaluation work plan to reflect the programs as we understand them based on final (Washington) and draft (Idaho) plans for 2018 as well as the project kickoff. We anticipate further revisions to this work plan after additional discussions with program staff. Because the programs could change during the evaluation period, we may further revise the proposed evaluation approaches. We view the evaluation plan as a living document, which can change in response to program modifications throughout the 2018–2019 cycle.

This document presents proven methods to conduct full impact and process evaluations for Avista's three sector portfolios (low-income, residential, and non-residential). The plans address 16 individual programs across the portfolios.

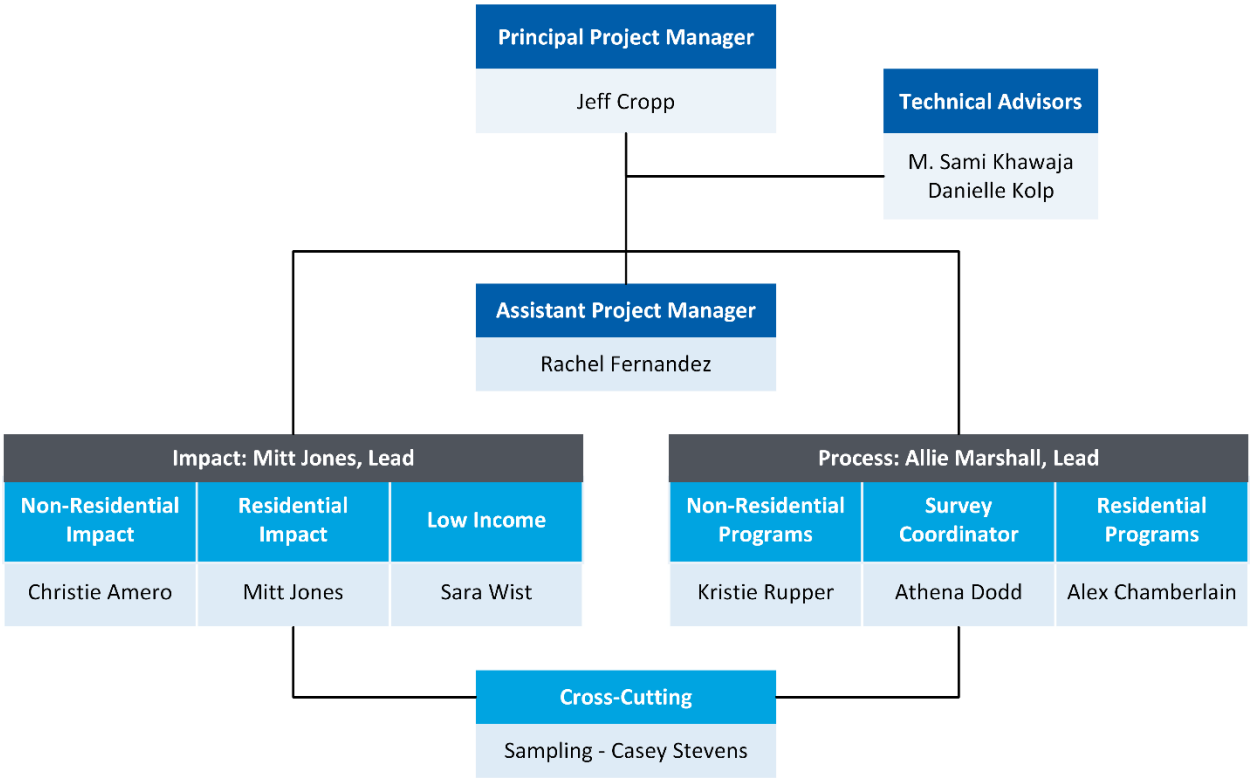
The following chapter summarizes the overall evaluation effort, followed by a chapter providing details of cross-cutting evaluation tasks (that is, general descriptions of the EM&V approaches applied as appropriate across individual programs). The remainder of this document addresses program-specific evaluation plans.

Evaluation Work Plan Overview

Evaluation Team

The Cadmus evaluation team is organized as shown in Figure 1.

Figure 1. Cadmus Evaluation Team Organizational Chart



Timeline and Deliverables

The overall timeline presented in Table 1 broadly depicts progress for each of the work tasks. The work plans for each program cluster include their own specific evaluation timelines. Deliverable reports associated with work tasks are specified in the *Communication and Reporting* section.

Table 1. 2018-2019 Task and Deliverable Schedule

Task	2018				2019				2020	
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2
Kickoff Meeting										
Work Plan										
Project Management										
Advisory Group Meetings, as needed										
Residential NTG/Verification Surveys										
Non-Residential NTG/Verification Surveys										
Non-Residential On-Site M&V and Analysis										
Residential Modeling and Billing Analysis										
Low Income Billing Analysis										
Cost-Effectiveness Analysis										
Document and Database Review										
Avista and Implementer Interviews										
Participant Surveys and Interviews (Process)										
Contractor Interviews										
Quarterly Reports										
Semiannual Reports										
Annual Reports										
Electric Impact Memos and Reports										
Natural Gas Impact Memos and Reports										
Process Memo and Report										

Communication and Reporting

Avista expects multiple communication and reporting activities to be performed as part of this evaluation effort.

Communication

Cadmus will design our project communications based on the following recommendations:

- The Avista DSM Planning and Analytics team should serve as the lead contact for all evaluation aspects (impact and process) and, for contract purposes, is the client. Amber Gifford of the DSM Planning and Analytics team will serve as the contract manager and primary contact for the Cadmus team.
- The Avista DSM Planning and Analytics team may work with the Cadmus team to facilitate incorporation of Avista's implementation team's input into the final product. Avista may encourage the implementation team to actively participate in the evaluations, seeking to deliver the best product possible, consistent with the evaluation's independent character.
- Avista would likely prefer to have a DSM Planning and Analytics team member present (in person, by phone, or copied on e-mails) during any interactions between the Cadmus team and Avista's DSM implementation team.

Cadmus expects to hold biweekly conference calls with the Avista DSM Planning and Analytics team. These calls will provide updates about the project's status and issues. *Ad hoc* calls may be required to

address specific project issues and activities. Cadmus anticipates attending and occasionally facilitating in-person, telephone, or web-based meetings in addition to regular and *ad hoc* project meetings and a final close-out meeting.

Throughout the evaluation process, Cadmus will remain highly engaged with Avista's regional stakeholders, participating as requested in DSM Advisory Group and Technical Committee meetings. We anticipate providing the following support to Avista through these meetings:

- Presenting evaluation plans
- Presenting interim or final results on energy savings, realization rates, and cost-effectiveness
- Acting as a technical resource to explain the details of evaluation methodology and the rationale behind the methods employed for Avista
- Exploring opportunities for new or expanded techniques to evaluate programs or inform program design

Reporting

The Cadmus team plans the following reporting activities:

- ***Monthly memos.*** Provided in conjunction with monthly invoices to the Avista contract manager, these reports will include the following:
  - Summary of accomplishments during the previous month
  - The current month's activities/plans, including any outstanding data requests
  - Variances in schedule and budget, including any necessary explanations
  - Any issues or concerns to be addressed (along with Cadmus-proposed solutions)
- **Ad hoc *reports*** will document problems, resolutions, and urgent issues, as they arise.
- ***Quarterly reports.*** Beginning in May 2018, these reports will document project status over the previous three months, progress toward completing milestones for each deliverable, percentage toward completion by deliverable and task, percentage of budget spent to date, preliminary findings, and any other relevant information.
- ***Semiannual reports.*** Beginning in September 2018, these reports will expand on the quarterly reports with a focus on preliminary estimates of energy savings results from the previous six months and cost-effectiveness by program.
- ***Annual reports.*** As specified in the RFP, annual reporting for this project will consist of the following Cadmus team deliverables:
  - 2018 program year electric impact evaluation memorandums for Washington by April 15, 2019, and for Idaho by April 30, 2019
  - 2018 program year DSM Annual Report and Cost Effectiveness Analysis for Washington by April 15, 2019, and for Idaho by April 30, 2019
  - 2018 program year natural gas impact evaluation memorandums for Washington and Idaho by May 15, 2019

- 2018 program year process evaluation statement of effort with notable observations and recommendations by June 1, 2019
- Combined 2018-2019 process evaluation report by April 15, 2020
- Combined 2018–2019 electric impact evaluation report for Washington by April 15, 2020, and for Idaho by April 30, 2020
- 2019 program year DSM Annual Report and Cost Effectiveness Analysis for Washington by April 15, 2020, and for Idaho by April 30, 2020
- 2019 program year natural gas impact evaluation reports for Washington and Idaho by May 15, 2020

For these annual reports, we will prepare a comprehensive outline and ask Avista for comments and approval. The final reports will describe our data collection and process methods, present the results of the analysis and summarize findings, draw conclusions, and recommend possible improvements. We will include data collection instruments used for the process evaluation as appendices to the final report.

Overview of Evaluation Methods

Cadmus will apply the methods described below to develop findings that will determine the impacts and cost-effectiveness of Avista's programs and guide the development of current and future programs.

Impact Evaluation Methods

Our analyses will use standard engineering approaches such as those defined by the International Performance Measurement and Verification Protocols (IPMVP) and the Uniform Methods Project (UMP). We will employ the following primary methods:

- Simple verification (phone, on-line, or on-site)
- Energy calculation models
- Metering (IPMVP A and B)
- Whole building billing analysis (IPMVP Option C)
- Simulation modeling (IPMVP Option D)

Table 2 summarizes the impact evaluation data collection and analysis activities by program. We will conduct the low-income and residential billing analyses in early 2020. We will conduct the online, phone, and on-site measurement and verification activities on a quarterly basis in both 2018 and 2019 to obtain a reasonable sample from each program year to provide early feedback to Avista.

Table 2. PY 2018–2019 Natural Gas and Electric Impact Evaluation Activities

Sector	Program	Database/ Document Review	Phone Verification	Site Visits	Metering	Billing Analysis	Modeling
Residential	Simple Steps, Smart Savings™	✓					
	HVAC	✓	✓			✓	
	Shell	✓	✓			✓	
	Fuel Efficiency	✓	✓			✓	
	ENERGY STAR Homes	✓	✓				✓
	MF Direct Install	✓				✓	
Nonresidential	Interior Lighting	✓	✓	✓	TBD		
	Exterior Lighting	✓	✓	✓			
	Shell	✓	✓	✓		TBD	
	Green Motors	✓	✓	✓			
	Motor Control (VFD)	✓	✓	✓	TBD	TBD	
	Fleet Heat	✓	✓	✓			
	Food Service Equip.	✓	✓	✓			
	AirGuardian	✓	✓	✓	TBD		
	MFMT	✓	✓	✓			
	Site-Specific	✓		✓	✓	✓	✓
	EnergySmart Grocer	✓	✓	✓	TBD		
Low-Income	Low-Income	✓				✓	

Simple Verification

Cadmus will verify some prescriptive measures (particularly those with relatively small reported savings) on site, by phone, or through an on-line questionnaire to confirm that measures are installed in the reported quantity and operating in a manner consistent with deemed-savings assumptions. We will also verify recorded nameplate efficiency data against manufacturer's specifications. We will accept the reported savings without further investigation if we can confirm that these details match the assumptions used for Regional Technical Forum (RTF) or Avista technical reference manual (TRM) unit energy savings. If we identify inconsistencies, we will adjust the savings based on the equipment and operating parameters found at the site.

Engineering Calculation Models

For some nonresidential site-specific measures, Avista uses spreadsheets to calculate the estimated energy savings for a variety of measures based on relevant inputs, such as quantity, fixture wattage, square footage, efficiency value, HVAC system details, and location details. For each spreadsheet, we will review input requirements and outputs to determine if the approach is reasonable. We will discuss any concerns about the approach with Avista's implementation team and explain why we think a different method may yield more accurate results. Where applicable, we will update calculations using on-site verification data, energy management system (EMS) trend data, spot measurements, and metering data.

Metering Analysis (IPMVP Options A and B)

To estimate the relevant operational parameters needed to inform engineering calculation models, Cadmus will perform any necessary data logging for a period of days, weeks, or months. During the site visits, we will confirm relevant information such as installation of the efficient equipment, set points, sequence of operations, operating schedules, and ambient conditions. We will also estimate the baseline energy performance, according to program documentation, on-site conditions, facility interviews, and relevant energy code requirements.

After downloading the meter data, we will clean it—checking key fields for missing data, correcting bad data, and removing sites with insufficient data. We will flag anomalies and send them to a senior engineer who will determine if the data should be used, corrected, or excluded from the analysis. Next, we will analyze the key variables in the metering data using spreadsheet tools or Python.[1] We will use the resulting information to calculate savings (as input variables in an engineering model) or for comparison to consumption estimates.

Whole Building Analysis (IPMVP Option C)

Residential billing analysis. For programs in the residential portfolio, Cadmus will perform billing analyses to develop the most accurate estimate of energy and demand savings. Where practical, we will

[1] More information about Python software is available online at: https://www.python.org/

rely on consumption data analysis, targeting a census of participants, which will maximize accuracy by preventing sampling bias.

We will perform billing analyses to quantify the electric- and gas-savings impacts associated with several of the residential programs. For each of these program, we will test several different regression models, including household-level Princeton Score-Keeping Method (PRISM)-like models (aligned with IPMVP Option C), as well as fixed effects panel models (discussed in UMP protocols). Running several different regression models is an effective way to test the robustness of the savings estimates.

We will tailor our billing analysis approach and research design to each program. When conducting experimental and quasi-experimental design of a billing analysis, a control or comparison group should be selected that accurately represents the counterfactual and accounts for the naturally occurring changes in consumption. For most programs, we propose constructing a ***comparison*** group of nonparticipants who are similar to participants, either selected from future program periods or through matching (using preprogram energy consumption, demographics, or home characteristics). In the latter case, we would use a propensity-scoring model to match nonparticipants to similar participants and to test the validity of the matches. In a randomized experiment, participants are put into test and ***control*** groups at the outset.

Nonresidential billing analysis. Cadmus can use monthly billing or interval data to conduct site-specific regression analyses for nonresidential retrofit projects, particularly in the site-specific and HVAC-related prescriptive programs (for example, HVAC and shell). This analysis method is particularly useful for accurately assessing the energy savings from comprehensive retrofit projects, especially those involving custom HVAC or controls measures.

Using the pre- and post-modeling approach, Cadmus will develop retrofit-savings estimates for the sampled sites, accounting for cooling degree days (CDDs) and heating degree days (HDDs). We will match the participant-consumption data to the nearest weather station by zip code. We will then calculate the building balance-point temperature by correlating monthly energy use with monthly average temperature.

Cadmus will use the balance-point temperature to calculate the CDDs and HDDs then match that to the monthly billing data. We will use the resulting regression estimates to extrapolate average energy savings based on normalized weather conditions. (For this calculation, we will use typical meteorological year, 15-year normal weather averages from 1991–2005, which we will obtain from the National Oceanic and Atmospheric Administration.)

For each project, Cadmus will model the average daily consumption in kilowatt hours (kWh) and/or therms as a function of base load, HDDs and CDDs, and, where appropriate, daily production. For the evaluated sites, we will estimate two demand models—one for the pre-period and one for the post-period. We typically choose this methodology over a single standard-treatment-effects model to account for structural changes in demand that can occur with retrofits, such as changes in occupancy or usage patterns. We will then estimate the annual consumption based these values.

Simulation Model Analysis (IPMVP Option D)

Residential simulation model analysis. For the ENERGY STAR® Homes program, Cadmus anticipates that Avista relies on simulation models developed through Simplified Energy Enthalpy Model (SEEM) or REM/Rate. Home Energy Rating System (HERS) raters should inspect each home during construction to create an energy analysis model to estimate the home's energy savings, as compared to the reference home. These models predict savings for homes in comparison to state energy code.

We will review the inputs to the simulation models for a sample of homes to make sure the homes adhere to program requirements. We will first compare program-tracking records against the HERS raters' home characterizations in the simulation models to verify participation and appropriate incentive levels. Then we will utilize simulation model-predicted savings to compute the gross program electricity and gas energy savings.

Nonresidential simulation model analysis. In past years, Avista's implementation team relied extensively on eQuest models to estimate energy savings for complex site-specific HVAC projects. Cadmus will review and verify the savings calculated from simulation models for a portion of the projects. Our simulation approach, which is based on *in situ* observations and measurements, is calibrated to the best available energy-use indices. It entails the use of well-developed, sophisticated building-simulation tools, such as DOE-2, and follows methods described in the U.S. Department of Energy M&V Guideline and ASHRAE Guideline 14.[2,3]

We will obtain the existing as-built and baseline models, utility billing data, and any available documentation for each simulated measure project in the sample. Step one will be to conduct a side-by-side comparison of the existing baseline and as-built models. Because different versions of the same software (mainly eQuest and EnergyPlus) can return conflicting results, we will open models only in the software-build version in which they were developed.

Our goal for the on-site visit will be to gather all data necessary to improve and calibrate the model. Using our on-site data collection form and following our facility operator interview guide, we will verify all necessary assumptions and obtain any available EMS data needed to further inform the calibration process.

Following the site visit, Cadmus will update the model with the verified values. We will input verified values and actual meteorological year (AMY) weather data for the appropriate location and time period into the model then test statistical calibration, comparing model results with utility and metered data. In accordance with ASHRAE Guideline 14, we will target a monthly accuracy within a mean bias error (MBE) of ±5% and a coefficient of variation root mean square error (CVRMSE) of ±15%. We will make logical improvements, based on engineering judgment where anomalies are identified. In our analysis, we will

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2 U.S. Department of Energy. *M&V Guidelines: Measurement and Verification for Performance-Based Contracts (Version 4.0).* Available online at: http://energy.gov/sites/prod/files/2016/01/f28/mv_guide_4_0.pdf

3 ASHRAE. *Measurement of Energy, Demand, and Water Savings.* Atlanta, GA. 2014.

account for fluctuations, such as those from initial building commissioning or first-year occupancy changes.

Once the adjusted as-built model has achieved the accuracy requirements, the remaining steps are fairly straightforward. We will replace the AMY data used for calibration purposes with typical meteorological year (TMY) data. To develop the baseline model, we will back out the conservation measures based on incentive documentation, changes between existing models documented during the initial comparison, and any measure stipulations, such as code requirements. Unless instructed otherwise by Avista, we will calculate measure savings in the same order and manner suggested by the existing models and documentation (that is, first measure in, last measure out, and so on). We will determine savings by comparing results from the calibrated typical year as-built and baseline models.

Rolling Net-to-Gross

One of the most challenging questions in DSM evaluation in general is the assessment of what would have happened absent the program (the counterfactual). This poses many challenges, chief among them determining what participants would have done had they not participated in the program. The most common approach is to determine the net-to-gross (NTG) values of a program or an offering within a program through a self-reporting approach. However, this approach is problematic in that it requires inquiry into a hypothetical situation.

In the Northwest, many have argued that it is best to use market practice (current practice) as the baseline and thus avoid the self-reporting issue altogether. This approach is not without merit but has created its own difficulties. In areas outside the Northwest, the EM&V process assumes the baseline to be the least expensive legal option. This produces a *gross* estimate of savings. Later in the process, this may be discounted for what people may have done on their own (for example, exceeded the least expensive legal option for some reason) through a self-reported NTG value. Although this market practice does have its problems, it has become the standard, and many industry standard EM&V protocols are constructed around its logical flow.

The Northwest has created its own challenge through the market baseline approach. Through previous work with Avista, Cadmus knows that for measures using unit energy savings (UES) from the RTF, no NTG adjustment is necessary. For measures with no RTF UES, we will estimate and apply a NTG ratio.

Given the differing needs and definitions of “net” within Avista’s territory, Cadmus suggests using a rolling NTG analysis. NTG analyses, which estimate the influence of program activities on the customer’s decision to participate, often are conducted at the end of a program cycle. The information provided may be of little use to program managers because much time has elapsed since the program ran, the delivery has changed sufficiently to make the findings not applicable, or the program is not offered anymore.

Another concern with traditional NTG analysis is that the customer is asked a hypothetical—that is, what the customer would have done absent the program—and often has difficulty recalling the decision if

significant time has elapsed. It stands to reason that, although the question continues to be difficult to answer, the closer in time it is asked to the actual decision, the easier it will be to answer accurately.

In large commercial and industrial (C&I) evaluations, other questions are often asked related to the decision—for example, what was already considered, was anything similar ever done in the past, was the work budgeted for, was it discussed with anyone else. All of these questions are better asked as close as possible in time to the actual decision, that is, soon after participation.

A rolling NTG study will deliver near real-time feedback regarding freeridership rates. Using quarterly participation information, we will survey participants for freeridership with a mix of on-site, web-based, and phone surveys to minimize potential bias and maximize response rate.

We will analyze data in real-time and deliver quarterly freeridership summaries to Avista. Collecting these data concurrent with program implementation activities not only increases the data accuracy (for example, reduced recall bias), it also closes the feedback loop between customers, program managers, and evaluators to allow program managers to react to findings during the program year.

Table 3 shows the proposed sample sizes for the residential and non-residential participant surveys. As discussed above, different timing and survey samples can maximize the efficiency and quality of responses. The 585 surveys that will determine freeridership and spillover will be spread out across quarters of calendar year 2018 and 2019 beginning with 2Q 2018..

Table 3. NTG Survey Sampling

Program	Surveys
Residential Programs	
HVAC	150
ENERGY STAR Homes (builder surveys)	6
Shell	150
Fuel Efficiency	75
Non-Residential Programs	
Prescriptive	129
Site-Specific	52
Energy Smart Grocer	23
Total	**585**

Freeriders are defined as participants who would have purchased and installed measures without the support of the program. Participant spillover indicates additional unrebated measures that customers have installed due to program influence, and nonparticipant spillover is defined as installed measures without program participation but still resulting from Avista influence. The equation to calculate NTG is as follows:

$$NTG = 100\% - Freeridership + Participant\ Spillover + Nonparticipant\ Spillover$$

Freeridership

Cadmus will determine freeridership through the participant online and phone survey using a participant self-report approach. Before we field our survey, we will submit it to Avista for review and refinement of the freeridership questions and scoring methodology. Using the survey results, we will calculate a freeridership rate and, where appropriate, apply it to evaluated savings to estimate net gas and electric impacts attributed to programmatic effects. The standard survey battery we use for determining freeridership includes these questions:

- Would the participant have installed the same measures without the program?
- Would the participant have installed products that were just as energy-efficient without the program?
- Would the participant have installed the same quantity of item?
- Would the participant have installed the item within the same year, within two years, within five years, or in more than five years?

Participant and Nonparticipant Spillover

Participant spillover will also be gathered through the customer surveys. Spillover measures must satisfy the following conditions to be counted:

- The measure could not have received a rebate from Avista or another entity.
- Respondents must indicate that Avista programs positively influenced their decision to install the measure.

As with our last evaluation in 2013, we will add any spillover that can be attributed to measures using RTF savings values to produce a true net savings value and not merely a "net of freeridership" value.

Calculating Cost-Effectiveness

Cadmus will calculate and report the program's cost-effectiveness using evaluated savings, avoided energy costs, and actual incurred implementation costs. We will use Portfolio ProPlus to provide cost-effectiveness assessments by portfolio, program, fuel type, year, measure, and state level.

We will determine the economic performance of a program from five standard perspectives—a combination of the utility and program participants, the utility, program participants, all ratepayers (including nonparticipants). Cadmus will evaluate these perspectives using five cost-effectiveness tests—total resource cost (TRC) test, utility cost test (UCT), participant cost test (PCT), rate impact measure (RIM) test, and Resource Valuation Test (RVT).

We will populate a database with Avista's utility data common to all programs (such as discount rates, avoided costs, load shapes, and retail rates) so that we can maintain a consistent approach to cost-effectiveness valuation across all programs and portfolios.

Process Evaluation Methods

We designed the process evaluation approach based on past evaluation findings, as well as on the draft and final 2018 electric and natural gas Washington and Idaho Annual Conservation Plans (ACPs)

For all programs, our research methods will consider these four fundamental objectives:

- Assess program delivery channel and marketing methods
- Assess participant and market actor program journey including barriers to participation, satisfaction, and effectiveness of incentive levels
- Assess Avista and implementer staff experiences including organizational structure, communication, and program processes
- Document areas of success, challenge, and changes to the program

To address these research objectives, we will conduct implementation and customer research. Our implementation research will include a document and database review for each program, in-depth interviews with key Avista and implementation staff and with participating contractors. Our customer research will include participant surveys and interviews for customers, as well as builder, retailer and manufacturer interview for relevant programs (Figure 2). We discuss each of these research areas and the associated tasks in more detail below.

Figure 2. Process Evaluation Research Areas and Tasks

Table 4 shows the research areas by program and year confirmed during the kick off on January 17, 2018.

Table 4. PY 2018–2019 Process Evaluation Activities

Program Name	Implementation Research		Customer Research	
	2018	2019	2018	2019
Residential Portfolio				
ENERGY STAR Homes		✓		✓
HVAC	✓		✓	✓
Shell	✓		✓	
Fuel Efficiency	✓		✓	✓
Simple Steps Smart Savings		✓		✓
Multifamily Market Transformation		✓		✓
Multifamily Direct Install (Pilot)	✓		✓	
Low Income Portfolio				
Low Income		✓		
Non-Residential Portfolio				
EnergySmart Grocer		✓		
Site-Specific	✓		✓	✓
Prescriptive*	✓		✓	✓

*Prescriptive: Lighting, HVAC, Shell, Variable Frequency Drive (VFD), Food Service Equipment, Green Motors, AirGuardian, and Fleet Heat.

The next sections describe the task methods for each research area.

Implementation Research

Cadmus will assess program processes and provide timely and actionable recommendations for continuous implementation improvement by reviewing the database and program documentation and conducting interviews with program staff and contractors. Our reviews of key program documents and corresponding databases will inform what data we collect to meet the research objectives.

We anticipate conducting interviews with critical program staff, such as these:

- DSM Analytical Manger
- Direct of Policy
- Manger of Energy Solutions
- DSM Marketing Communications Manager
- Utility Resources Analyst
- Low Income Program manger
- Residential Program Manager(s)
- Non-Residential Program Manager(s)

We will also interview key third-party implementers, such as CLEAResult, the Green Motors Practices Group (GMPG), and the Community Action Partner (CAP) agencies.

Finally, for programs in which contractors play a vital role, we will conduct contractor interviews. Because contractors may provide services for more than one program, we will work with Avista to determine the appropriate target audience within each sector, such as high impact contractors.

Table 5 lists the implementation research by program.

Table 5. Implementation Research by Program

Program	Implementation Research			
	Implementer Interviews	Avista Interviews	Contractor Interviews	Document & Database Review
Residential Programs				
ENERGY STAR Homes		✓		✓
HVAC		✓	✓	✓
Shell		✓		✓
Fuel Efficiency		✓		✓
Simple Steps Smart Savings	✓	✓		✓
Multifamily Market Transformation		✓		✓
Multifamily Direct Install (Pilot)	✓	✓		✓
Low Income Programs				
Low Income	✓	✓		✓
Nonresidential Programs				
EnergySmart Grocer	✓	✓	✓	✓
Site-Specific		✓	✓	✓
Prescriptive Lighting		✓	✓	✓
Prescriptive HVAC		✓	✓	✓
Prescriptive Shell		✓	✓	✓
Prescriptive VFD		✓	✓	✓
Food Service Equipment		✓	✓	✓
Green Motors	✓	✓	✓	✓
AirGuardian	✓	✓	✓	✓
Fleet Heat	✓	✓	✓	✓

The following sections describe each of the implementation research tasks. Program-level details are provided in the *We will conduct in-depth interviews* with one manufacture and up to three retailers participating in the Simple Steps program, up to ten builders participating in the Multifamily Market Transformation program, and up to 10 participants of the Multifamily Hard-to-Reach pilot.

Individual Program Process Evaluation Activities section of this work plan.

Document and Database Review

Cadmus will review program materials—such as operation manuals, program theory and objectives documents, marketing plans, logic models, and the program website, as well as program databases—to gain a thorough understanding of the processes and identify trends in measures, savings, and overall performance. In our database review, we will also assess the accuracy and quality of program tracking data and its adherence to Avista's program and regulatory policies and will explore any anomalies in evaluation results. We propose to review the database once per program, within the two-year

evaluation period, so Avista has time to incorporate recommendations before assessing the database again.

We also will review Avista's most recent process and impact evaluation results to learn how Avista has incorporated earlier recommendations and to identify trends in program performance. We will apply our findings from the program document and database reviews to refine program-specific research objectives and develop data-collection instruments.

Avista Staff and Third-Party Implementer Interviews

Avista and its third-party implementers hold critical insight into program administration and delivery processes. Telephone interviews with these key stakeholders will focus on these topics:

- Program roles and responsibilities
- Program goals and objectives
- Program design and implementation
- Data tracking
- Program participation
- Marketing and outreach
- Program successes
- Market barriers
- Program impact on the market
- Future program changes including redesign

During the interview, we will be conscientious of staff members' time. Because we know they sometimes oversee multiple programs, our interview guides will avoid repetitive questions for programs with similar processes, such as data tracking. For example, we may cover all programs overseen by one or more staff members in one interview. We anticipate conducting five Avista program manager interview sessions and an additional three interviews with Avista senior DSM managers.

We will build on our early findings from the program staff interviews to focus the interviews with third-party staff about areas of interest, such as how the CAP agencies address decreasing participation in the Low Income program or how CLEAResult continues to spur manufacturer and retailer participation in the Simple Steps Smart Savings program.

Contractor Interviews

For many customers, contractors are an important source of program awareness and their involvement, cooperation, and understanding can be an indicator of program success. Cadmus proposes to conduct in-depth interviews to gain insights into contractors' motivations, experience, marketing strategies, how contractors identify customers, their standard business practices, knowledge about customer perceptions and experience, and perspectives on program processes, the program's influence on business, and the opportunities for improvement.

The exact number of interviews will depend on the number and type of contractors and overlap in participation across programs; however, for this work plan we estimate conducting up to nine residential and up to 30 non-residential contractor interviews. As discussed during the kick-off meeting and confirmed on February 8, 2017, we will concentrate the residential contractor interviews on the HVAC program. For all contractor interviews, we will consult with Avista program managers and account

executives to identify target contactors, such as those with a high impact and who serve customers participating in specific programs, as well as to ensure that communication to program contractors is coordinated.

Customer Research

As shown in Table 6, Cadmus will conduct online participant surveys, as well as interviews with participants where smaller populations exist.[4]

Table 6. Customer Research by Program

Program	Customer Research	
	Participant Surveys	Participant Interviews
Residential Programs		
HVAC	✓	
Shell	✓	
Fuel Efficiency	✓	
Simple Steps Smart Savings (Manufactures and Retailers)		✓
Multifamily Market Transformation (Builders)		✓
Multifamily Direct Install (Pilot)		✓
Non-Residential Programs		
Site-Specific	✓	
Prescriptive*	✓	

*Prescriptive: Lighting, HVAC, Shell, VFD, Food Service Equipment, Green Motors, AirGuardian, and Fleet Heat.

Participant Online Surveys and Interviews

Cadmus will prepare survey and interview guides for participants in all of Avista's programs except the EnergySmart Grocer and ENERGY STAR Homes programs. Questions will focus on topics that can help Avista understand trends in measure adoption and overall program performance and that gather critical data to inform the impact evaluation.

[4] As discussed in the kick off meeting, we will not conduct customer research for the ENERGY STAR Homes or EnergySmart Grocer programs under this scope of work.

Our participant survey and interview guides will gather critical insights into participants' program journey, such as these aspects:

- Program awareness
- How respondents learned about the program
- General program participation
- Reasons for participation
- Program benefits
- Program delivery experience
- Overall program satisfaction
- Satisfaction with Avista
- Current energy-efficient behaviors and purchases
- Participant freeridership and spillover
- Suggestions for program improvements including testing pilot program concepts

For all process evaluations, we will use an online survey, which involves emailing a link to the survey to a random sample of participating customers for whom an email address is available. Because online surveys can be administered at low costs, we could consider emailing the survey to all participants.

We typically recommend simple random sampling when the population is sufficiently large but will finalize the sampling plan according to the target sample sizes and expected response rates and after receiving comprehensive participant tracking data. For programs with unique populations (Simple Steps, Multifamily Market Transformation, and Multifamily Hard-to-Reach) we will conduct participant (manufacturer, retailers, builders, and small pilot populations) telephone interviews to allow for a greater range of topic exploration. See Table 10. Participant Survey Sample Design for Washington and Idaho CombinedTable 10 in the *Sampling Plans* section for sampling details.

Our team will follow these three practices to manage and implement high-quality data collection:

- **Data-collection instruments that conform to best practices.** Our team is dedicated to the quality and rigor of primary research. Project managers will review questionnaires to ensure they are consistent with best practices (for example, do not use double-barreled questions and use appropriate scales) and, whenever possible, use consistent questions across programs to enable trend analysis. We will provide all instruments to Avista for review prior to launch and will provide a final copy of the instrument with the final report.
- **Online survey coordinator for streamlined and efficient data collection.** We will designate a single survey coordinator who manages all survey activities to ensure consistent data collection across all research efforts and who is the primary contact for online programming and survey administration for our team. The coordinator will review each survey instrument, oversee the secure exchange of data with Avista and/or survey vendor, monitor data-collection results on a daily basis, and report progress to Avista and our team.
- **Expert survey oversight and quality assurance.** Cadmus' survey research specialists will supervise every step of survey programming, testing, and data-collection process. We always check programming for errors before fielding the survey to ensure skip patterns work as intended and that responses show the appropriate understanding of the survey questions.

Natural Gas and Electric Impact Evaluations

Cadmus will apply best practices based on our previous experience with Avista's programs and other portfolio evaluations to evaluate the natural gas and electric impacts for the relevant programs.

Impact Sampling Plan

Our approach to developing impact evaluation sampling plans is consistent with the methods described in the UMP. Specifically, we will include these guidelines in our approach:

- **Determine confidence and precision requirements for key metrics.** Within each program, our team will use key metrics to support our gross and net energy estimates for each program. For programs with more complex or comprehensive offerings, we typically expect variation between customers to be larger than for programs with fewer variables or more streamlined installations. We will rely on our experience evaluating Avista's programs to estimate the homogeneity or heterogeneity of the population of participants. When possible, we will design a sample for each program so that we can estimate the overall portfolio energy savings with 90% confidence and ±10% precision.
- **Develop the sample design.** We will apply sample designs including simple random sampling, stratified sampling, and cluster sampling and will employ the method most appropriate to the program and the population of interest. The optimal design depends on the homogeneity or heterogeneity of the population of participants within each program as well as any targeted research we plan to perform (that is, if we are particularly interested in evaluating savings for a particular measure or collection of measures, we will stratify accordingly to ensure ample sample sizes from that population). We will sample large projects with certainty, when the expected savings among them is expected to differ substantially from the rest of the population.
- **Calculate sample sizes.** We will calculate sample sizes based on the confidence and precision requirements, expected variation, sample design, and population size for each program. Sample sizes will be sufficient to estimate gross and net savings for each program and the portfolio as a whole.

For most residential program energy savings (except Simple Steps, Smart Savings and ENERGY STAR Homes), we will not need to identify a sample because we will conduct a billing analysis on the whole program population. However, we will conduct a random sample of residential program participants on a quarterly basis to determine measure verification rates and conduct NTG surveys.

For non-residential programs, Cadmus proposes a stratified sample design, with strata defined based on fuel type (electric and natural gas) and project savings. Within each program and fuel type, we will identify large- or small-savings projects and conduct site visits with a census of the largest-saving projects and a simple random sample of the small projects.

We will determine sample sizes for each program and fuel type. We will use a combined sample for because Avista programs are substantially the same in Washington and Idaho. Data obtained during site

visits will inform calculation of realization rates used to estimate population savings for each program and fuel type. We will report these results and the corresponding state-specific program savings results.

We determined sample sizes according to the most recent evaluation results, actual participant and project population sizes, additional stratification variables, and/or alternative sampling approaches (for example, probability proportional to size), with portfolio-level target confidence of 90% and precision of 10%. If possible, we will apply a finite correction to sample sizes to decrease the sample sizes. Table 7 shows the sample design for Washington and Idaho combined.

Table 7. Sample Design for Verification Surveys and Site Visits for Washington and Idaho Combined

Sector/ Evaluation Activity	Program	Fuel Type	Confidence	Precision	Expected Population Size*	Sample Size
Residential/ Verification Surveys	HVAC	Electric	90%	10%	4,000	75
		Natural Gas	90%	10%	10,000	75
	Shell	Electric	90%	10%	100	75
		Natural Gas	90%	10%	2,000	75
	Fuel Efficiency	Electric	90%	10%	N/A	N/A
		Natural Gas	90%	10%	3,000	75
	ENERGY STAR Homes	Electric	90%	10%	44	N/A
		Natural Gas	90%	10%	40	
Total Residential Verification Surveys			**90%**	**10%**		**428**
Non-Residential/Site Visits	Site-Specific	Electric	90%	20%	300	23
		Natural Gas	90%	20%	110	20
	EnergySmart Grocer	Electric	90%	20%	100	23
	Prescriptive Lighting	Electric	90%	20%	689	29
	Green Motors	Electric	90%	20%	20	10
	AirGuardian	Electric	90%	20%	20	10
	Fleet Heat	Electric	90%	20%	6	6
	Prescriptive VFD	Electric	90%	20%	18	12
	Prescriptive HVAC	Natural Gas	90%	20%	79	18
	Prescriptive Shell	Electric	90%	20%	49	11
		Natural Gas	90%	20%	54	13
	Food Service Equipment	Electric	90%	20%	52	10
		Natural Gas	90%	20%	68	10
Total Nonresidential Site Visits/Verification Surveys			**90%**	**10%**		**190**

*Population size is our best estimate of the number of residential program participants and nonresidential programs projects. We will update these and adjust sample sizes, based on 2018–2019 Avista program data across both states.

As in the previous evaluations we have conducted for Avista, we do not believe site visits are necessary for residential participants and plan to use surveys to confirm verification of program records and savings. We will field the survey quarterly (discussed in greater detail in the *Rolling Net-to-Gross*

section), and the sample sizes will cover both program years. The state and fuel mix will be random for each program and proportional to the mix of gas and electric rebates for Washington and Idaho.

Impact Evaluation Activities by Program

Cadmus will conduct the verification activities in four waves and provide interim results on program progress to Avista after each semiannual wave. The four waves will occur in summer 2018, January 2019, summer 2019, and January 2020. The site visits and phone surveys will collect baseline data, operations data, and other information that inform the energy savings analyses.

The following sections describe each Avista program and the proposed impact evaluation activities.

Low Income Program

A group of seven CAP agencies delivers energy efficiency programs to low-income communities. With annual funding of $2,000,000, these CAP agencies qualify low-income customers, generate referrals through energy assistance efforts, and make funding resources available to meet customers' home energy needs.

As in the previous evaluation cycles, Cadmus will assess the energy savings of Avista's Low Income program using statistical billing analyses, which is industry best practice for estimating the impacts associated with whole-building programs, as noted in the UMP. In our experience, smaller program populations pose challenges in the analysis of billing data that could demonstrate more robust results given larger sample sizes. We will also develop fixed effects conditional-savings regression models, with paired pre- and post-participation months as needed, to estimate actual changes in energy consumption in participating homes from energy efficiency and behavioral improvements. We will populate the model using detailed installation data collected through the program tracking system for a census of available program participants.

Cadmus will also estimate home-specific performance by running multiple regression models similar to PRISM. If these models do not produce similar results, as we expect, we will use additional diagnostics to detect anomalies.

ENERGY STAR Homes Program

The ENERGY STAR Homes program offers 15% to 25% savings relative to state energy code requirements. The program relies on the partnership of Avista and other member utilities of the Northwest Energy Efficiency Alliance (NEAA) to develop and implement the program and train contractors to provide third-party verification of qualifying stick-built and manufactured homes. NEAA administers the program, and Avista pays the rebate for homes that successfully achieve the designation of ENERGY STAR Home or ENERY STAR/ECO-Rated Manufactured Home.[5]

[5] Cadmus understands that ENERY STAR Homes with electric heating built in Washington will not be eligible for rebate in 2018.

As noted in the *Impact Evaluation Methods* section, Cadmus will review program records and simulation model inputs for a sample of homes, which we estimate at 46. We will first compare program-tracking records against the HERS raters' home characterizations in the simulation models to verify participation and appropriate incentive levels. We will then use simulation model-predicted savings to compute the gross program electricity and gas energy savings. We will apply average program savings by HERS level to the program population to estimate overall program savings.

We will calculate the NTG ratio for Idaho through participant builder surveys to gather information about participant builder practices when not incented by the program (that is, building practices used for non-program homes represent the baseline for that particular builder). This contrasts with most other programs, which will rely on participant surveys to determine the NTG ratio. We will attempt to understand the extent to which participant builders construct homes outside the ENERGY STAR Homes program different than inside it. If we learn that participating builders construct homes above the baseline for nonparticipating homes, the NTG for those builders will be based on the difference in energy consumption between a non-program home and a program home. If non-program homes were built to the same standards as the simulation model baseline home, net savings would be equal to gross savings. We will weight results up to the population based on the number of homes built in Avista service territory by each builder contacted.

Residential HVAC Program

The Residential HVAC program encourages residential customers to choose high-efficiency home energy upgrade solutions. Avista offers incentives for such upgrades through the prescriptive rebates, which are paid to the customer after installation. Vendors' use of the rebate as a sales tool generates participants. The program is advertised through utility websites, vendor training sessions, and customer presentations at retail events.

Cadmus will conduct 70 document reviews to assess the quality of HVAC program tracking data (noting missing, duplicate, and out-of-range values) and will verify that values of key metrics are within expected limits. We will also review Avista's reported gross *ex ante* savings estimates and assumptions, particularly for increasingly significant equipment such as air source heat pump measures, and benchmark these against similar programs in the Northwest.

We will determine verified net savings using a billing analysis of participant and comparison groups where practical. If obtaining a comparison group for one or more of the measures or measure groups in the HVAC program groups proves infeasible, because of the difficulty of identifying a sufficient nonparticipating population using the same baseline equipment, we will estimate gross savings with the billing analysis for those measures and apply a separate NTG based on data from online surveys.

Residential Shell Program

Avista's Residential Shell program offers prescriptive rebates to encourage residential customers to improve the energy efficiency of their homes' shell by upgrading windows and storm windows. The

program is advertised through utility websites, vendor training sessions, and customer presentations at retail events.

As with the Residential HVAC program, Cadmus will conduct 70 document reviews to assess the quality of program tracking data. We will also review Avista's reported gross *ex ante* savings estimates and assumptions about per-home consumption and benchmark these against similar programs in the Northwest.

We will determine verified net savings using a billing analysis of participant and nonparticipant groups. We will estimate savings for each participant using two modeling approaches—monthly fixed effects panel modeling and customer-specific regression—and summarize the results by measure.

Residential Fuel Efficiency Program

The Residential Fuel Efficiency program encourages customers to convert their electric space and water heater to natural gas. Although natural gas is an efficient fuel choice with decreasing prices over the years, the cost of infrastructure continues to increase for the utility and the customer. However, for the 2018–2019 biennium, conversions to natural gas water heaters will no longer have a stand-alone rebate; Avista now combines the rebate for water heaters with conversions to natural gas furnaces.

Cadmus will assess the quality of program tracking data and review Avista's reported gross *ex ante* savings estimates and assumptions. We will use the most recent data from the Northwest Energy Efficiency Alliance (NEEA) Residential Building Stock Assessment (RBSA) to analyze the saturation of the water heater fuel type in the territory and update the allocation of energy savings to electric and natural gas accordingly. Cadmus recently completed site visits for the RBSA and is compiling the data for regional stakeholders. We will work with Avista to determine the most appropriate programs to which we can apply this new regional residential data and benchmark these against similar programs in the Northwest.

We will determine verified net savings using a billing analysis of participant and nonparticipant groups. We will estimate savings for each participant using two modeling approaches—monthly fixed-effects panel modeling and customer-specific regression—and will summarize results by measure type. We will also perform a gas billing analysis to better estimate the increase in the gas usage from fuel conversion.

Simple Steps, Smart Savings

Simple Steps, Smart savings, a collaborative program between Avista and Bonneville Power Administration, is designed to increase adoption of energy-efficient residential products, partly through influencing retail stocking practices and consumer purchasing. Residential customers are encouraged to purchase and install high-quality LEDs, light fixtures, and energy-efficient showerheads

For the Simple Steps, Smart Savings program, Cadmus will calculate *ex post* savings using RTF UES and primary data gathered by Avista's vendors regarding units sold.[6] Savings calculated using RTF UES can be considered net savings values because the RTF uses a market average baseline, which effectively accounts for freeridership. We will determine appropriate spillover values using primary or secondary research as necessary.

For any lighting measures without RTF UES, Cadmus will calculate savings using an annual savings algorithm with these variables—lamp wattage, delta watt multiplier, hours of use, days-per-year, waste heat factor, and in-service rate—and apply RTF assumptions where practical. This algorithm is derived from industry-standard engineering practices and is consistent with the methodology used by the RTF for calculating energy use and savings for residential lighting.

Multi-Family Hard to Reach Pilot

Cadmus will conduct document reviews on the census of projects installed through the pilot program through May 1, 2018. We will assess the quality of program tracking data (noting missing, duplicate, and out-of-range values) and will verify that values of key metrics are within expected limits. We will verify measure installation through an on-line survey with building managers and tenants, to the extent that contact information is available.

Cadmus will then compare the *ex post* measure savings for each project against the most recent 12 months of energy consumption to confirm the magnitude of savings is reasonable. We will request the most granular consumption data associated with each building. In the best case scenario, that would represent separate utility accounts for the multifamily common spaces and each individual living unit. In many cases, we anticipate one combined account for common spaces and living spaces.

We will aggregate the *ex post* energy savings associated with the appropriate level of billing data (e.g., full building, individual living areas), based on the granularity of information provided by the direct install vendor. We will calculate the portion of consumption that the direct install measures are expected to offset. We will then benchmark the portion of consumption expected as savings against similar measures and expected savings for other regional utilities, based on resources such as impact evaluations and resource potential studies.

We will provide Avista with *ex post* savings values by measure, along with our assessment of the reasonableness of the deemed savings assumptions relative to building energy consumption. We will also calculate the pilot program's cost-effectiveness.

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[6] Cadmus has noted that the Avista TRM provided during the RFP process stated that matching lumens ranges for measures in the Simple Steps, Smart Savings program were not found in the RTF measures. Based on the lumens ranges in the Avista 2018 DSM Annual Conservation Plan and version 5.2 of the RTF ResLighting workbook, it appears RTF lumens values will match Simple Steps, Smart Savings values and that RTF UES values will be available.

Non-Residential Site-Specific Program

The Non-Residential Site-Specific program is a core element of Avista's C&I portfolio because it brings in the largest portion of savings. The program provides flexible opportunities to achieve energy savings for measures that do not fit a prescriptive path. In the past, these projects have included compressed air, custom lighting, process improvement, and complex HVAC measures, among others. The Multifamily Market Transformation projects are also included within this program.

Cadmus will calculate participants' gross reductions in electricity and natural gas consumption using data collected through on-site visits, customer billing histories (as needed), and engineering models and calculations.

We will conduct site visits to all the largest projects (typically defined as greater than 500,000 kWh or 30,000 therms in expected savings) and a sample of smaller projects. The number of site visits will depend on actual enrollment and sample-size calculations, based on expected variability and the desired confidence and precision of evaluated savings. During the site visits, we will verify measure installations, collect baseline and equipment data, and identify addressable enrollment or installation issues. We will also examine new or emerging technologies that have been given incentives through the program because the newness of such measures may lead to more issues with installation or operation.

We will analyze gross program impacts using data collected from site visits and from tracking data. We will verify reported *ex ante* savings by recalculating energy savings using Excel spreadsheet analysis tools, site-specific data, and standard engineering analysis methods. Data may include savings calculations, manufacturers' specification sheets, and commissioning reports. We may also conduct regression analyses, as needed for measures whose savings impact cannot readily be evaluated through other means (for example, a comprehensive HVAC controls measure). Information collected during our site visits will determine if the sample projects reasonably address the measure's operating parameters and accurately reflect operating conditions.

Because we will not inspect all participant sites, we need a mechanism to extrapolate the difference between reported and evaluated to the population. To resolve this, we will apply a correction factor based on the realization rates to reported savings to calculate evaluated *ex post* gross savings. We will document the reasons and impacts on savings of all adjustments and will review these with Avista's implementation team during a presentation before committing results to the draft reports.

Non-Residential Prescriptive Programs

Avista implements these eight prescriptive programs that provide incentives directly to customers for a variety of measures supported by RTF UES or Avista's TRM:

- AirGuardian
- Fleet Heat
- Food Service
- HVAC
- Prescriptive Lighting
- Prescriptive Shell
- Prescriptive Variable Frequency Drive (VFD)

- Green Motors

Cadmus will first work with Avista to prioritize and review prescriptive measures in the TRM. We will identify those measures that have the most variance based on previous impact evaluation results. These measures may benefit from primary data collection and analysis during the 2018–2019 impact evaluation. This review requires in-depth knowledge and understanding about the specifics of each measure to ensure that the baseline and savings calculations reflected the best possible *ex ante* values for the region. Cadmus and Avista engineers will coordinate to ensure consistency in inputs and calculations and to ensure that the TRM uses the most up-to-date sources for Avista's engineering calculations. Additionally, our knowledge and understanding of federal minimum codes and standards will augment our review. Ultimately, we will provide recommendations for examined measures, including references, algorithms, and inputs.

Cadmus will design a sample for verification activities to include all prescriptive programs, with primary emphasis on those that contribute the most savings or represent the highest level of uncertainty. Although we anticipate that most participants will have installed lighting, our desk reviews, phone interviews, and site inspections will include lighting and non-lighting projects. Our sample will represent both distributions, and we will apply sampling weights accordingly as part of the correction factor.

We will conduct on-site inspections during the initial round of impact data collection to confirm Avista's quality-assurance processes have been maintained. This is particularly relevant for any new programs or those with updated program processes. If in these initial site visits, we find a high correlation between the reported and evaluated results, we will likely use less intrusive data collection methods, such as desk reviews and phone interviews with participants.

We will review project documents, verify assumptions, adjust reported calculations, and compute evaluated savings using Excel spreadsheet analysis tools or by approving installation rates for RTF measures with well-defined UES. We will derive baseline data from on-site visits, customer interviews, and Avista's program data. We will calculate evaluated savings using site visit data and standard engineering analysis practices. We will also calculate a realization rate based on sampled sites and will apply this rate to the project population to estimate program total evaluated savings.

As with the site-specific program, we will document all reasons and impacts on savings for adjustments and will review these with Avista's implementation team during a presentation before committing the results to the draft reports.

Non-Residential EnergySmart Grocer

The EnergySmart Grocer program is designed to provide customers with a comprehensive overview of their refrigeration systems and the savings that can be achieved by increasing the energy efficiency of their cases and grocery equipment. Through the program, customers are encouraged to increase energy efficiency through direct financial incentives. As a benefit, customers receive a no-cost audit of their facility's refrigeration, a detailed savings report, and technical assistance.

Like the non-residential prescriptive programs and others described above, Cadmus will review project documents, verify assumptions, adjust *ex ante* calculations, and compute *ex post* evaluated. We will collect baseline data and calculate *ex post* savings and realization rate. As with the site-specific program, we will document all reasons and impacts on savings of adjustments and review these with Avista's implementation team before committing results to the draft reports.

Real-Time Evaluation and Measurement

Cadmus will coordinate with Avista's implementation team to identify projects with both relatively large expected energy savings and relatively high uncertainty (for example, demand-controlled ventilation, multi-stage compressed air retrofit). In comparison, projects such as a large lighting retrofit may not require real-time EM&V because the savings should be relatively certain if the operating hours are well-characterized. Once Avista identifies the most likely projects for real-time EM&V, we will coordinate with implementation engineers and/or contractors to track project installation progress and estimate the completion date.

We will develop a site-specific M&V plan for each project. Our metering engineer will be prepared to travel to the site to install meters during a time frame estimated by Avista's implementation team. Upon meter removal, we will follow our standard analysis procedures for metered data. We will summarize our methodology and results for further discussion with Avista before finalizing the energy savings.

M&V for Advanced Metering Infrastructure (AMI)

Where relevant, Cadmus will conduct measurement and verification for projects with advanced metering infrastructure (AMI) data. This section describes our general approach for this type of analysis. We assume that electricity interval consumption data will be available for the pre-treatment, or *baseline*, and treatment, or *reporting,* periods.

The approach to calculating energy savings starts with building a predictive statistical model using baseline data, which includes baseline weather conditions and facility operating conditions as explanatory variables in the model. By applying the baseline model to the explanatory data measured during the reporting period, the model outputs represent the expected energy usage during the reporting period that would have occurred without the influence of the energy-saving measures. Therefore, subtracting the observed energy usage and predicted energy usage at each point in time results in the evaluated energy savings (adjusted for reporting period weather and facility operations).

Our proposed method has several advantages over other approaches:

- The method allows for ***flexible modeling*** of each facility's energy consumption. Because we conduct a separate analysis for each facility, it is possible to select a set of variables that are specific to that facility.
- Baseline models are ***uncontaminated*** by project treatment effects. Because the model is fit with baseline period data, the parameters of the adjusted baseline consumption reflect only baseline period operation.

- The model-building process is ***objective***. Because we rely on automated machine-learning to select the model variables, we can identify relevant variables affecting a facility's consumption from a larger set of candidate variables based on pre-determined criteria, which reduces time and the possibility for idiosyncratic analyst choice in building a model.
- The proposed approach is ***versatile, scalable, and cost-effective***. Much of the estimation can be automated and applied to a variety of commercial building types and samples with large numbers of facilities.

AMI M&V Analysis Details

Our proposed analysis approach has four main steps, which are described in the next sections—data collection and pre-processing, modeling, savings estimation, and reporting.

Data Collection and Pre-Processing

Cadmus will collect the following data for the evaluation:

- Interval data of facility energy consumption
- Project implementation data including installation dates, project description, and *ex ante* savings estimate
- Building systems data from the facility's energy management system (if available)
- Interval weather data from nearest weather station

Cadmus will then conduct a quality review of the raw data. This process involves a visual inspection by a domain expert and automated checks for max and min values, consumption per square footage, rates of change, completeness of the data, etc. Once the validity of the data is established, we will define the facility's baseline and reporting periods from documentation about the project implementation.

Modeling

Cadmus will develop models using these steps:

- **Identify candidate model inputs**. Cadmus will begin by plotting energy usage against all explanatory variables and identify trends. Trends identified from visual inspection will be linear, non-linear, or periodic; they will require evaluation in the context of Cadmus' physical understanding of the systems involved and experience modeling similar facilities. We will also consider derived variables, such as day of week or degree days, and will assess correlations of these inputs and interactive effects between variables.
- **Select model type**. Cadmus has applied a range of modeling techniques and methods and understands that the performance of an algorithm can depend on the dataset it is attempting to fit. Our approach is to select a class of models based on a specific use case and test various model types within that class for performance (that is, predictive accuracy, minimization of prediction error, minimal data requirements, etc.). Table 8 summarizes the collection of models we have used.

Table 8. Model Selection

Model Class	Model Type	Use Case
Linear	Single and multiple linear, ridge, Lasso regression	Low temporal resolution usage data, known physical relationships, observed linear trends
Time Series	Autoregressive integrated moving average (ARIMA), error term models, transfer functions	High temporal periodicity and seasonality, predicting future response
Bayesian	Decision trees, random forests, neural networks	Non-linear relationships, complex systems, large amounts of data

Model validation and testing. Cadmus will create a set of candidate models based on prior experience and understanding of energy-savings projects. We will rigorously evaluate these models against the facility-specific data, with the objective of choosing the best model in the energy-savings calculations. We will apply graphical analysis of the relationship between energy usage and possible explanatory variables as a starting point in selecting best model. We will then use evaluation of existing seasonality or temporal changes in selecting model types. In this initial step, we will consider using the model that is the simplest, has the fewest explanatory variables, and can be interpreted based on good engineering judgment.

To select a set of candidate models, Cadmus will test model prediction ability using a procedure that minimizes selection bias. We begin by randomly splitting the baseline period data into training and testing sets, giving us two datasets of independent variables and measured energy consumption. Models are fit to the training data, applied to the test data, and scored on bias, model fit, and prediction accuracy metrics, such as the mean prediction error, relative root mean-squared error of prediction, mean absolute percentage error of prediction, and the median and other percentiles of prediction errors, r-square, and Akaike information criterion (AIC).

Randomly splitting the data does introduce bias and to fully understand a model we repeat this process for each model a large number of times. These simulations build distributions of test statistics for each model that inform the selection of a final model.

Furthermore, we will identify patterns in the prediction errors by plotting or regressing the errors against variables such as hour of the day and day of the week. Also, we will investigate the evolution of errors over weeks and months to determine if there are prolonged trends that require further investigation.

Once a final model has been selected, Cadmus will fit that model to the entire set of baseline data. In the model validation and testing phase, we may find that several models provide relatively good fit and predictions. In this case, we will calculate energy savings using several models and provide the results to Avista. For any given model that is chosen during the validation and testing phase, we will calculate the uncertainty in energy savings obtained using the entire dataset.

Additionally, Cadmus expects that a variety of factors could confound the savings analysis. For example, a facility may undertake energy efficiency projects that are not funded through Avista during the reporting period. If these other projects are unaccounted for, it is likely that the estimate of electricity savings will be biased upward. Table 9 lists possible confounding factors and the strategies for addressing them.

Table 9. Potential Confounding Variables

Confounding Variable	Problem	Solution Strategy
Other energy efficiency projects	Unaccounted savings from other energy efficiency projects during the reporting period may bias the savings estimate.	Develop an engineering estimate of savings for the other project(s) and subtract validated savings estimates from Cadmus' regression-based estimate.
Floor space additions or changes in use of facility space	These changes can bias the savings estimates.	Cadmus will review project documentation and available energy management system data to identify significant changes. Cadmus may make engineering-based adjustments to the savings estimates or model energy intensity instead of consumption.

Savings Estimation

After developing a model, estimating savings is straightforward. Cadmus will fit the model to the baseline data and apply it to the conditions present during the reporting period, generating facility consumption at each interval, and subtract these estimates from the actual measured consumption. To calculate "typical year" savings, Cadmus fits a baseline model and a reporting period model, applies each of these models to TMY3 data, and takes the difference in the estimated energy consumption. Savings are provided on a per-site basis in each of these cases.

Conduct Process Evaluation Tasks and Reporting

In this section, Cadmus describes its program-specific research plan to assess Avista's administrative processes and delivery of DSM programs in Washington and Idaho and identify areas for improvements.

Sampling Plans

Cadmus will calculate sample sizes for each program and fuel type and based on participant and project population sizes, expected variation, and confidence and precision targets. We will select one combined sample for electric service because Avista programs are the same in Washington and Idaho. For this work plan, we have described the sample design and estimated sample sizes but can revise them according to actual participant and project population sizes if program data indicate these factors could improve the accuracy or precision of the sample.

In Table 10, we provide the finite survey sample sizes for each program and fuel type, determined based on target 90% confidence and 15% precision for each program and to far exceed 90% confidence and 10% precision for the portfolio overall with error ratios of 0.5 within program and fuel type. We will apply a finite population correction to the sample sizes to decrease the number of survey completes if possible.

Table 10. Participant Survey Sample Design for Washington and Idaho Combined

Program	Fuel Type	Estimated Population Size*	Survey Completes
HVAC	Electric	4,000	30
	Natural Gas	10,000	30
Shell	Electric	100	24
	Natural Gas	2,000	30
Fuel Efficiency	Natural Gas	3,000	30
Residential Total		**~19,100**	**144**
Site-Specific	Electric	300	28
	Natural Gas	110	24
Prescriptive Lighting	Electric	689	29
Prescriptive HVAC	Natural Gas	79	22
Prescriptive Shell	Electric	49	19
	Natural Gas	54	20
Prescriptive VFD	Electric	18	12
Food Service Equipment	Electric	52	20
	Natural Gas	68	21
Green Motors	Electric	20	10
AirGuardian	Electric	20	10
Fleet Heat	Electric	6	6
Non-Residential Total		**~1,465**	**247**
Portfolio Total		**~20,565**	**391**

* Population size is the number of residential program participants and non-residential program projects. Note EnergySmart Grocer are not included as surveys for these programs are not part of this scope of work.

We will conduct in-depth interviews with one manufacture and up to three retailers participating in the Simple Steps program, up to ten builders participating in the Multifamily Market Transformation program, and up to 10 participants of the Multifamily Hard-to-Reach pilot.

Individual Program Process Evaluation Activities

This section describes the process evaluation activities by program. Although many of the process research activities are similar, such as reviewing program documents and tracking database to assess roles and responsibilities, marketing and outreach, participation trends, and informing subsequent interview and survey questions, the descriptions below note more program-specific focus areas.

Low Income Program Evaluation

The process evaluation of the Low Income program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to assess how Avista and the CAP agencies conduct marketing and outreach focusing on how they strive to increase participation in hard-to-reach areas and data-tracking transparency.
- **Interview Avista staff** about coordination with and support of the CAPs overall and more specifically about measures selection including those that are not approved or on the State Priority Rebate List.
- **Interview (n=5) CAP agencies** to document their understanding of the program, including implementation challenges that lead to underspending, how CAP agencies allocate health and safety funding to help cover gas measures that are not cost-effective (that is, benefit-cost ratios are under 1.0 for the TRC or UCT).

ENERGY STAR Homes Program

The process evaluation of the ENERGY STAR Homes program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to assess marketing and outreach efforts and participation trends.
- **Interview Avista staff** to document regional communication and coordination with NEEA and other partnering utilities that offer contractor training and third-party verification of qualifying projects, explore future iterations for the program such as Build it Green (currently offered in areas in WA and being expanded to additional areas) and the DOE's Zero Ready Home program, or other residential new construction certification or labeling programs.

Residential HVAC Program

The process evaluation of the HVAC program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to assess participation trends, such as continuing trend of natural gas furnaces to provide a significant portion of gas savings.

- **Interview Avista staff** to discuss and document the inclusion of the energy-use component of program eligibility. Examine vendor training, rebate changes, and how visiting retailers and making presentations builds market awareness.
- **Interview participating contractors (n=9)**to assess program understanding, experience, and satisfaction, how contractors identify customers, use of rebates as a sales factor, customer awareness of the program prior to engaging the contractor, standard business practices, influence of the program on business, and of qualifying equipment offered.
- **Survey participating customers** to explore their experience, including application processing and influence of the contractor, continued levels of satisfaction, and marketing preferences.

Residential Shell Program

The process evaluation of the Residential Shell program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to document tactics used to drive the customer to the website, rebate changes, and contractor engagement strategies.
- **Interview Avista staff** to discuss and document the energy-usage component of program eligibility. Examine vendor training, rebate changes, and how visiting retailers and making presentations builds market awareness.
- **Survey participating customers** to explore customer experience, including application processing and influence of contractor, satisfaction, and marketing preferences.

Residential Fuel Efficiency Program

The process evaluation of the Fuel Efficiency program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to identify changes in eligibility requirements, rebate changes, and contractor support documentation.
- **Interview Avista staff** to confirm status of program in WA, document success and challenges of such items as confirming electric resistance heating and/or water heating for eligibility, no longer offering a stand-alone rebate for the conversion to a natural gas water heater, as well as other rebate changes. Examine vendor training, the role of retail location visits and presentations, and other efforts to build market awareness.
- **Survey participating customers** to explore awareness of fuel switching as an energy efficiency opportunity, motivation to participate, application processing, influence of contractor, satisfaction, and marketing preferences.

Simple Steps, Smart Savings

The process evaluation of the Simple Steps, Smart Savings program's design, delivery, and performance will include the following data collection activities:

- **Review program documents and database** to assess the roles and responsibilities of the implementer, manufacturer, retailer, and coordination with Bonneville Power Administration.
- **Interview Avista staff** to document the impact of rebate changes, engagement with internal stakeholders facilitating the implementation contract, and engagement with external stakeholders such as homeowners, landlords (renters), retailers, and contractor to increase participation.
- **Interview Implementer** to document program understanding, including coordination of program marketing, outreach to retailers, product tracking, development of measure costs and savings, and overall program experience, including satisfaction and suggestions for improvement.
- **Interview participating manufacturers** to document program understanding, participant motivation and experience, perceived impact of program on the market, and suggestions for improvement.
- **Interview participating retailers** to document program understanding, participant motivation and experience, including point-of-purchase marketing, impact of program on customer uptake of eligible products, and suggestions for improvement.

Multifamily Market Transformation

The process evaluation of the Multifamily Market Transformation program's design, delivery, and performance will include the following data collection activities:

- **Interview Avista staff** to document program design and delivery, roles and responsibilities confirm status of program in WA, identify program changes (delivery, rebates, etc.), and areas of success and challenges.
- **Interview Implementer** to document program understanding, including coordination of program marketing, outreach to retailers, product tracking, development of measure costs and savings, and overall program experience, including satisfaction and suggestions for improvement.
- **Interview participating builders (n=10)** to document their understanding of the program, experience including program influence on business practices, satisfaction, and suggestions for improvement

Multifamily Direct Install (Pilot)

The process evaluation of the Multifamily Direct Install pilot's design, delivery, and performance will include the following data collection activities:

- **Review program documents and database** to document the overarching topics described for all programs at the beginning of this process evaluation section including program processes, marketing efforts, and data tracking.
- **Interview Avista and implementer staff** to document pilot design including goal setting, delivery process, customer eligibility, incentive structure, and data tracking, as well as roles and responsibilities, areas of success, challenge, and if the pilot will transform into a full program.
- **Interview participating customers** to explore customer experience, including pilot awareness, satisfaction, energy efficiency actions, barriers to energy efficiency programs, and marketing preferences.

Non-Residential Site-Specific Program

The process evaluation of affect the Site-Specific program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to assess clarity of roles and responsibilities including technical assistance, marketing and outreach (for example, multifamily), data-tracking transparency, and participation trends, including types of measures installed.
- **Interview Avista staff**, including account executives, to document program changes; areas of success; and challenges, such as the effectiveness of the Avista website to communicate program requirements, incentives, and rebate forms, engagement of the multifamily sector (new construction of five or more units), and how potential changes in rebate levels may affect the program as a critical driver of portfolio savings.
- **Interview participating contractors** to document standard business practices, program influence, identification of customers, timing of projects, and impact of potential change in rebate levels. For lighting specific contactors, we will also assess their awareness of higher efficient lighting to inform new marking approach to target the replacement of T12 lamps.
- **Survey participating customers** to explore customer experience, such as if the program successfully addresses the split-incentive challenge and encourages adoption of energy-efficient equipment and behaviors, satisfaction with contractors and key program components such as incentive levels and technical assistance, and marketing preferences.

Non-Residential EnergySmart Grocer Program

The process evaluation of the EnergySmart Grocer program's design, delivery, and performance will include the following data-collection activities:

- **Review program documents and database** to document the overarching topics described for all programs at the beginning of this process evaluation section including program processes, marketing efforts, and data tracking.

- **Interview Avista staff**, including account executives, to document program changes; areas of success; and challenges, such as coordination with implementer and contractors, and data tracking and reporting, such as the monthly analysis of program measures.
- **Interview Implementer** to document coordination of field energy analyst, use of Grocer Smart modeling, marketing and outreach, contractor support, project tracking and processing, and overall program experience, including satisfaction and suggestions for improvement.
- **Interview participating contractors** to document program understanding, experience, and satisfaction. Examine standard business practices, as well as the program influence on business, identification of customers, and suggestions for improvement.

Non-Residential Prescriptive Programs

For the purposes of this plan, and for efficiencies of scale, Cadmus suggests combining these non-residential programs under the term "prescriptive": Lighting, HVAC, Shell, VFD, Food Service Equipment, Green Motors, AirGuardian, and Fleet Heat. We plan to conduct the same process tasks for all programs with the addition of interviews for the three programs with third-party implementers. The process evaluation will include the following data-collection activities for each program:

- **Review program documents and database** as described for all of the programs at the beginning of this process evaluation section. We will examine program documents to assess the clarity of roles and responsibilities, including overlap between programs, identify marketing and outreach efforts, and review the database for data tracking transparency and participation trends.
- **Interview Avista staff,** including account executives, to document program eligibility, vendor training, efforts to build program specific and across program market awareness, rebate changes, and implementer and contractor communication and coordination.
- **Interview participating contractors** to document program understanding, experience, and satisfaction, including program communication. We will assess how contractors identify customers, use of rebate as a sales factor, level of customer program awareness prior to engaging the contractor, standard business practices, and program influence on business.
- **Survey participating customers** to explore experience with eligibility, application processing, communications with implementers and/or contractors (as appropriate), satisfaction, and marketing preferences.
- **Interview implementers** to document program understanding, roles and responsibilities, experience, satisfaction, and suggestions for improvement.
  - GreenMotors: Green Motor Program Group
  - AirGuardian: Sight Energy Group LLC

Budget and Level of Effort

Table 11 outlines the budget by major deliverable for EM&V of Avista's 2018–2019 DSM portfolio, with a not-to-exceed amount of $971,762.

Table 11. Budget for 2018-2019 DSM Portfolio Evaluation

Deliverables	Total Budget
Kickoff and Work Plan	$35,755
Impact Evaluations	$443,914
Process Evaluation	$188,463
Annual Reports with Cost-Effectiveness	$70,590
Meetings and Interim Reporting	$67,710
Project Management	$127,940
Multi-Family Direct Install Pilot	$37,390
Total	**$971,762**

Cadmus developed the budget with the following assumptions. Material changes or circumstances that result in a departure from these conditions may result in delays or additional costs to the project:

- This pricing assumes one round of client review and revision for every deliverable. To help ensure that the project schedule is maintained, we ask that Avista provide any comments on deliverables within 10 business days.
- This work plan describes Cadmus' data needs to support Avista's 2018–2019 DSM Programs. Our budget assumed that data requests from Avista will be fulfilled within a reasonable time and will require no more cleaning than is reasonable and customary for the industry. If we encounter unexpected issues with the data received (for example, if the data requires extensive cleaning or reformatting or research to complete missing data components) that will affect our ability to evaluate program impacts, this could cause additional effort not accounted for in the work plan. Cadmus will work with the appropriate department at Avista to identify these issues early in the evaluation process to avoid unnecessary delays or obstacles to the work plan.
- The pricing for data collection is based on target quotas for surveys and interviews, estimated by Cadmus to maximize this effort, and summarized in this proposal. However, we are glad to work with Avista to adjust the targets as needed to reduce project costs or better achieve evaluation objectives.

Table 12 provides an estimate of hours and portion of budget associated with the various tasks and preparation required for each deliverable.

Table 12. Cadmus Expected Level of Effort by Task

Task	Expected Hours	Portion of Total Hours
Kickoff Meeting	78	1%
Work Plan	109	2%
Project Management	646	11%
Advisory Group Meetings, as needed	84	1%
Residential NTG/Verification Surveys	143	2%
Non-residential NTG/Verification Surveys	141	2%
Non-residential On-Site M&V and Analysis	1,833	32%
Residential Modeling and Billing Analysis	479	8%
Low Income Billing Analysis	100	2%
Cost-Effectiveness Analysis	260	5%
Database Review	56	1%
Interviews and Material Review	156	3%
Process Surveys	107	2%
Customer Research Analysis	123	2%
Program Implementation Process Review	180	3%
Quarterly Reports	100	2%
Semiannual Reports	151	3%
Annual Reports	130	2%
Electric Impact Reports	411	7%
Natural Gas Impact Reports	206	4%
Process Memo and Report	231	4%