Avista Utilities

Summary of Idaho Demand-Side Management Energy Savings and Levelized Costs

January 1, 2010 through December 31, 2012

	Regular income portfolio		Limited income portfolio	
	MWh savings	Therm savings	MWh savings	Therm savings
Electric DSM programs	108,503	(288,030)	597	(7,781)
Gas DSM programs	973	918,042	0	32,780
Total	109,476	630,012	598	24,999

	Total portfolio	
	MWh savings	Therm savings
Electric DSM programs	109,100	(295,811)
Gas DSM programs	974	950,822
Total	110,074	655,011

Note: Electric savings derived from gas DSM programs include the impact of electric to natural gas conversions as well as interactive savings resulting from natural gas DSM projects. Therm savings derived from electric DSM projects recognize interactive impacts of electric DSM measures.

DSM Program Portfolio Levelized Cost Calculations

Electric DSM Program Portfolio		Natural Gas DSM Program Portfolio	
Total Resource Cost (TRC)	$ 32,976,939	Total Resource Cost (TRC)	$ 11,824,492
Weighted average measure life	12.56	Weighted average measure life	21.17
Discount rate	6.80%	Discount rate	6.80%
MWh energy savings	109,100	Therms energy savings	950,822
TRC levelized cost	$ 36.551	TRC levelized cost	$ 1.125
Program Administrator Cost (PAC)	$ 18,016,365	Program Administrator Cost (PAC)	$ 5,551,544
Weighted average measure life	12.56	Weighted average measure life	21.17
Discount rate	6.80%	Discount rate	6.80%
MWh energy savings	109,100	Therms energy savings	950,822
PACT levelized cost	$ 19.969	PACT levelized cost	$ 0.528

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Avista Utilities

Summary of Idaho Electric Demand-Side Management Cost-Effectiveness

January 1, 2010 through December 31, 2012

Line	TOTAL RESOURCE COST TEST	Regular income portfolio	Limited income portfolio	Overall portfolio
5	Electric program electric avoided cost	$ 61,139,419	$ 598,200	$ 61,737,619
6	Electric program natural gas avoided cost	$ (1,316,541)	$ (46,908)	$ (1,363,449)
7	Electric program non-energy benefits	$ 2,306,200	$ 208,423	$ 2,514,623
8	TOTAL TRC BENEFITS	$ 62,129,078	$ 759,715	$ 62,888,793
10	Electric program non-incentive utility cost	$ 5,509,020	$ 124,784	$ 5,633,804
11	Electric program customer cost	$ 26,363,799	$ 979,336	$ 27,343,135
12	TOTAL TRC COSTS	$ 31,872,819	$ 1,104,120	$ 32,976,939
14	NET TRC BENEFITS	$ 30,256,259	$ (344,405)	$ 29,911,854
15	TRC BENEFIT / COST RATIO	1.95	0.69	1.91

Line	OGRAM ADMINISTRATOR COST TEST	Regular income portfolio	Limited income portfolio	Overall portfolio
19	Electric program electric avoided cost	$ 61,139,419	$ 598,200	$ 61,737,619
20	Electric program natural gas avoided cost	$ (1,316,541)	$ (46,908)	$ (1,363,449)
21	TOTAL PAC BENEFITS	$ 59,822,878	$ 551,292	$ 60,374,170
23	Electric program non-incentive utility cost	$ 5,509,020	$ 124,784	$ 5,633,804
24	Electric program incentive cost	$ 11,443,812	$ 938,749	$ 12,382,561
25	TOTAL PAC COSTS	$ 16,952,832	$ 1,063,533	$ 18,016,365
27	NET PAC BENEFITS	$ 42,870,046	$ (512,241)	$ 42,357,805
28	PAC BENEFIT / COST RATIO	3.53	0.52	3.35

Line	PARTICIPANT TEST	Regular income portfolio	Limited income portfolio	Overall portfolio
32	Electric program electric bill reduction	$ 37,077,169	$ 543,949	$ 37,621,118
33	Electric program gas bill reduction	$ 170,470	$ (68,731)	$ 101,739
34	Non-energy benefits	$ 2,306,200	$ 208,423	$ 2,514,623
35	TOTAL PARTICIPANT BENEFITS	$ 39,553,839	$ 683,641	$ 40,237,480
37	Customer project cost	$ 26,363,799	$ 979,336	$ 27,343,135
38	Electric program incentive cost	$ (11,443,812)	$ (938,749)	$ (12,382,561)
39	TOTAL PARTICIPANT COSTS	$ 14,919,987	$ 40,587	$ 14,960,574
41	NET PARTICIPANT BENEFITS	$ 24,633,852	$ 643,054	$ 25,276,906
42	PARTICIPANT BENEFIT / COST RATIO	2.65	N/A	2.69

Line	NON-PARTICIPANT TEST	Regular income portfolio	Limited income portfolio	Overall portfolio
45	Electric program electric avoided cost	$ 61,139,419	$ 598,200	$ 61,737,619
46	TOTAL NON-PARTICIPANT BENEFITS	$ 61,139,419	$ 598,200	$ 61,737,619
48	Electric program lost electric revenue PV	$ 37,247,639	$ 475,218	$ 37,722,857
49	Electric program non-incentive utility cost	$ 5,509,020	$ 124,784	$ 5,633,804
50	Electric program incentive cost	$ 11,443,812	$ 938,749	$ 12,382,561
51	TOTAL NON-PARTICIPANT COSTS	$ 54,200,471	$ 1,538,751	$ 55,739,222
53	NET NON-PARTICIPANT BENEFITS	$ 6,938,948	$ (940,551)	$ 5,998,397
54	I-PARTICIPANT BENEFIT / COST RATIO	1.13	0.39	1.11

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Avista Utilities

Summary of Idaho Natural Gas Demand-Side Management Cost-Effectiveness

January 1, 2010 through December 31, 2012

Line	**TOTAL RESOURCE COST TEST**	Regular income portfolio	Limited income portfolio	Overall portfolio
6	Gas program natural gas avoided cost	$ 16,792,478	$ 307,917	$ 17,100,395
7	Gas program electric avoided cost	$ 1,381,089	$ 810	$ 1,381,899
8	Gas program non-energy benefits	$ 119,766	$ 187,445	$ 307,211
9	TOTAL TRC BENEFITS	$ 18,293,333	$ 496,172	$ 18,789,505
10				
11	Gas program non-incentive utility cost	$ 1,561,763	$ 149,609	$ 1,711,372
12	Gas program customer cost	$ 9,362,409	$ 750,711	$ 10,113,120
13	TOTAL TRC COSTS	$ 10,924,172	$ 900,320	$ 11,824,492
14				
15	NET TRC BENEFITS	$ 7,369,161	$ (404,148)	$ 6,965,013
16	TRC BENEFIT / COST RATIO	1.67	0.55	1.59
17				
18	**PROGRAM ADMINISTRATOR COST TEST**	Regular income portfolio	Limited income portfolio	Overall portfolio
19				
20	Gas program gas avoided cost	$ 16,792,478	$ 307,917	$ 17,100,395
21	Gas program electric avoided cost	$ 1,381,089	$ 810	$ 1,381,899
22	TOTAL PAC BENEFITS	$ 18,173,567	$ 308,727	$ 18,482,294
23				
24	Gas program non-incentive utility cost	$ 1,561,763	$ 149,609	$ 1,711,372
25	Gas program incentive cost	$ 3,153,925	$ 686,247	$ 3,840,172
26	TOTAL PAC COSTS	$ 4,715,688	$ 835,856	$ 5,551,544
27				
28	NET PAC BENEFITS	$ 13,457,879	$ (527,129)	$ 12,930,750
29	PAC BENEFIT / COST RATIO	3.85	0.37	3.33
30	**PARTICIPANT TEST**	Regular income portfolio	Limited income portfolio	Overall portfolio
31				
32	Gas program gas bill reduction	$ 8,386,091	$ 294,999	$ 8,681,090
33	Gas program electric bill reduction	$ 1,426,754	$ 156	$ 1,426,910
34	Non-energy benefits	$ 119,766	$ 187,445	$ 307,211
35	TOTAL PARTICIPANT BENEFITS	$ 9,932,611	$ 482,600	$ 10,415,211
36				
37	Customer project cost	$ 9,362,409	$ 750,711	$ 10,113,120
38	Gas program incentive cost	$ (3,153,925)	$ (686,247)	$ (3,840,172)
39	TOTAL PARTICIPANT COSTS	$ 6,208,484	$ 64,464	$ 6,272,948
40				
41	NET PARTICIPANT BENEFITS	$ 3,724,127	$ 418,136	$ 4,142,263
42	PARTICIPANT BENEFIT / COST RATIO	1.60	n/a	1.66
43				
44	**NON-PARTICIPANT TEST**	Regular income portfolio	Limited income portfolio	Overall portfolio
45				
46	Gas program natural gas avoided cost	$ 16,792,478	$ 307,917	$ 17,100,395
47	TOTAL NON-PARTICIPANT BENEFITS	$ 16,792,478	$ 307,917	$ 17,100,395
48				
49	Gas program lost gas revenue PV	$ 9,812,845	$ 295,155	$ 10,108,000
50	Gas program non-incentive utility cost	$ 1,561,763	$ 149,609	$ 1,711,372
51	Gas program incentive cost	$ 3,153,925	$ 686,247	$ 3,840,172
52	TOTAL NON-PARTICIPANT COSTS	$ 14,528,533	$ 1,131,011	$ 15,659,544
53				
54	NET NON-PARTICIPANT BENEFITS	$ 2,263,945	$ (823,094)	$ 1,440,851
	NON-PARTICIPANT BENEFIT / COST RATIO	1.16	0.27	1.09

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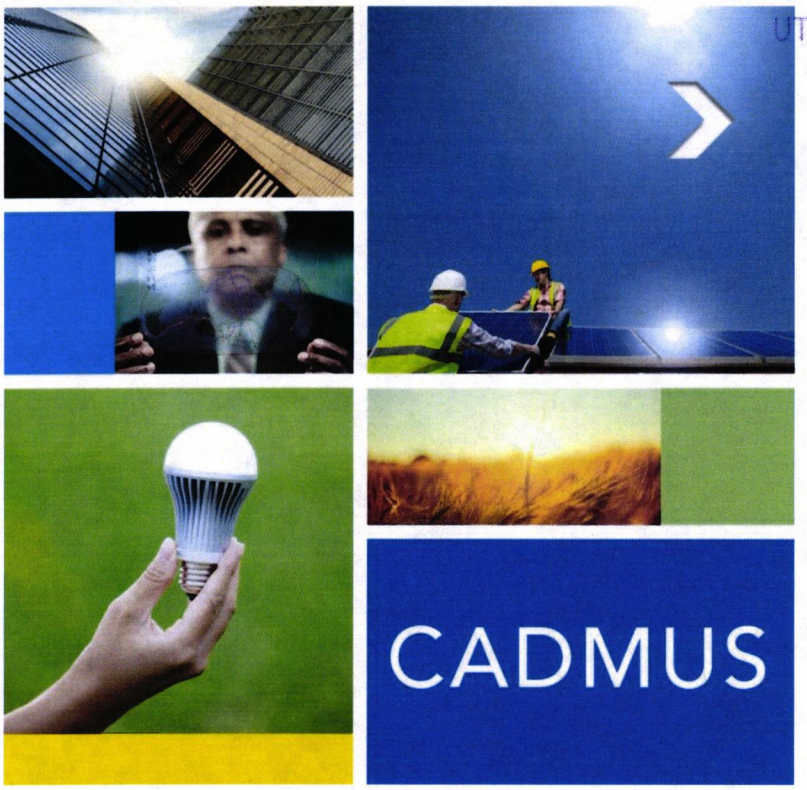

FINAL REPORT

AVISTA 2012 IDAHO ELECTRIC IMPACT EVALUATION REPORT

August 30, 2013

Avista Corporation
1411 E Mission Ave
Spokane, WA 99220

The Cadmus Group, Inc.

An Employee-Owned Company • www.cadmusgroup.com

CADMUS

Prepared by:
Danielle Côté-Schiff Kolp, MESM
Andrew Wood
Jeff Cropp, P.E.
Scott Reeves
M. Sami Khawaja, Ph.D.
Cadmus

CADMUS

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DEFINITIONS

Reported Savings – Electricity savings that are reported in Avista's tracking database.

Gross Evaluated Savings – Electricity savings that have been verified through evaluation activities such as records review, verification surveys or site visits, and engineering analysis.

Realization Rate – The ratio of gross evaluated savings over the reported savings.

Net Evaluated Savings – Net savings signify the portion of savings directly attributable to the program; savings that would have otherwise not occurred without program influence.

Net-to-Gross – The ratio of net evaluated savings to gross evaluated savings.

Savings Goal – The Integrated Resource Planning (IRP) savings goal.

Achievement Rate – The ratio of the net evaluated savings over the savings goal.

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CADMUS

PORTFOLIO EXECUTIVE SUMMARY

For several decades, Avista Corporation has been administering DSM programs to reduce electricity and natural gas energy use for its portfolio of customers. Most of these programs have been implemented in-house, but a few utilize external implementers. Avista performed a potential study for ID in 2011 to determine the savings goals for 2012 and 2013. Avista contracted with Cadmus to complete process and impact evaluations of the company's 2012 electric demand-side management (DSM) programs. Cadmus completed a combined 2010-2011 electric report for both Washington and Idaho. This report presents our impact findings for the PY 2012 electric portfolio for Idaho.

Evaluation Activities

We conducted the evaluation using a variety of methods and activities, as shown in Table 1.

Table 1. 2012 Electric Programs Evaluation Activities

Sector	Program	Document/ Database Review	Metering	Verification Site Visit	Survey	Billing Analysis	Modeling
Residential	Simple Steps, Smart Savings™	✓					
	Second Refrigerator and Freezer Recycling	✓			✓		
	ENERGY STAR® Products	✓			✓		
	Heating and Cooling Efficiency	✓			✓		
	Weatherization/Shell	✓			✓		
	Water Heater Efficiency	✓			✓		
	ENERGY STAR Homes	✓					
	Space and Water Conversions	✓			✓		
Nonresidential	Prescriptive Programs	✓	✓	✓			
	Site-Specific	✓	✓	✓		✓	✓
	EnergySmart Grocer	✓	✓	✓			
Low Income	Low Income Programs	✓			✓	✓	
Residential/ Nonresidential	CFL Contingency	✓			✓		✓

Savings Results

Overall, the Idaho portfolio achieved a 98.7% realization rate, and acquired 37,483,952 kWh in annual gross savings (Table 2).

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Table 2. 2012 Reported and Gross Evaluated Savings for Idaho

Sector	Reported Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate
Residential*	13,627,696	14,098,435	103.5%
Nonresidential*	24,093,322	23,104,034	95.9%
Low Income	274,913	281,483	102.4%
Total	**37,995,931**	**37,483,952**	**98.7%**

*Including compact fluorescent lamp (CFL) Contingency savings.

Table 3 shows evaluated gross and resulting net savings for Idaho's 2012 DSM programs.

Table 3. 2012 Idaho Net Savings

Sector	Gross Evaluated Savings (kWh)	NTG	Net Evaluated Savings (kWh)
Residential*	14,098,435	93%	13,107,862
Nonresidential*	23,104,034	79%	18,250,606
Low Income	281,483	100%	281,483
Total	**37,483,952**	**84%**	**31,639,951**

*Including CFL Contingency savings

Table 4 shows net evaluated savings, as compared to the Integrated Resource Plan (IRP) goal of 17,115,000 kWh. The IRP states its goal as a portfolio-level target; so, for purposes of sector-level comparison, Cadmus adopted the Avista Business Plan goals by sector, and applied those proportions to the IRP target. The 2012 program year achieved 184.9% of the IRP target in Idaho with 31,639,951 kWh. Even excluding the CFL Contingency savings, Idaho still surpassed the IRP goal, at 111.9% with 19,151,861 kWh.

Table 4. 2012 Reported and Gross Evaluated Savings for Idaho

Sector	Savings Goal (kWh)	Net Achieved (kWh)	Achievement Rate
Residential	7,495,108	13,107,862	174.9%
Nonresidential	8,423,000	18,250,606	216.7%
Low Income	1,196,892	281,483	23.5%
Total	**17,115,000**	**31,639,951**	**184.9%**

Key Findings and Conclusions

Residential

- For PY2012, residential electric programs produced 13,107,862 kWh in net savings, yielding a 103.5% overall realization rate. Residential electric savings achieved 174.9% of IRP goals.
- Overall, residential electric customers responded well to the programs, often installing several measures within the same year.
- Tracking databases proved adequate for evaluation purposes, providing sufficient contact information, and measure and savings information. The database review confirmed the information was reliable and accurate.

- All rebated measures had been installed and continued to operate. With one exception, all measures reviewed met the program qualification standards.

Nonresidential

- In general, Cadmus determined that Avista implemented the programs well. The overall nonresidential electric portfolio achieved a 95.9% realization rate, upon comparing gross evaluated savings to gross reported savings, and achieved 216.7% of the IRP goal.
- Power metering on one industrial process measure indicated lower-than-expected post-installation power consumption, which increased energy savings.
- Light logging on three projects identified a slight decrease in operating hours from the reported values.
- Cadmus applied algorithms different from those used by Portland Energy Conservation, Inc. (PECI) to determine energy savings for electrically commutated motors (ECMs). This resulted in a slight decrease in energy savings.
- One project installed PC Network Controls in 2009, but did not provide the final data that demonstrated a reduction in consumption until 2012. Avista paid the incentive in 2012, but the participant reported deactivating the system soon after.

Low Income

- Avista's low income electric programs produced 281,483 kWh in savings, yielding an overall 102.4% realization rate. Low income electric savings achieved 23.5% of IRP goals.

Recommendations and Further Analysis

Residential

Based on the evaluation results, Cadmus offers the following recommendations for Avista:

- List energy factors (or, at least, model numbers) for appliances. Including more information about the actual efficiency of equipment installed would allow greater accuracy in estimating gross energy savings.
- If possible, include existing equipment information.
- If the ENERGY STAR Clothes Washer measure is reinstated, consider moving all rebates to the electric program.

The following research recommendations draw upon this impact evaluation's results and from known future changes to program requirements:

- Perform a targeted billing analysis on weatherization participants using both electricity and gas to heat their homes.

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- Perform a billing analysis on ENERGY STAR homes using a nonparticipant comparison group once enough homes have participated under the new requirements to justify conducting the work.

Nonresidential

Cadmus recommends that Avista continue to offer incentives for measure installation through the evaluated programs. Based on the results from the Idaho projects, the following recommendation focuses on improving program energy savings impacts and evaluation effectiveness:

- Work with participants to accelerate the process of claiming energy savings and paying the project incentive. This preferably should occur within one year of measure installation, depending on Avista's requirements for post-installation data on the particular project.

Low Income

The impact evaluation revealed several areas where program performance and savings accuracy could be improved. Consequently, Cadmus recommends Avista consider the following:

- Include a comparison group in future billing analyses.
- Work with Idaho agencies to provide refrigerator replacements.
- Consider targeting high-use customers.
- Track and compile additional data from agency audits.
- Consider analyzing easy-to-quantify, non-energy benefits, which could be added to program cost-effectiveness reporting.

1. RESIDENTIAL ELECTRIC IMPACT REPORT

1.1 Introduction

During the 2012 program year, Avista's residential electric demand-side management (DSM) programs in Idaho reported unverified savings of 5,073,009 kWh for 436,837 measures. The 2012 DSM residential electric programs included:

- Simple Steps, Smart Savings™
- Second Refrigerator and Freezer Recycling
- ENERGY STAR© Products
- ENERGY STAR Homes
- Heating and Cooling Efficiency
- Water Heating
- Weatherization Measures
- Space and Water Conversions

This report explains the methods used to qualify and verify these savings.

1.1.1 Evaluation Methodology

Using the following methods, Cadmus designed the impact evaluation to verify tracked program participation and energy savings:

- Data collected in the tracking database;
- Online application forms;
- Phone surveys; and
- Applicable deemed values developed for Avista's technical reference manual (TRM).[1]

As shown in Table 5, Cadmus employed up to two evaluation methods and activities for each program.

[1] In 2011's first quarter, Cadmus created a TRM for use in performing deemed measure savings calculations, and updated it where necessary for the 2012 program year. The TRM first looks to the RTF.

Table 5. Evaluation Methodology

Program	Document/Database Review	Survey
Simple Steps, Smart Savings™	✓	
Second Refrigerator and Freezer Recycling	✓	✓
ENERGY STAR Products	✓	✓
Heating and Cooling Efficiency	✓	✓
Weatherization/Shell	✓	✓
Water Heater Efficiency	✓	✓
ENERGY STAR Homes	✓	
Space and Water Conversions	✓	✓

1.1.2 Energy Savings

Table 6 shows aggregated evaluated gross savings and resulting realization rates by program.

Table 6. Reported and Evaluated Gross Savings

Program Name	Reported Savings (kWh)	Evaluated Gross (kWh)	Realization Rate
Simple Steps, Smart Savings™	3,330,478	3,914,480	117.5%
Second Refrigerator and Freezer Recycling	268,752	350,968	130.6%
ENERGY STAR Products	380,897	193,963	50.9%
Heating and Cooling Efficiency	676,843	671,428	99.2%
Weatherization/Shell	37,675	37,373	99.2%
Water Heater Efficiency	8,933	8,861	99.2%
ENERGY STAR Homes	24,698	24,698	100.0%
Space and Water Conversions	344,734	341,977	99.2%
Total	**5,073,009**	**5,543,748**	**109.3%**

Cadmus evaluated gross savings of 5,543,748 kWh through the installation of 436,837 measures during PY 2012. Table 7 shows reported measure counts. Overall, residential electric programs achieved an adjusted 109.3% gross realization rate.

Table 7. Avista 2012 DSM Programs Reported Measure Counts in Idaho

Program	Measure Count
Simple Steps, Smart Savings™	433,777
Second Refrigerator and Freezer Recycling	327
ENERGY STAR Products	1,791
Heating and Cooling Efficiency	769
Weatherization/Shell	49
Water Heater Efficiency	75
ENERGY STAR Homes	11
Space and Water Conversions	38
Total	**436,837**

1.2 Methodology

1.2.1 Sampling

Cadmus randomly sampled program participants to complete verification surveys, and another, separate random sample of participant applications for documentation review. Where possible, sampling was designed to utilize similarities between programs and states to decrease necessary sample sizes, while maintaining sufficient confidence and precision. The following subsections describe methods used to select the required samples.

Record Review Sampling

To determine the percentage of measures incented that qualified for the Avista's programs, Cadmus designed sample sizes to achieve 90% confidence and ±10% precision levels for each application type, across both states and fuels served by Avista's programs. Cadmus randomly selected individual participant measures for a record qualification review from the 2012 gas and electric program populations. However, if a customer applied for multiple rebates on the same application form during the program year, the record review checked all measures included in the application for qualification, whether for electric or gas.

Table 8 shows the number of record reviews completed for unique accounts and unique measures.

Table 8. Measure Level Record Review Completes

Record Review Type	Number Completed
Total Participants Reviewed	217
Total Measures Reviewed	260

Survey Sampling

For program-level survey results, Cadmus designed participant survey sample sizes to achieve 90% confidence and ±10% precision levels for each program. The participant survey sampling plan drew upon the following multiple factors:

- The feasibility of reaching customers;
- The program participant population; and
- Research topics of interest.

Fuel types did not factor into survey sampling.

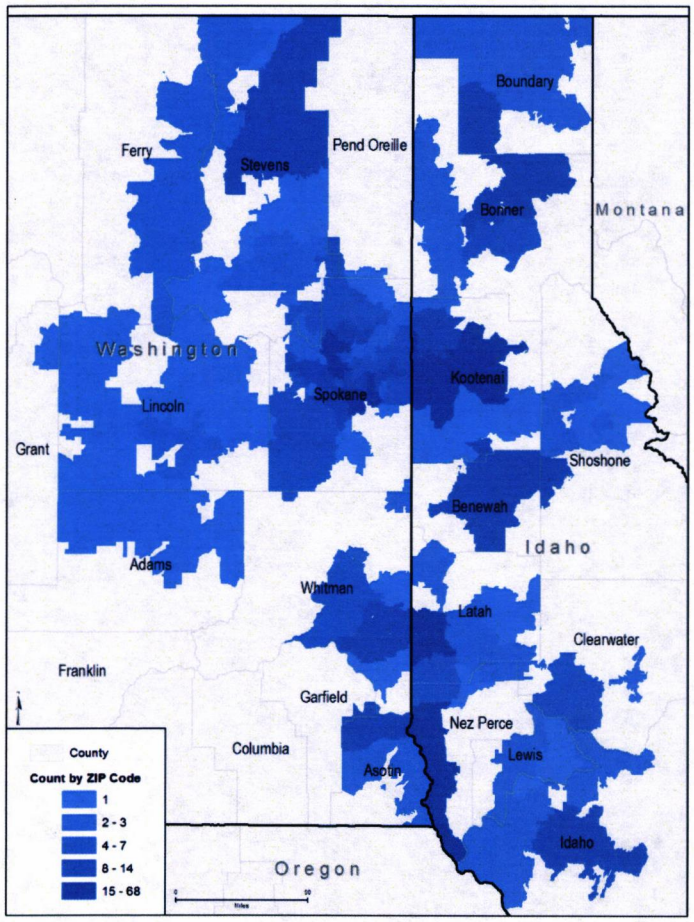
Cadmus did not survey home buyers for the ENERGY STAR New Homes program as home builders received the rebates. Surveys for the Simple Steps program could not be conducted as it is an upstream program without participant records. The evaluation completed 274 surveys with Idaho participants. Table 9 shows the number of surveys achieved and the resulting absolute precision for each program. The absolute precision achieved did not always meet the ±10% goal (due to low program participation), but falls safely within the portfolio precision goal of 90/10.

Table 9. Participant Survey Sample Sizes and Savings-Weighted Precision Estimates by Program

Programs	Population (N)	Proposed (n)	n/N	Completes	Absolute Precision at 90% Confidence
Space and Water Conversions	38	30	78.9%	11	±20%
Water Heating	127	50	39.4%	26	±13%
ENERGY STAR Products	2,323	70	3.0%	73	±9 %
Heating and Cooling Efficiency	1,806	70	3.9%	71	±10%
2nd Refrigerator & Freezer Recycling	346	60	17.3%	62	±9%
Weatherization and Shell Measures	221	60	27.1%	31	±13%

Cadmus randomly called program participants included in the survey sample frames. As shown in Figure 1, geographic distributions of survey respondents clustered around urban centers within Avista's service territory (specifically, the cities of Spokane, Pullman, Moscow, and Lewiston).

Figure 1. Geographic Distribution of Participant Survey Completes



1.2.2 Data Collection and Analysis

Record Review

Cadmus reviewed all records for the selected account sample, using the data they contained to check for completion and program compliance. Measures qualified if all data in the application complied with program specifications. As the evaluation randomly sampled customers by application type (and several measures can be found on different application forms), Cadmus tracked qualification rates at the application type level.

The review revealed one improperly issued insulation rebate on a Home Improvement application (it had an existing R-value above the participation requirements). Applied qualification rates include this result.

Surveys

Cadmus contracted with Discovery Research Group (DRG) to conduct surveys with sampled participants. To minimize response bias, DRG called customers during various hours of days and evenings (including weekends), and made multiple attempts to contact individual participants. Cadmus monitored survey phone calls to ensure accuracy, professionalism, and objectivity. Analysis addressed survey data at the program level rather than the measure level, and weighted survey results at the portfolio level by program participation to ensure proper representation.

Database Analysis

Cadmus reviewed the participant database Avista provided to check for inconsistencies in tracked savings and measure duplications. This review did not identify inconsistencies in data tracking. All tracked savings were based on the 2012 Avista TRM.

Unit Energy Savings Analysis

When necessary, Cadmus updated the unit energy savings (UES) achieved by residential measures based on new survey data of Avista participants, improved analysis methodologies, recent decisions by the Regional Technical Forum (RTF), and the results of the Residential Building Stock Assessment (RBSA), all of which are incorporated into our TRM. Each section below describes the changes made.

1.2.3 Verification Rates

Cadmus determined verification rates for each program (but analysis was performed at the measure level). Where applicable, the review covered the following topics:

- Checking the database tracked the correct measures;
- Accounting for correct quantities; and
- Determining whether units remained in place and were operable.

All measures researched remained in place and were operable, resulting in a 100% verification rate across all programs.

1.2.4 Measure Qualification Rates

Cadmus considered a measure qualified if it met the requirements particular to its category, such as receiving an ENERGY STAR certification or achieving program minimum efficiency standards. When necessary, the evaluation included online database searches for model numbers and noted characteristics necessary to verify achievement of all qualifications.

Of the entire verification sample, Cadmus identified one nonqualified measure:

- An attic insulation project had a base case condition that should have prevented it from qualifying.

1.3 Program Results and Findings

1.3.1 Overview

Cadmus analyzed data records, maintained by either Avista or an implementation contractor, to determine appropriate UES and measure counts for each supported measure within each program. The end result is the total adjusted gross savings for each measure and program as well as overall realized savings for each program.

Cadmus followed the same steps for calculating adjusted gross measure savings for all programs, except: Simple Steps, Smart Savings™, Second Refrigerator and Freezer Recycling, and Residential Weatherization (which necessitated individual methodologies). The calculations required the following:

1. Reviewing the program database to determine if adjusted measure counts correctly represented the number of installations.
2. Conducting a phone survey or site visit to verify the installation occurred within Avista's service territory.
3. Calculating verification and qualification rates.
4. Calculating deemed measure savings for products rebated during the program period.
5. Applying verification and qualification rates and deemed savings to the measure counts to determine the adjusted gross savings for each measure.

Details regarding the calculation methods used for Simple Steps, Smart Savings™, Second Refrigerator and Freezer Recycling, and Residential Weatherization follow in their specific sections, below.

1.3.2 Simple Steps, Smart Savings™

Program Description

An upstream incentive program, Avista's Simple Steps, Smart Savings ™ serves as an effective alternative to traditional mail-in incentives, given its ease of participation, widespread accessibility, and low administrative costs. Such programs allow the utility's incentives to pass directly from manufacturers to retailers, which then reduce prices to their customers. The program motivates retailer participation by

reducing bulb prices without causing a loss in profits. For the customer, participation may occur so seamlessly they remain unaware that they have purchased an incentivized bulb or participated in a utility program.

Upstream programs, however, pose particular evaluation challenges because calculating metrics—such as in-service rates (ISR) and attributions—traditionally rely on finding purchasers of incentivized products. In determining program savings, Cadmus referred to:

- The Northwest Regional Technical Forum (RTF) UES assumptions;
- The Residential Building Stock Assessment (RBSA) results;
- Avista's program records; and
- The CFL Contingency Program (discussed in Chapter 4).

The program incents various compact fluorescent lamp (CFL) products, from standard twist bulbs to specialty bulbs (including three-way, reflector, dimmable, globe, and others). As standard twist bulbs and specialty bulbs require unique assumptions, Cadmus analyzed each separately.

Analysis

This program utilizes six different parameters to inform the calculation of gross savings for the lighting component: CFL wattage (CFL Watts); delta watt multiplier (DWM); hours-of-use (HOU); days-per-year; waste heat factors (WHF); and ISR. The following algorithm shows annual energy lighting savings:

Where:

CFL Watts	=	Wattage of the CFL
DWM	=	The difference in wattage between the baseline bulb and the CFL, divided by the CFL's wattage
HOU	=	Daily lighting operating hours
DAYS	=	Days per year (365)
WHF	=	An adjustment representing the interactive effects of lighting measures on heating and cooling equipment operations
ISR	=	The percentage of units installed

The annual savings algorithm is derived from industry-standard engineering practices, consistent with the methodology used by the RTF for calculating energy use and savings for residential lighting. The following sections discuss each component in detail.

CFL Watts

According to Avista's reported sales, the program incented over 456,746 CFLs. Cadmus reviewed Avista's sales database and verified approximately 433,777 CFLs. This discrepancy likely resulted from monthly adjustments made in the database, which could have caused over or undercounting.

Table 10. Total Reported and Evaluated CFLs Sold by Year

Program Year	Reported			Evaluated		
	Twist	Specialty	Total	Twist	Specialty	Total
2012	327,350	129,396	456,746	326,785	106,992	433,777

Avista sales data included: CFL wattage, units sold, and bulb type. Cadmus analyzed savings for each bulb type separately. Analysis for three-way bulbs used the middle wattage. In PY 2012, the standard twist and specialty lamps sold had average weighted CFL wattage of 16.2 watts and 15.6 watts, respectively.

DWM

Cadmus relied on the RTF methodology for both standard twist and specialty bulbs for each wattage and type of bulb sold. The standard twist bulb DWM used by the RTF assumed the Energy Independence and Security Act (EISA) of 2007[2] impacted the baseline incandescent wattage, per the schedule shown in Table 11. EISA did not impact the baseline wattage for specialty CFLs. The RTF uses this table to reduce the assumed average, standard twist baseline bulb wattage for 2012 by replacing all 85 W to 150 W incandescent bulbs with 72 W bulbs in the calculations. The RTF analyses produce average baseline wattages and average installed CFL wattages for each bulb type; these can then be used to calculate the DWM for all bulbs of that type.

Table 11. Assumed EISA Effectiveness Schedule, Standard Twist CFLs

Standard Incandescent Lamp (Baseline Before EISA)	EISA Effective Dates	EISA's Intended Replacement Lamp (Baseline After EISA Effective Date)	Typical ENERGY STAR Qualified Lighting Replacement Option
40 W incandescent (approx. 490 lumens)	January 1, 2014	29 W (310–749 lumens)	9–11 W CFL (440–600 lumens)
60 W incandescent (approx. 840 lumens)	January 1, 2014	43 W (750–1,049 lumens)	13–15 W CFL (750–900 lumens)
75 W incandescent (approx. 1,190 lumens)	January 1, 2013	53 W (1,050–1,489 lumens)	18–20 W CFL (1,100–1,300 lumens)
100 W incandescent	January 1, 2012	72 W (1,490–2,600 lumens)	23–26 W CFL (1,600–1,800 lumens)

[2] EISA 2007. Public Law 110-140. December 19, 2007. Section 121 Stat. 1577

(approx. 1,690 lumens)			

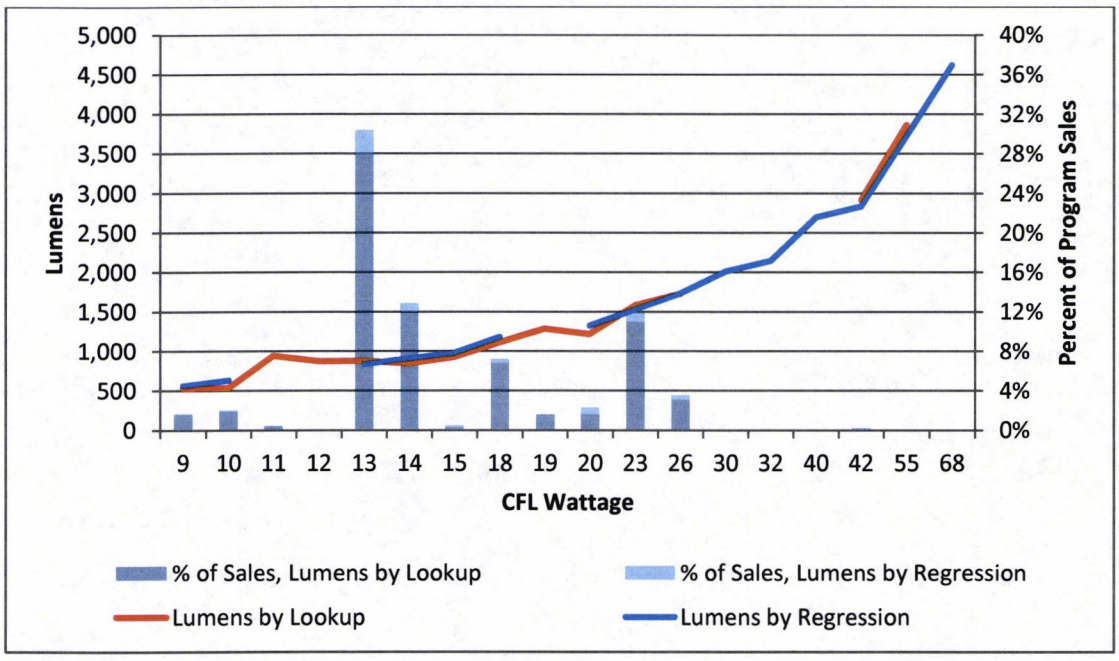
This evaluation calculated energy savings for each wattage and bulb type purchased during the program year. Cadmus determined the baseline wattage for each bulb, based on the type of bulb purchased and the lumens produced by that bulb. Looking up stock keeping unit (SKU) numbers in the ENERGY STAR lighting database provided bulb lumens,[3] a procedure matching 91% of the bulbs sold. For the remaining 9% of bulbs, **Error! Reference source not found.** estimated the bulb's lumen output (Cadmus developed he regression equation using the ENERGY STAR lighting database):

Equation 1. Estimating CFL Lumens

$$CFL\_Lumens = 68.739 \times CFL\,Wattage - 56.549$$

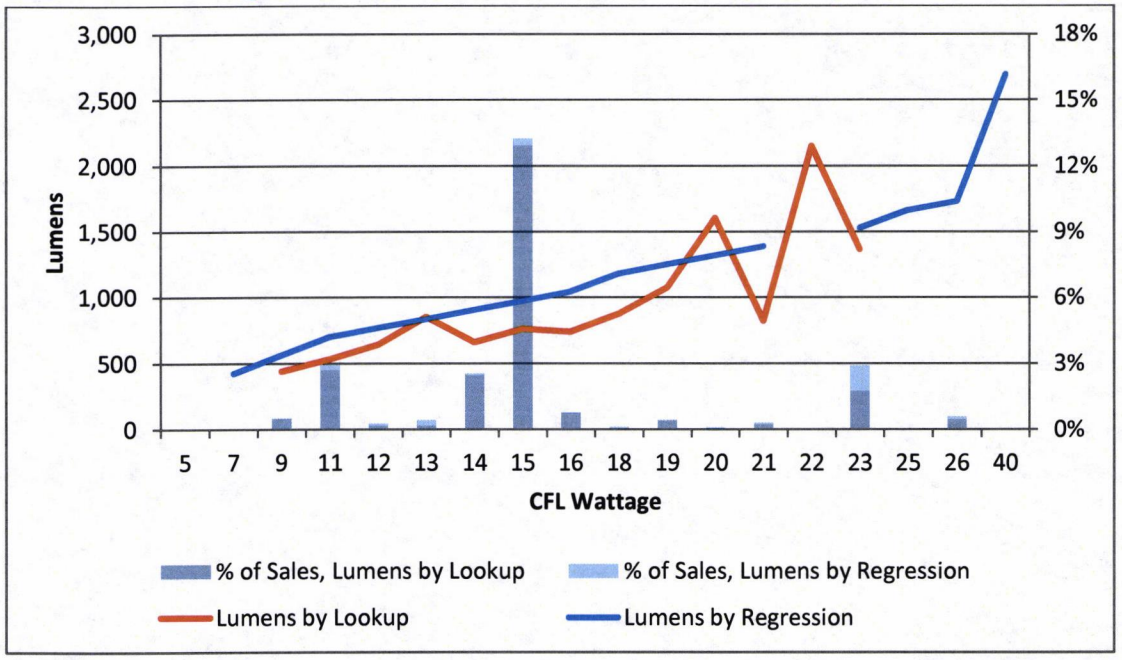
Figure 2 and Figure 3 compare lumens determined by the lookup method and lumens determined using the regression equation, along with the percentage of program sales for the wattage and type. The charts indicate that the regression method provided a better match for looking up standard twist CFLs than specialty bulbs. Cadmus assumed the lumen output estimated by the regression as adequate for both types of bulbs, due to the low percentages of sales volumes for which the regression was required.

Figure 2. Results of Lumens Determination, Standard Twist CFLs



[3] ENERGY STAR website: http://www.energystar.gov/ia/products/prod_lists/compact_fluorescent_light_bulbs_prod_list.xls

Figure 3. Results of Lumens Determination, Specialty CFLs



Cadmus then determined the baseline wattage for each bulb, based on the CFL's lumen output and if the bulb included a reflector, as EISA did not affect reflector bulbs. Table 12 and Table 13 show the schedules used to determine baseline wattages for bulbs included in PY 2012.

Table 12. Baseline Wattage based on CFL Lumens, Non-Reflector Bulbs

Lumens Range [L]	Incandescent Baseline [W]		Average CFL Wattage	Bulbs Rebated	Percent of Program Sales
	CFL or LED sold before 1/1/12	CFL or LED sold on or after 1/1/12			
0-309	25	25	5.00	5	0.0
310–749	40	40	10.32	31,617	7.3
750–1,049	60	60	13.44	202,018	46.6
1,050–1,489	75	75	18.58	48,393	11.2
1,490–2,600	100	72	23.61	68,171	15.7
2,601–3,300	150	150	40.03	1,190	0.3
3,301–4,815	200	200	62.63	470	0.1

Table 13. Baseline Wattage based on CFL Lumens, Reflector Bulbs

Lumens Range [L]	Incandescent Baseline [W]	Average CFL Wattage	Bulbs Rebated	Percent of Program Sales
0–419	30	11.00	519	0.1
420–560	45	14.74	1,271	0.3
561–837	65	14.93	64,779	14.9
838–1,203	75	19.70	4,213	1.0
1,204–1,681	90	23.56	10,812	2.5
1,682–2,339	120	26.00	319	0.1
2,340–3,075	175	N/A	0	0.0

The evaluation then calculated the DWM for each bulb using the baseline wattage and the purchased CFL wattage.

Table 14 compares the current DWM assumed by the RTF and the DWM determined through the evaluation. Differences occurred due to the distribution of sales expected by the RTF and those achieved by the program. The program records indicated 57% of the standard twist bulbs rebated were 13 W or 14 W CFLs, which presumably replaced a 60 W incandescent.

Table 14. Comparison of RTF 2012 DWM to Evaluation DWM

Type	Category	RTF 2012 DWM	Evaluation PY2012 DWM
Twist	All	2.38	2.96
Specialty	Three-Way	2.05	2.74
	Dimmable	2.68	N/A
	Cold Cathode Candelabra—decorative	4.00	2.74
	Cold Cathode Candelabra—primary	4.00	
	CFL Candelabra	3.79	
	Dimmable Reflector	3.23	N/A
	Globe	2.98	2.84
	Outdoor	2.34	2.86
	Reflector	3.23	3.19
	Any Specialty CFL	3.12	3.13

HOU

Cadmus estimated standard twist CFL HOU for residential installations using Avista's survey of room types and a multistate modeling approach, built on light logger data collected from five states: Missouri, Michigan, Ohio, Maine, and Maryland.[4] The Maine HOU study, completed in the past year, was added to the model used for the previous evaluation. A regression statistical model calculated the average HOU, using combined multistate, multiyear data. Cadmus used the multistate model's estimate of HOU by

[4] The Cadmus Group, Inc. *2010 Evaluation, Measurement, and Verification Report*. Dayton Power and Light. March 15, 2011

room type, weighted based on Avista's survey results to determine an overall average HOU of 2.38, a 3% reduction from the 2.45 estimated previously.

Similar to our DWM analysis, HOU for specialty CFLs were derived from the current approved RTF assumptions.

Though the Simple Steps, Smart Savings™ program could introduce bulbs into residential and commercial applications, an all-residential application presented the more conservative assumption. As compelling evidence did not exist to assume a proportion of commercial sales, Cadmus exclusively used residential assumptions in this analysis.

Waste Heat Factor

The WHF is used to account for the change in annual HVAC energy, either lost or gained, due to a reduction in facility lighting energy. Cadmus based the WHF on SEEM building models, developed by the Northwest Power and Conservation Council. These SEEM building models estimate the change in HVAC equipment energy use resulting from a change in lighting technology (e.g., from incandescent lamps to CFLs). In general, the models account for the interaction using load shape profiles of the HVAC and lighting equipment, based on dwelling occupancy.

The Council uses an inherently conservative method, as it assumes a closed shell (i.e., all interior lamps), including ceiling recessed cans contained in a closed system. Thus, heat produced by the bulbs enters the building. In reality, waste heat could transfer out of the conditioned space.

Cadmus based the calculation on Avista's share of electric heating equipment,[5] along with its associated efficiencies and surveys of interior and exterior distributions, producing a WHF of 89.8%.[6]

Cadmus used the commercial WHF of 85.5% provided in the 6th Power Plan.

ISR

The program's ISR was derived from the results of the 2012 Residential Building Stock Assessment (RBSA), which determined the CFL storage rate for each home visited. The RTF recently accepted and approved this storage rate.[7] All PY 2012 bulb purchases had a 76% assumed first-year ISR.

Cadmus considers the utilized Council method inherently conservative as it assumes the remaining 24% of bulbs in storage never provide energy savings. Research indicates almost all bulbs will be installed within three years of purchase. Despite its conservative nature, the evaluation assumed the RTF methodology presented the appropriate method for determining energy savings in Idaho.

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5 Avista equipment-type saturations derived from a 2011 participant survey for the CFL Contingency Program.

6 Given an RTF WHF of 86.4% and an adjusted Avista WHF of 89.8%.

7 http://rtf.nwcouncil.org/measures/measure.asp?id=142

Results and Findings

Table 15 compares the current approved RTF assumptions for CFLs to the assumptions used in this evaluation, and the resulting UES.

Table 15. Comparison of Current RTF Assumptions to PY 2012 Assumptions

Assumption	Standard Twist CFL		Specialty CFL	
	Current RTF Value*	PY 2012 Evaluation	Current RTF Value**	PY 2012 Evaluation
CFL Watts (Weighted Average)	17.16	16.21	13.42	15.61
DWM (Weighted Average)	2.38	2.96	3.12	3.13
HOU (Weighted Average)	1.90	1.91	1.71	1.86
Days	365	365	365	365
WHF	86.4%	84.6%	84.6%	84.6%
ISR	64.0%	76.3%	76.3%	76.3%
Average UES (kWh/year)	**15.6**	**21.6**	**16.8**	**21.4**

* http://rtf.nwcouncil.org/measures/measure.asp?id=141

** http://rtf.nwcouncil.org/measures/measure.asp?id=142

Overall Program Savings

For PY 2012, Avista's reported Idaho savings of 3,330,478 kWh and evaluated savings of 3,914,480 kWh, as shown in Table 16. Determining the regional distribution of purchased CFLs drew upon Avista's service territory of residential customers, with two-thirds in Washington and one-third in Idaho.

Table 16.Simple Steps, Smart Savings ™ PY 2012: Reported and Evaluated Total Savings

2012	Reported			Evaluated			Realization Rate
	Twist	Specialty	Total	Twist	Specialty	Total	
Avista—All	7,856,400	2,135,034	9,991,434	9,265,946	2,477,494	11,743,440	118%
Avista—Idaho	2,618,800	711,678	3,330,478	3,088,649	825,831	3,914,480	118%

An 118% realization rate resulted for PY 2012 for all bulbs.

1.3.3 Second Refrigerator and Freezer Recycling

Summary of Program Participation

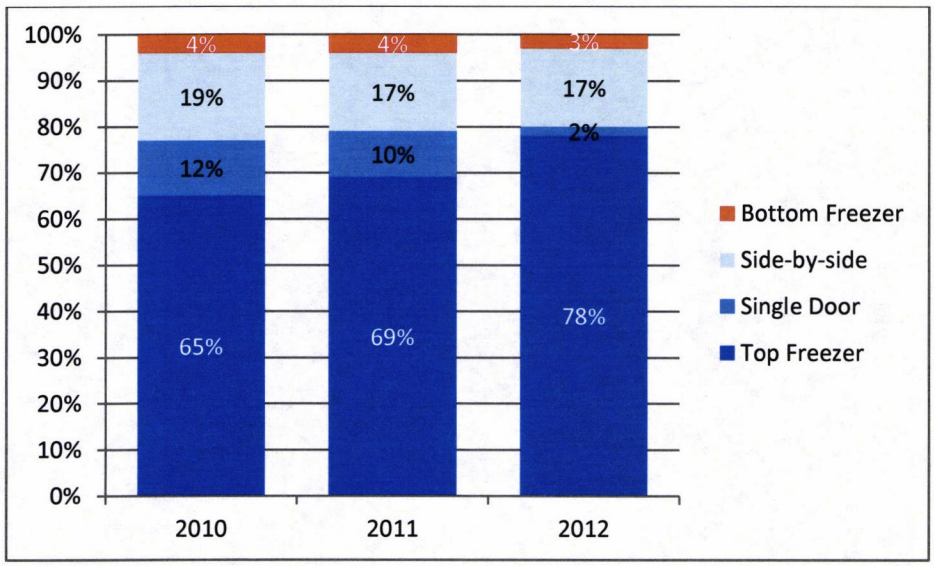
Cadmus reviewed the participant database, maintained by JACO, the program implementer, to test the reliability of program data. As shown in Table 17, the program recycled 327 units during PY 2012. Some participants recycled more than one appliance through the program.

Table 17. Program Participation by Measure

Year	Measure	Total
2010	Recycled Refrigerator	317
	Recycled Freezer	75
	Total	**392**
2011	Recycled Refrigerator	412
	Recycled Freezer	121
	Total	**533**
2012	Recycled Refrigerator	257
	Recycled Freezer	70
	Total	**327**
Total	Recycled Refrigerator	986
	Recycled Freezer	266
	Total	**1,252**

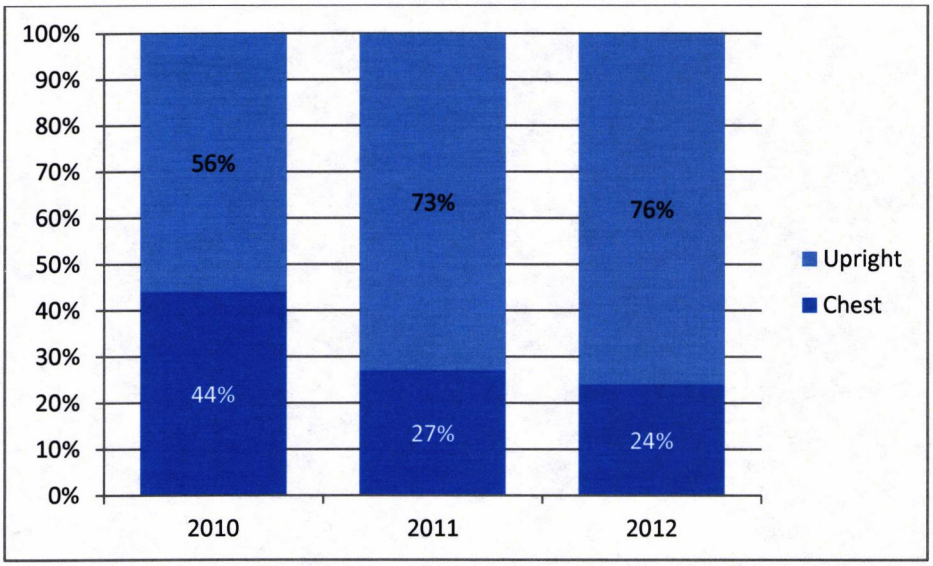
As shown in Figure 4, refrigerator configurations did not change substantially during the last two program years.

Figure 4. Refrigerator Configurations by Program Year



As shown in Figure 5, the program recycled more upright freezer units than chest units in 2012.

Figure 5. Freezer Configurations by Program Year



In 2012, recycled refrigerators averaged 28 years old, with 18 cubic feet of internal capacity. Recycled freezers averaged 36 years old, with 18 cubic feet of internal capacity.

Determination of Average Annual Gross Savings

Cadmus developed a multivariate regression model to estimate gross UEC for retired refrigerators and freezers. Model coefficients were estimated using an aggregated *in situ* metering dataset, composed of over 600 appliances (metered as part of five California, Wisconsin, and Michigan evaluations, conducted between 2009 and 2012). These evaluations offered a wide distribution of appliance ages, sizes, configurations, usage scenarios (primary or secondary), and climate conditions. The diversity of the

Uniform Methods Project and RTF Protocols

Recent guidelines developed by the U.S. Department of Energy (DOE) informed Cadmus' impact evaluation methodology for the 2012 program year. In 2011, DOE launched the Uniform Methods Project (UMP), intending to "*strengthen the credibility of energy savings determinations by improving EM&V, increasing the consistency and transparency of how energy savings are determined.*"[8]

The UMP identified seven common residential and commercial DSM measures, and enlisted a set of subject matter experts to draft evaluation protocols for each measure category, with refrigerator recycling one of the seven identified measures. The DOE recruited Cadmus to manage the UMP process and to serve as the lead author for the refrigerator recycling protocol.

[8] U.S. Department of Energy. "About the Uniform Methods Project." Last modified January 21, 2013. Accessed June 4, 2013. http://www1.eere.energy.gov/office_eere/de_ump_about.html

Through a collaborative process that included reviews by a technical advisory group and a steering committee as well as a public review and response period, the UMP resulted in a set of protocols (including one for refrigerator recycling) capturing the collective consensus of the evaluation community. Each protocol established broadly accepted best practices for evaluating key measures in the category, including identifying and explaining key parameters, data sources, and gross- and net-related algorithms.

This evaluation followed the methodology outlined in the refrigerator recycling protocol, which largely mirrored the method Cadmus used in the 2010–2011 program evaluation, except for changes recommended by the UMP. A discussion follows of the two most notable changes, with each discussed in greater detail in the **Error! Reference source not found.** and Net-to-Gross (NTG) sections.

1. ***Prospective Part-Use***. The UMP recommends assessing part-use based on how the recycled appliance likely would have been used if not recycled (not on how it was previously used). For example, if a primary refrigerator would have become a secondary refrigerator independent of the program, Cadmus based its 2012 part-use on the average usage of secondary refrigerators rather than primary refrigerators.
2. ***Secondary Market Impacts.*** The UMP recommends evaluations utilize a grid-level approach to estimating net program savings. Therefore, in 2012, Cadmus considered the program's impact on the used appliance market. The secondary market impact adjustment accounted for changes in the availability of used appliances resulting from the program.

DOE's Website[9] provides more information about the UMP.

Refrigerator Regression Model

Table 18 shows the variables used to estimate refrigerators' annual energy consumption and its estimated parameters.

[9] U.S. Department of Energy. "Uniform Methods Project for Determining Energy Efficiency Program Savings." Last modified April 9, 2013. Accessed June 4, 2013. http://www1.eere.energy.gov/office_eere/de_ump.html

Table 18. Refrigerator UEC Regression Model Estimates
(Dependent Variable = Average Daily kWh, R-square = 0.30)

Independent Variables	Coefficient	p-Value
Intercept	0.805	0.166
Age (years)	0.021	0.152
Dummy: Manufactured Pre-1990	1.036	<.0001
Size ($ft.^3$)	0.059	0.044
Dummy: Single Door	-1.751	<.0001
Dummy: Side-by-Side	1.120	<.0001
Dummy: Primary	0.560	0.008
Interaction: Unconditioned Space x HDDs	-0.040	0.001
Interaction: Unconditioned Space x CDDs	0.026	0.188

Results indicated:

- Older refrigerators experienced higher consumption due to year-on-year degradation.
- Refrigerators manufactured before the 1990 NAECA standard consumed more energy.
- Larger refrigerators consumed more energy.
- Single-door units consumed less energy, as these units typically did not have full freezers.
- Side-by-side refrigerators experienced higher consumption due to greater exposure to outside air when opened and due to the through-door features common in these units.
- Primary appliances experienced higher consumption due to increased usage.
- At higher temperatures, refrigerators in unconditioned spaces consumed more energy.
- At colder temperatures, refrigerators in unconditioned spaces consumed less energy.

Freezer Regression Model

Table 19 shows the freezer model's details.

Table 19. Freezer UEC Regression Model Estimates
(Dependent Variable = Average Daily kWh, R-square = 0.38)

Independent Variables	Coefficient	p-Value
Intercept	-0.955	0.237
Age (years)	0.045	0.001
Dummy: Manufactured Pre-1990	0.543	0.108
Size ($ft.^3$)	0.120	0.002
Dummy: Chest Freezer	0.298	0.292
Interaction: Unconditioned Space x HDDs	-0.031	<.0001
Interaction: Unconditioned Space x CDDs	0.082	0.028

Results indicated:

- Older freezers experienced higher consumption due to year-on-year degradation.

- Freezers manufactured before the 1990 NAECA standard consumed more energy.
- Larger freezers consumed more energy.
- Chest freezers experienced higher consumption.
- At higher temperatures, freezers in unconditioned spaces consumed more energy.
- At colder temperatures, freezers in unconditioned spaces consumed less energy.

Extrapolation

After estimating the final regression models, Cadmus analyzed the corresponding characteristics (the independent variables) for participating appliances (as captured in the JACO database). Table 20 summarizes program averages or proportions for each independent variable.

Table 20. 2012 Participant Mean Explanatory Variables*

Appliance	Independent Variables	Participant Population Mean Value
Refrigerator	Age (years)	28.40
	Dummy: Manufactured Pre-1990	0.74
	Size ($ft.^3$)	18.16
	Dummy: Single Door	0.02
	Dummy: Side-by-Side	0.17
	Dummy: Primary	0.38
	Interaction: Unconditioned Space x HDDs*	8.51
	Interaction: Unconditioned Space x CDDs*	0.40
Freezer	Age (years)	35.79
	Dummy: Manufactured Pre-1990	0.86
	Size ($ft.^3$)	18.14
	Dummy: Chest Freezer	0.24
	Interaction: Unconditioned Space x HDDs*	11.84
	Interaction: Unconditioned Space x CDDs*	0.52

* Cooling Degree Days (CDDs) and Heating Degree Days (HDDs) derive from the weighted average from Typical Meteorological Year (TMY3) data for weather stations that Cadmus mapped to participating appliance ZIP codes. TMY3 uses median daily values for a variety of weather data, collected from 1991–2005.

For example, using values from Table 19 and Table 20, Cadmus calculated the estimated annual UEC for 2012 freezers as:

$$\text{2012 Freezer UEC} = 365.25\ days * (-0.955 + 0.045 * [35.79\ years\ old] + 0.543 * [86\%\ units\ manufactured\ pre-1990] + 0.120 * [18.14\ ft.^3] + 0.298 * [24\%\ units\ that\ are\ chest\ freezers] + 0.082 * [0.52\ Unconditioned\ CDDs] - 0.031 * [11.84\ Unconditioned\ HDDs]) = 1{,}117\ kWh/year$$

Figure 6 compares distributions of estimated UEC values for refrigerators and freezers.

Figure 6. 2012 Distribution of Estimated Annual UECs by Appliance Type

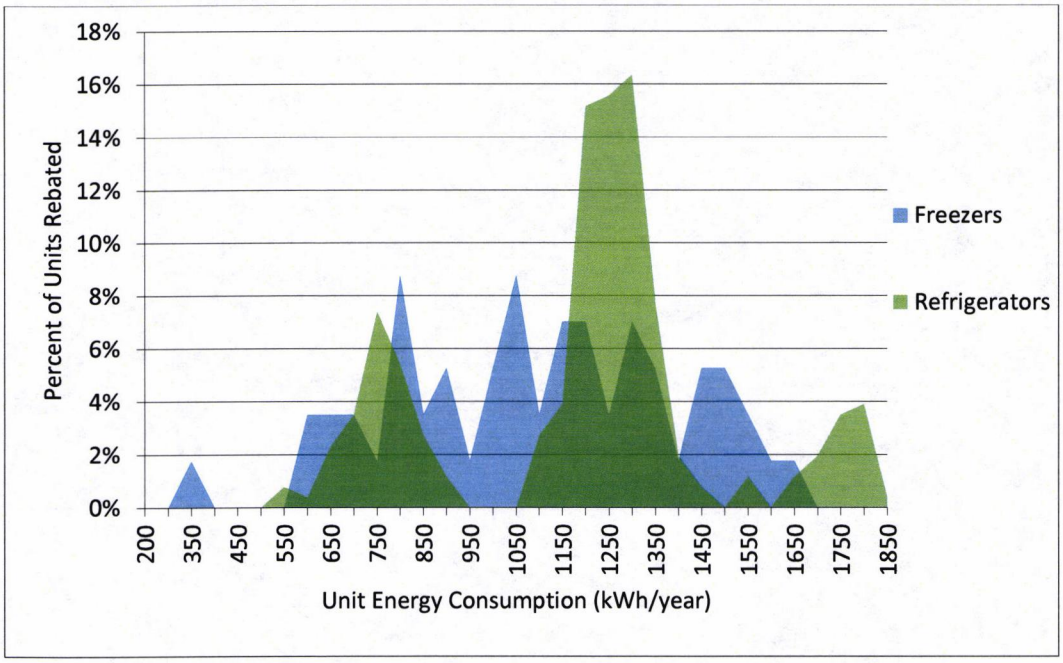


Table 21 presents estimated, per-unit, average annual energy consumption for refrigerators and freezers recycled by Avista in 2012. The next sections describe how Cadmus adjusted these estimates to arrive at gross per-unit saving estimates for participant refrigerators and freezers.

Table 21. Estimate of Per-Unit Annual Energy Consumption

Appliance	*Ex Post* Annual UEC (kWh/year)	Relative Precision(90% confidence)
Refrigerators	1,199	8.8%
Freezers	1,117	18.3%[10]

Table 22 presents the 2012 UEC results for Avista and compares it with utilities located in Canada and the U.S. For 2012, Cadmus found Avista to have a slightly higher UEC for refrigerators and freezers than other utilities.

[10] Relative Precision for Freezers was substantially higher than refrigerators due to a small sample size of 13

Table 22. Benchmarking: Average UEC Values

Utility	Years Implemented	Average UEC (kWh/Year)	
		Refrigerator	Freezer
Ontario Power Authority	4	1,126	1,045
PacifiCorp (Washington)	5	1,153	935
Midwest Utility	2.5	1,175	1,072
Avista 2010-2011 Evaluation Report	6	1,147	1,074
Avista 2012 Evaluation Report	7	1,199	1,117

Part-Use

"Part-use" serves as an adjustment factor, specific to appliance recycling, used to convert the UEC into average per-unit gross savings value. The UEC itself does not equal gross savings value, due to the following:

- The UEC model yields an estimate of annual consumption.
- Not all recycled refrigerators would have operated year-round, had they not been decommissioned through the program.

As Cadmus applied UMP's methodology, the determination of 2012 part-use differs slightly from that used in previous evaluations. Specifically, the previous evaluation assumed that the way customers operated participating appliances prior to the program served as a reasonable proxy for how the same appliances would likely be operated in the future, had they not been recycled through the program (either by the participant or, if the appliance was transferred, by the would-be recipient).

While the UMP part-use methodology uses information from surveyed customers regarding pre-program usage patterns, the final part-use estimate reflects the way appliances would likely be operated, had they not been recycled (not how they were previously operated). For example, a primary refrigerator operated year-round could become a secondary appliance and be operated part-time.

The updated methodology accounts for such potential shifts in usage types. Specifically, it calculates part-use using a weighted average of the following, prospective part-use categories and factors:

- Appliances that would have run full-time (part-use = 1.0).
- Appliances that would not have run at all (part-use = 0.0).
- Appliances that would have operated for a portion of the year (part-use between 0.0 and 1.0).

Using information gathered through the participant survey, Cadmus utilized the following multistep process to determine part-use, as outlined in the UMP:

1. The surveys determined if recycled refrigerators were primary or secondary units (with all stand-alone freezers considered secondary units).

2. For participants indicating they recycled a secondary refrigerator, the survey asked if the refrigerator was unplugged, operated year-round, or operated for a portion of the preceding year (and assuming all primary units operated year-round). All freezer participants were asked the same question.

The survey asked participants indicating their secondary refrigerator or freezer operated for only a portion of the preceding year to estimate how many months during that time their appliance was plugged in. This subset of participants estimated 5.0 and 3.9 months for secondary refrigerators and freezers, respectively. Dividing both values by 12 provided the annual part-use factor for all secondary refrigerators and freezers operated for only a portion of the year. For 2012, the average secondary refrigerator and freezer operating part-time had part-use factors of 0.42 and 0.33, respectively. These two steps determined how refrigerators and freezers operated prior to recycling, with results shown in Table 23.

Table 23. Historical Part-Use Factors by Category

Usage Type and Part-Use Category	Refrigerators			Freezers		
	Percent of Recycled Units	Part-Use Factor	Per-UES (kWh/year)	Percent of Recycled Units	Part-Use Factor	Per-UES (kWh/year)
Secondary Units Only	**n = 28**					
Not in Use	0%	0.00	-			
Used Part Time	11%	0.42	500			
Used Full Time	89%	1.00	1,199			
Weighted Average	**100%**	**0.9375**	**1,124**			
All Units (Primary and Secondary)	**n = 49**			**n = 13**		
Not in Use	0%	0.00	-	0%	0.00	-
Used Part Time	6%	0.42	500	38%	0.33	372
Used Full Time	94%	1.00	1,199	62%	1.00	1,117
Weighted Average	**100%**	**0.96**	**1,157**	**100%**	**0.74**	**831**

Table 24. Benchmarking: Part-Use Factors by Appliance Type

Utility	*Years Implemented*	Part-Use Factors	
		Refrigerator	Freezer
Midwest Utility	2.5	0.86	0.86
Ontario Power Authority	4	0.9	0.89
PacifiCorp (Washington)	5	0.93	0.89
Avista 2010-2011 Evaluation Report	6	0.94	0.82
Avista 2012 Evaluation Report	7	0.95	0.74

Cadmus then asked participants how the appliances likely would have been operated, had they not been recycled through the program. For example, if surveyed participants indicated they would have kept a primary refrigerator (independent of the program), the survey asked if they would have continued to use the appliance as their primary refrigerator or would have relocated it and used as a secondary refrigerator.

Participants indicating they would have discarded their appliance independent of the program were not similar questions (as the future usage of their appliance would be determined by another customer).

Combining the historically based, part-use factors shown in Table 23 with participants' self-reported action, had the program *not* been available, resulted in the distribution of likely future usage scenarios and corresponding part-use estimates.

Table 25 shows the weighted average of these future scenarios, determining the program's part-use factor for refrigerators (0.95 and freezers (0.74).[11]

Table 25. Part-Use Factors by Appliance Type

Use Prior to Recycling	Likely Use Independent of Recycling	Refrigerator		Freezer
		Part-Use Factor	Percent of Participants	Part-Use Factor
Primary	Kept (as primary unit)	1.00	0%	
	Kept (as secondary unit)	0.94	18%	
	Discarded	0.96	29%	
Secondary	Kept	0.94	25%	0.74
	Discarded	0.96	29%	0.74
Overall		**0.95**	**100%**	**0.74**

Net-to-Gross

Cadmus used the following formula to estimate net savings for recycled refrigerators:

$$Net\ savings = Gross\ Savings - Freeridership\ and\ Secondary\ Market\ Impacts - Induced\ Replacement$$

Where:

Gross Savings = The evaluated *in situ* UEC for the recycled unit, adjusted for part-use

Freeridership and Secondary Market Impacts

[11] As the future usage type of discarded refrigerators cannot be known, Cadmus applied the weighted part-use average of all units (0.88) for all refrigerators that would have been discarded independent of the program. This approach acknowledged that discarded appliances could be used as primary or secondary units in a would-be recipient's home.

= Program savings that would have occurred in the program's absence

Induced Replacement = Average, additional energy consumed by replacement units purchased due to the program

Applying the UMP protocol introduced an additional parameter related to net savings—secondary market impacts—and required use of a decision-tree approach to calculate and present net program savings. Cadmus did not include this adjustment for the 2010–2011 impact evaluation; therefore, changes in net savings could partially be attributed to changes in evaluation methodology.

The decision tree—populated by responses of surveyed participants—presented savings under all possible scenarios concerning the participants actions in regard to the discarded equipment. Cadmus used a weighted average of these scenarios to calculate net savings attributable to the program. This chapter includes specific portions of the decision tree to highlight specific aspects of the net savings analysis.

Freeridership

Cadmus' freeridership analysis first asked participants if they considered discarding the participating appliance prior to learning about the program. If the participant did not indicate a previous consideration to dispose of the appliance, Cadmus categorized them as a non-freerider and excluded them from the subsequent freeridership analysis.

Next, Cadmus asked all remaining participants (i.e., those who had considered discarding their existing appliance before learning about the program) a series of questions to determine the distribution of participating units likely to have been kept versus those discarded absent the program. Three scenarios independent of program intervention could occur:

- The unit would be discarded and transferred to someone else.
- The unit would be discarded and destroyed.
- The unit would be kept in the home.

To determine the percentage of participants following each three scenario, Cadmus asked surveyed participants about the likely fate of their recycled appliance, had it not been decommissioned through the program. Cadmus categorized their responses into the following options:

- Kept the appliance.
- Sold the appliance to a private party (either an acquaintance or through a posted advertisement).
- Sold or gave the appliance to a used appliance dealer.
- Gave the appliance to a private party, such as a friend or neighbor.
- Gave the appliance to a charity organization, such as Goodwill Industries or a church.
- Left the appliance on the curb with a "free" sign.

- Had the appliance removed by the dealer who provided the new or replacement unit.
- Hauled the appliance to a landfill or recycling center.
- Had the appliance picked up by local waste management company.

Once Cadmus determined the final assessments of participants' actions independent of appliance recycling program, the percentage of refrigerators and freezers that would have been kept or discarded could be calculated, with the results shown in Table 26.

Table 26. Final Distribution of Kept and Discarded Appliance

Stated Action Absent Program	Indicative of Freeridership	Refrigerators (n=48)	Freezers (n=12)	Had Considered Disposing Recycled Appliance Prior to Hearing About the Program	Refrigerators (n=48)	Freezers (n=13)
Kept	No	25%	17%	Yes	78%	85%
Discarded	Varies by Discard Method	75%	83%	No	22%	15%
Total		**100%**	**100%**	**Total**	**100%**	**100%**

Table 27. Benchmarking Kept Appliances

Utility	Years Implemented	Percent Likely To Have Been Kept Independent of the Program	
		Refrigerator	Freezer
Midwest Utility	2.5	67%	46%
Avista 2010-2011 Evaluation Report	6	17%	17%
Ontario Power Authority**	4	7%	10%
Avista 2012 Evaluation Report	7	25%	17%
East Coast Utility 1	2.5	26%	33%
PacifiCorp (Washington)	5	20%	20%

**http://www.powerauthority.on.ca/sites/default/files/new_files/2009/2009%20Residential%20Great%20Refrigerator%20Roundup%20Program%20Evaluation.pdf (The more recent 2010 evaluation cited previously relied on the NTG analysis from this 2009 evaluation).

Secondary Market Impacts

If a participant would have directly or indirectly (through a market actor) transferred the program-recycled unit to another Avista customer, absent the program, Cadmus determined what actions the would-be acquirer might have taken, with the unit unavailable due to the program.

Some would-be acquirers would find another unit; others would not. This possibility reflects some acquirers being in the market for a refrigerator (and would acquire another unit), while others were not (and would have taken the unit opportunistically). It is difficult to quantify this absent program-specific information, regarding changes in the total number of refrigerators and freezers (overall and for used appliances) in use before and after implementing the program. Without this information, the UMP recommends evaluators assume one-half of the would-be acquirers would obtain an alternate unit. Without information to the contrary, Cadmus applied the UMP recommendation to this evaluation.

Next, Cadmus determined whether the alternate unit would likely be another used appliance (similar to those recycled through the program) or a new, standard-efficiency unit (presuming fewer used appliances remained available due to program activity).[12]

As discussed, estimating this distribution definitively proves difficult. The UMP again recommends taking a midpoint approach when primary research is unavailable: evaluators should assume one-half of the would-be acquirers would obtain a similar used appliance, and one-half would acquire a new, standard-efficiency unit.

Cadmus used the ENERGY STAR Website[13] to determine energy consumption for new, standard-efficiency appliances. Specifically, Cadmus averaged the reported energy consumption of new, standard-efficiency appliances of comparable sizes and configurations as the program units.

Figure 7 details Cadmus' methodology for assessing the program's impact on the secondary refrigerator market and for applying the recommended midpoint assumptions when primary data were unavailable. As shown, accounting for market effects resulted in three savings scenarios:

- Full per-unit gross savings;
- No savings; and
- Partial savings (i.e., the difference between energy consumption of the program unit and the new, standard-efficiency appliance acquired instead).

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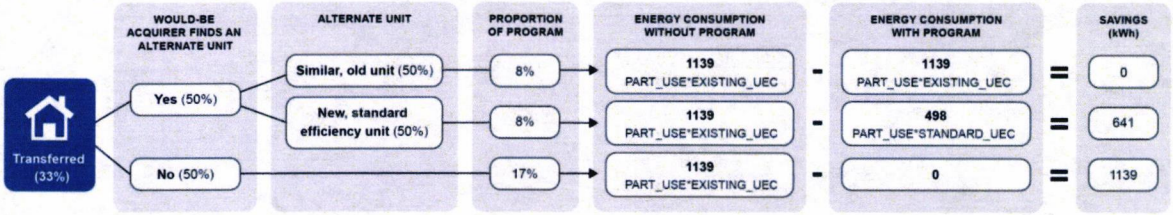
12 The would-be acquirer also could select a new ENERGY STAR unit. However, Cadmus assumed most customers in the market for a used appliance would upgrade to the next lowest price point (a standard-efficiency unit).

13 http://www.energystar.gov/index.cfm?fuseaction=refrig.calculator

Figure 7. Secondary Market Impacts—Refrigerators

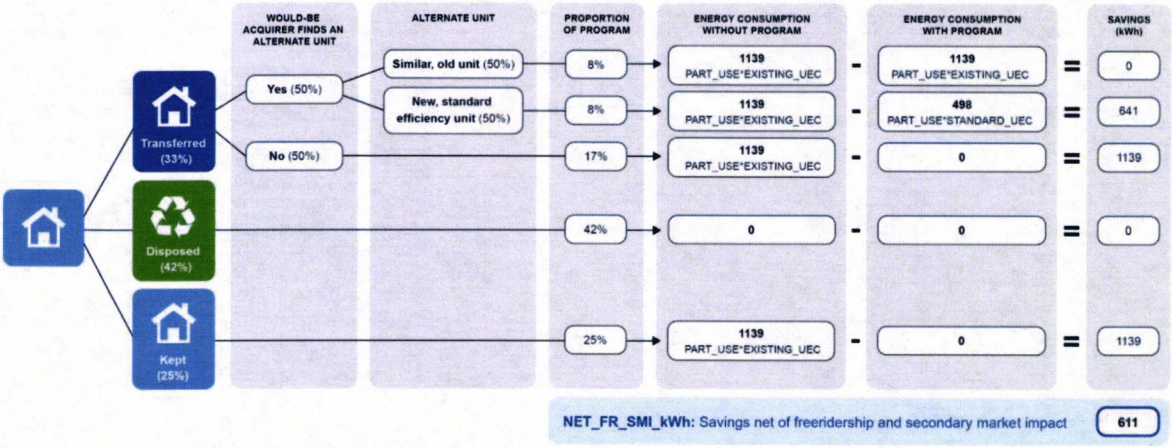


Integration of Freeridership and Secondary Market Impacts

After estimating the parameters of the freeridership and secondary market impacts, Cadmus used the UMP decision tree to calculate the average, per-unit program savings, net of their combined effect. Figure 8 shows how Cadmus integrated these values into an estimate of savings, net of freeridership and secondary market impacts. Again, Cadmus applied secondary market impacts to maintain consistency with UMP: previous Cadmus Avista appliance recycling evaluations did not account for this.

To ensure survey participants provided the most reliable responses possible, and to mitigate socially desirable response bias as much as possible, Cadmus averaged the participant and nonparticipant transfer and disposal ratios.

Figure 8. Savings Net of Freeridership and Secondary Market Impacts—Refrigerators



Induced Replacement

The UMP states that evaluators must account for the energy consumption of replacement units *only* when the program induced that replacement (i.e., when the participant would *not* have purchased the replacement refrigerator in the recycling program's absence).

In the case of non-induced replacements, the energy consumption of the replacement appliance does not prove germane to the savings analysis as the appliance would have been purchased or acquired

regardless of the program. The acquisition of another appliance in conjunction with participation in the program does not necessarily indicate induced replacement. Again, this is consistent with the methods outlined in the UMP.

Cadmus used the results of the participant surveys to determine which replacement refrigerators and freezers program participants acquired due to the program. Survey results indicated the program: reduced the total number of used appliances operating within Avista's Idaho service territory; and raised the average efficiency of the active appliance stock.

Cadmus then used participant survey results to estimate the proportion of replacements induced by the customer's participation in the program. Specifically, Cadmus asked each participant that indicated they replaced the participating appliance: "*Would you have purchased the new refrigerator/freezer without the incentive you received for recycling the old one*?"

As a $30 incentive likely will not provide sufficient motivation for most participants to purchase an otherwise unplanned for replacement unit (which can cost $500 to $2,000), Cadmus asked a follow-up question of participants who responded "*No*." Intended to confirm the participant's assertion that only the program caused them to replace their appliance, the question was: "*Just to confirm: you would not have replaced your old refrigerator/freezer without the Avista incentive for recycling, is that correct*?"

To further increase the reliability of these self-reported actions, the induced replacement analysis also considered:

1. Whether the refrigerator was a primary unit.
2. The participant's stated intentions in the program's absence.

For example, if participants would have discarded their primary refrigerators independent of the program, the replacement could not be program induced (since it is extremely unlikely a participant would live without a primary refrigerator). For all other usage types and stated intention combinations, however, induced replacement could stand as a viable response.

As expected, results indicated the program only induced a portion of the total replacements: the program induced 0% of all refrigerator participants and 0% of freezer participants to acquire a replacement unit, as shown in Table 28. As shown in Table 29, Avista's induced replacement was lower than the comparison utilities.

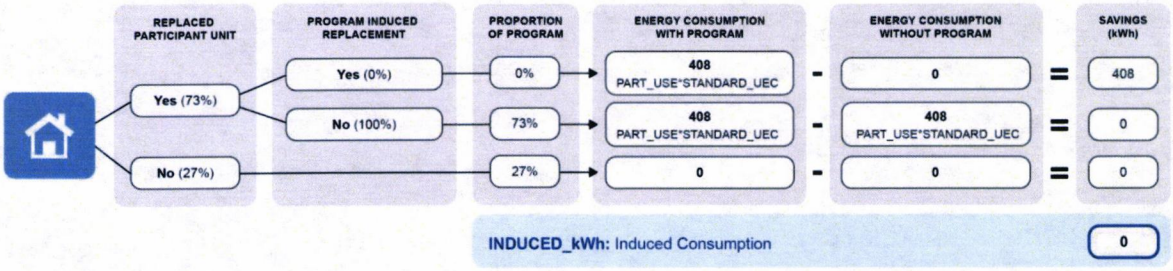
Table 28. 2011-2012 Induced Replacement Rates

Appliance	Induced Replacement Rates
Refrigerator	0%
Freezer	0%

Table 29. Benchmarking: Induced Replacement

Utility	Years Implemented	Induced Replacement Refrigerators	Induced Replacement Freezers
Midwest Utility	2.5	13%	2%
Avista 2010-2011 Evaluation Report	6	4%	4%
Avista 2012 Evaluation Report	7	0%	0%
PacifiCorp (Washington)	5	3%	3%

Figure 9. Induced Replacement Refrigerators



Final NTG

As summarized in Table 30, Cadmus determined final net savings as gross savings less freeridership, secondary market impacts, and induced replacement kWh.

Table 30. 2012 NTG Ratios

Scenario	Gross Per-Unit Savings (kWh)	Freeridership and Secondary Market Impacts (kWh)	Induced Replacement Savings (kWh)	Induced Additional Savings (kWh)	Net Per-Unit Savings (kWh)	NTG
Refrigerator	1,139	611	0	0	528	46%
Freezer	831	559	0	0	272	33%

As noted, the application of the UMP protocol introduced two parameters related to net savings—secondary market impacts and induced replacements—not included in the previous evaluation. The application of these factors, through adherence with the UMP, contributed to a downward shift in the program's NTG from previous years.

Summary of Impact Findings

Using the above per-unit values, Cadmus calculated total program savings for the Second Refrigerator and Freezer Recycling program in Idaho at 154,811 kWh per year, after adjustments (as shown in Table 31).

Table 31. Idaho 2012 Annual Second Refrigerator and Freezer Recycling Program Savings

Measure	Evaluated Participation	Reported Gross Savings (kWh)	Evaluated Gross Savings (kWh)	Evaluated Net Savings (kWh)	Net Realization Rate
Refrigerator Recycling	257	213,060	292,818	135,791	64%
Freezer Recycling	70	55,692	58,149	19,019	34%
Totals	**N/A**	**268,752**	**350,968**	**154,811**	**58%**

As shown in Table 32, Avista's NTG gross ratio is less than other utilities. The NTG gross results from 2012 were driven downward primarily by the ratio of appliances that would have been discarded in absence of the program as well as the mature nature of the program relative to other programs.

Table 32 Benchmarking NTG Ratio's

Utility	Years Implemented	NTG Ratio's	
		Refrigerator	Freezer
Avista 2012 Evaluation Report	7	46%	33%
Avista 2010-2011 Evaluation Report	6	41%	42%
Midwest Utility	2.5	73%	68%
East Coast Utility 2	2	57%	62%
Wisconsin Focus on Energy	1	51%	52%

1.3.4 ENERGY STAR Products

Program Description

The ENERGY STAR Products program includes the following measures:

- Clothes Washer (Electric and Gas)
- Dishwasher (with Electric or Gas Water Heater)
- Freezer (Electric)
- Refrigerator (Electric)

The program offers direct financial incentives to motivate customers to use more energy-efficient appliances. The program indirectly encourages market transformation by increasing demand for ENERGY STAR products. The program includes electric and gas measures, but this report only considers electric savings.

Analysis

Energy savings credited to the ENERGY STAR Products program had to meet the following criteria:

- Measures had to remain in place and operate properly at the time of verification;
- Numbers of installed equipment pieces and their corresponding model numbers in the applications had to match the database; and
- Units must have been ENERGY STAR-qualified at the time of the program offering.

Clothes Washers

Energy-saving calculations drew upon a 2009 Cadmus study,[14] which metered more than 100 clothes washers in California homes for three weeks—the largest *in situ* metering study on residential clothes washers and dryers conducted in the last decade. Cadmus updated the analysis for this evaluation to improve the accuracy of the savings estimated.

Dryers produced the majority of energy consumption and savings, as high-efficiency washing machines removed more moisture from clothes, allowing shorter drying times.

Determining adjusted gross savings required using the following, additional input assumptions:

- Recent independent evaluation surveys from the RBSA[15] and 2012 Avista Participant surveys estimated 262 washing cycles per year. UES values have been adjusted accordingly, as reflected in this measure's realization rate.
- Cadmus utilized the data from the California metering study to estimate consumption per wash and dry cycle for the base and efficient equipment.

Dishwashers

Cadmus estimated dishwasher savings based on methods currently used in the ENERGY STAR Calculator[16] (the only calculator available providing consistent energy-savings estimates in the presence of a gas or electric domestic hot water heater). The utilized the following input assumptions:

- Cadmus calculated the average base case and efficient case Energy Factor (EF), with both based on data utilized by the RTF. The baseline EF equaled the average market efficiency of units not qualifying for the program, and the efficient EF equaled the average market efficiency of units qualifying for the program at the time of their rebate.

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[14] The Cadmus Group, Inc. 2010. "Do the Savings Come Out in the Wash? A Large Scale Study of In-Situ Residential Laundry Systems." http://www.cadmusgroup.com/pdfs/Do_the_Savings_Come_Out_in_the_Wash.pdf

[15] Ecotope Inc. *2011 Residential Building Stock Assessment: Single-Family Characteristics and Energy Use*. Seattle, WA: Northwest Energy Efficiency Alliance. 2012.

[16] http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDishwasher.xls?7182-1c92

- Recent evaluation surveys conducted in the region estimated 245 washing cycles per year.[17, 18]
- Water heating consumed 56% of the electricity required to run a dishwasher connected to an electric domestic hot water heater.[19]

Refrigerators

Cadmus used the methodology shown in the RTF's FY11v2_1 refrigerator analysis to estimate gross per-UES. The RTF's analysis assumed 32% of baseline units would be ENERGY STAR-qualified. This assumption embedded NTG in the calculated savings. Cadmus modified the analysis to assume 0% of baseline units would be ENERGY STAR-qualified. The resulting savings equaled the gross savings achieved by the installation of an ENERGY STAR refrigerator. Chapter 5 addresses net savings.

Freezers

Cadmus used the methodology shown in the RTF's FY10v2_0 freezer analysis to estimate gross per-UES. The RTF's analysis assumed 10% of baseline units would be ENERGY STAR-qualified. This assumption embedded NTG in the savings calculated. Cadmus modified the analysis to assume 0% of baseline units would be ENERGY STAR-qualified. The resulting savings equaled the gross savings achieved by the installation of an ENERGY STAR freezer. Chapter 5 addresses net savings.

Results and Findings

Table 33 shows: total reported and qualified counts, savings, and realization rates of electric ENERGY STAR Products measures in Idaho.

Table 33. ENERGY STAR Products Program Results

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
E Clothes Washer With Electric Water Heater	627	307,318	120,384	100.0%	100.0%	120,384	39.2%
E Freezer	106	4,931	4,931	100.0%	100.0%	4,931	100.0%
E Refrigerator	867	56,806	56,806	100.0%	100.0%	56,806	100.0%
E Dishwasher With Electric Water Heater	191	11,842	11,842	100.0%	100.0%	11,842	100.0%
Program Total	**1,791**	**380,897**	**193,963**	**100.0%**	**100.0%**	**193,963**	**50.9%**

[17] Pacific Power. *Washington 2009–2010 Residential Home Energy Savings Evaluation.* January 2012.

[18] Rocky Mountain Power. *2009–2010 Idaho Residential Home Energy Savings Evaluation*. February 2012.

[19] http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDishwasher.xls?7182-1c92

1.3.5 Heating and Cooling Efficiency

Program Description

The electric Heating and Cooling Efficiency program included the following equipment:

- Ductless Heat Pumps
- Air Source Heat Pumps
- Electric Forced Air Furnace to Air Source Heat Pumps
- Variable Speed Furnace Fans
- Air Conditioner Replacements

Analysis

The PY 2010–2011 electric impact evaluation report documented analysis Cadmus performed to determine the change in energy consumption resulting from installation of electric heating and cooling measures. As the analysis continued to provide the best information on this measure, results were retained for the 2012 program year.[20]

Results and Findings

Table 34 shows: total tracked and qualified counts, savings, and realization rates for electric Heating and Cooling Efficiency measures in Idaho.

Table 34. Heating and Cooling Efficiency Program Results

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
E Air Source Heat Pump	204	68,650	68,650	99.2%	100%	68,101	99.20%
E Ductless Heat Pump	34	6,277	6,277	99.2%	100%	6,227	99.20%
E Electric To Air Source Heat Pump	60	395,359	395,359	99.2%	100%	392,196	99.20%
E Variable Speed Motor	471	206,557	206,557	99.2%	100%	204,905	99.20%
Program Total	**769**	**676843**	**676843**	**99.2%**	**100%**	**671,428**	**99.20%**

The program achieved a 99.2% realized adjusted gross savings rate, reduced slightly due to qualification.

[20] Cadmus. *Avista 2010–2011 Multi-Sector Electric Impact Evaluation Report*. May 2012.

1.3.6 Space and Water Conversions

Program Description

The Space and Water Conversions program incents two measures available to residential electric customers currently using electricity to heat their homes and water, but may be able to use natural gas instead:

- Electric Forced Air Furnace to Natural Gas Forced Air Furnace
- Electric Water Heater to Gas Water Heater

Avista customers receive a rebate to reduce the cost of purchasing new equipment when making a conversion. These measures may be claimed in addition to the heating and cooling efficiency measures previously described. The installed, efficient equipment case therefore is assumed to be the standard efficiency equipment assumed for the base case equipment in the measures discussed.

Analysis

All Measures

The PY 2010–2011 electric impact evaluation report documented analysis Cadmus performed to determine the change in energy consumption resulting from conversion of electric air or water heating to gas air or water heating. As the analysis continued to provide the best information on this measure, results were retained for the 2012 program year.[21] For Q1 2014, a billing analysis is slated to address 2012 participants.

Results and Findings

Table 35 shows total tracked and qualified counts, savings, and realization rates for electric Space and Water Conversion measures in Idaho.

Table 35. Space and Water Conversion Measures and Reported and Adjusted Savings

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
E Electric To Natural Gas Furnace	24	288,298	288,298	99.2%	100%	285,992	99.2%
E Electric To Natural Gas Water Heater	14	56,436	56,436	99.2%	100.0%	55,985	99.2%
Program Total	**38**	**344,734**	**344,734**	**99.2%**	**100.0%**	**341,977**	**99.2%**

[21] Avista. *2010–2011 Multi-Sector Electric Impact Evaluation Report*. May 2012.

The program achieved a 99.2% realized adjusted gross savings rate, reduced slightly due to qualifications.

1.3.7 Residential Weatherization

Program Description

The Residential Weatherization program incented four categories of measures available to residential electric and gas customers heating their homes with fuel provided by Avista:

- Fireplace Dampers (Electric and/or Gas Savings)
- Insulation—Ceiling/Attic (Electric and/or Gas Savings)
- Insulation—Floor (Electric and/or Gas Savings)
- Insulation—Wall (Electric and/or Gas Savings)

Avista customers primarily heating with electric or natural gas and having a wood burning fireplace could receive up to $100 for installing a rooftop damper. This measure was removed for the 2012 program year. The one participant is a legacy from the previous program year.

The program incented qualifying ceiling and attic insulation (both fitted/batt and blown-in), which increased the R-value by 10 or more, at $0.25 per square foot of new insulation, and up to 50% of installation costs. Homes qualified if they had existing attic insulation less than R-19.

The program incented floor and wall insulation (both fitted/batt and blown-in), which increased the R-value by 10 or more, at $0.50 per square foot of new insulation, up to 50% of the installation cost. Homes qualified if they had existing floor and/or wall insulation less than R-5.

Analysis

The PY 2010–2011 electric impact evaluation report documented a census billing analysis Cadmus performed to determine the change in energy consumption resulting from installation of weatherization measures. As the billing analysis continued to provide the best information on this measure, results were maintained for the 2012 program year.[22]

The billing analysis did not include Fireplace Dampers, retaining the deemed savings value developed for the 2011 Avista TRM.

Table 36 shows total reported and qualified counts, savings, and realization rates of gas weatherization program measures.

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[22] Avista. *2010–2011 Multi-Sector Electric Impact Evaluation Report*. May 2012.

Table 36. Weatherization Program Results

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
X E Fireplace Damper With Electric Heat	1	163	163	99.2%	100.0%	162	99.2%
E Insulation	48	37,512	37,512	99.2%	100.0%	37,212	99.2%
Program Total	**49**	**37,675**	**37,675**	**99.2%**	**100.0%**	**37,373**	**99.2%**

1.3.8 Water Heater Efficiency

Program Description

The Water Heater Efficiency program represented one measure:

- High-Efficiency Water Heater (Electric)

Through this program, Avista offered a $50 incentive to residential electric customers installing an eligible high-efficiency water heater. Electric water heaters with a tank had to have a 0.93 EF or greater to qualify for the program.

Analysis

The PY 2010–2011 electric impact evaluation report documented analysis Cadmus performed to determine the change in energy consumption resulting from installation of this measure. As the analysis continued to provide the best information on this measure, results were retained for the 2012 program year.[23]

Results and Findings

Table 37 shows total tracked and qualified counts, savings, and realization rates for the electric Water Heater Efficiency program measure.

Table 37. Water Heater Efficiency Measure and Reported and Adjusted Savings

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
E Electric Water Heater	75	8,933	8,933	99.2%	100.0%	8,861	99.2%
Program Total	**75**	**8,933**	**8,933**	**99.2%**	**100.0%**	**8,861**	**99.2%**

[23] Cadmus. *Avista 2010–2011 Multi-Sector Electric Impact Evaluation Report*. May 2012.

1.3.9 ENERGY STAR Homes

Program Description

This program offered incentives to builders constructing single-family or multifamily homes complying with ENERGY STAR criteria and certified as ENERGY STAR Homes. Avista provided a $900 incentive for homes using its electric or electric and natural gas service for space and water heating.

Analysis

The PY 2011 electric impact evaluation report documented the simulation modeling Cadmus performed to determine energy savings achieved by these measures. As the simulation results continued to provide accurate estimates of savings, results were maintained for the 2012 program year.[24]

Results and Findings

Table 38 shows total tracked and adjusted counts, savings, and realization rates for measures within ENERGY STAR Homes. The electric and gas programs funded participating homes using both Avista electric and gas.

Table 38. ENERGY STAR Home Program Results

Program Name	Reported Measure Count	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Adjusted Gross (kWh)	Realization Rate
Home-Electric Only	9	22,590	22,590	100.0%	100.0%	22,590	100.0%
Elec/Gas (Electric)	2	2,108	2,108	100.0%	100.0%	2,108	100.0%
Program Total	**11**	**24,698**	**24,698**	**100.0%**	**100.0%**	**24,698**	**100.0%**

1.4 Conclusions

For PY 2012, Avista's Idaho residential electric programs produced 5,543,748 kWh in gross savings, yielding an overall realization rate of 109.3%. Table 39 shows reported and evaluated gross savings as well as realization rates per program.

[24] Cadmus. *Avista 2011 Multi-Sector Gas Impact Evaluation Report*. May 2012.

Table 39. Total Program Reported and Evaluated Gross Savings and Realization Rates

Program Name	Reported Savings (kWh)	Adjusted Savings (kWh)	Qualification Rate	Verification Rate	Evaluated Gross (kWh)	Realization Rate
Simple Steps, Smart Savings™	3,330,478	3,330,478	NA	NA	3,914,480	117.5%
Second Refrigerator and Freezer Recycling	268,752	350,968	NA	100.0%	350,968	130.6%
ENERGY STAR Products	380,897	193,963	100.0%	100.0%	193,963	50.9%
Heating and Cooling Efficiency	676,843	676,843	99.2%	100.0%	671,428	99.2%
Weatherization/Shell	37,675	37,675	99.2%	100.0%	37,373	99.2%
Water Heater Efficiency	8,933	8,933	99.2%	100.0%	8,861	99.2%
ENERGY STAR Homes	24,698	24,698	100.0%	100.0%	24,698	100.0%
Space and Water Conversions	344,734	344,734	99.2%	100.0%	341,977	99.2%
Total	**5,073,009**	**4,968,292**	**95.3%**	**100.0%**	**5,543,748**	**109.3%**

1.5 Recommendations

Cadmus recommends the following changes to Avista's residential electric programs:

- Consider updating per-unit assumptions of recycled equipment to reflect this evaluation, ensuring planning estimates of program savings more closely match evaluated savings.
- Move all clothes washer rebates to the electric program unless gas dryers achieve substantial penetration. Forthcoming RBSA data can support future analysis.
- Include a SEER requirement to increase savings for high-efficiency heat pump participation. Consider continuing the Variable Speed Motor measure in conjunction with any change to equipment efficiency requirements. Often, the highest efficiency heat pump systems use an electrically commutated motor (ECM) as standard equipment.
- Consider restricting dual-fuel customers who acquire multiple rebates and have interactive effects. If program changes reduce the participation of dual-fuel customers in certain measure categories, future evaluation activities should reassess the participant penetration of the dual-fuel home.
- Increase measure-level detail captures on applications and include in the database. Specific additional information should include: energy factors or model numbers for appliances; baseline information for insulation; and home square footage, particularly for the ENERGY STAR Homes program.
- Consider estimating savings and incenting systems separately for all-electric heating systems.
- Consider tiered incentives by SEER rating, as higher SEER systems generally require ECM fan motors to achieve certain SEER ratings.

1.5.1 Future Research Areas

Cadmus recommends the following future research areas:

- Review all available secondary research and/or collect primary data on the penetration of gas-heated clothes dryers within Avista's gas territory. This information can be used to refine the estimated gas and electric savings associated with the purchase of an ENERGY STAR clothes washer in a home with a gas domestic hot water tank.
- Perform a targeted billing analysis on weatherization participants using both electricity and gas to heat their homes.
- Perform a billing analysis on ENERGY STAR homes using a nonparticipant comparison group, once sufficient homes have participated under the new requirements.
- Identify new, cost-effective measures to be added to the portfolio.[25]

[25] At the time of this report, Cadmus was aiding Avista in identifying new programs and measures.

2. NONRESIDENTIAL ELECTRIC IMPACT REPORT

2.1 Introduction

Avista's nonresidential portfolio of programs promotes commercial utility customers' purchases of high-efficiency equipment. Avista provides rebates to partially offset the difference in cost between high-efficiency and standard equipment.

The nonresidential electric portfolio offers 16 programs in three major categories: Prescriptive, Energy Smart Grocer, and Site-Specific (Custom). Descriptions of the programs follow.

2.1.1 Prescriptive

Prescriptive Commercial Clothes Washer (PCW)

To encourage customers to select high-efficiency clothes washers, this program targets nonresidential electric and natural gas customers in multifamily or commercial Laundromat facilities. The program's streamlined prescriptive approach seeks to reach customers quickly and effectively to promote ENERGY STAR or Consortium for Energy Efficiency (CEE) listed units.

Prescriptive Commercial Windows and Insulation (PCS)

Beginning in January 2011, the installation of commercial insulation has been processed through a prescriptive program, in addition to the site-specific program. Projects eligible for the prescriptive commercial shell program have preexisting:

- Wall insulation levels of less than R4, improved to R11 or better.
- Attic insulation of less than R11, improved to R30 or better.
- Roof insulation of less than R11, improved to R30 or better.

Prescriptive Food Service (PFS)

Applicable to nonresidential electric and gas customers with commercial kitchens, this program provides direct incentives to customers choosing high-efficiency kitchen equipment. The equipment must meet ENERGY STAR or CEE tier levels (depending on the unit) to qualify for an incentive.

Prescriptive Green Motors Initiative (PGM)

Operated in partnership with the Green Motors Practices group, this program provides education to foster organization and promotion of member motor service centers' commitments to energy-saving shop rewind practices for motors ranging from 15 to 500 HP.

Prescriptive Lighting (PL)

Since a significant opportunity exists for lighting improvements in commercial facilities, this program offers direct financial incentives to customers that increase the efficiency of their lighting equipment. Existing commercial and industrial electric customers qualify if their facilities have rate schedules 11 or above. This program provides pre-determined incentive amounts for 38 measures, including:

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- T12 fluorescents to T8 fluorescents.
- High bay, high-intensity discharge lighting to T5 fluorescents or T8 fluorescents.
- High bay, high-intensity discharge lighting to induction fluorescents.
- Incandescents to compact fluorescents or cold cathode fluorescents.
- Incandescents to LEDs.
- Incandescent exit signs to LED exit signs.

Prescriptive HVAC Variable Frequency Drive (PHV)

The use of single-speed motors to drive fans or pumps often allows energy savings through use of a variable frequency drive (VFD). The VFD can convert a single-speed motor to variable speed without modification to the motor itself. This can be an efficient way to convert, for example, constant volume air systems into variable volumes. VFDs are readily available for motors from 1 hp to 300 hp, and can be easily installed directly into the power line leading to the motor, replacing the existing motor starter. VFDs can earn installation incentives through Avista.

Prescriptive PC Network Controls (PNC)

Computers remaining in a full-power state when idle can waste significant energy for customers with numerous PCs. This program, available to nonresidential electric customers, provides an incentive to install a network-based power management software solution to control the power of networked PCs.

Prescriptive Standby Generator Block Heater (PSG)

Most block heating technology employs natural convection within the engine block's system to drive circulation—more commonly known as thermosiphon. This program promotes the replacement of thermosiphon style engine block heaters with pump driven circulation units, which reduces overall block temperature. Because it also decreases the heat transfer rate from the block to the environment, it can reduce overall block heater energy consumption, which is tied to the circulation method.

Renewables (REN)

This program provides prescriptive incentives for residential and nonresidential projects that install photovoltaic (solar electric) systems and/or wind turbines.

2.1.2 Energy Smart Grocer (ESG)

Though refrigeration offers a high potential for energy savings, it is often overlooked due to the technical aspects of the equipment. The Energy Smart Grocer program assists customers with technical aspects of their refrigeration systems while providing a clear view of the savings they can achieve. A field energy analyst offers customers technical assistance, produces a detailed report of the potential energy savings at their facility, and guides customers through the ESG process, from inception to payment of incentives for qualifying equipment.

2.1.3 Site Specific (SS)

The site-specific program provides nonresidential measures that do not fit under the prescriptive

applications and thus must be considered based on their project-specific information. For a measure to be considered, it must have demonstrable kWh and/or therm savings. All commercial, industrial, or pumping customers that receive electric or natural gas service from Avista may qualify for these measures. The program includes the following electric and gas saving measures:

- Site Specific HVAC (SSHVAC)
  - HVAC Combined
  - HVAC Cooling
  - HVAC Heating
  - Motor Controls HVAC
  - Multifamily
- Site-specific Lighting (SSL)
  - Lighting Exterior
  - Lighting Interior
- Site-specific Other (SSO)
  - Appliances
  - Compressed Air
  - Industrial Process
  - Motors
  - Motor Controls Industrial
- Site-specific Shell (SSS)

Avista implements the site-specific and prescriptive programs, and PECI implements the ESG program. Both Avista and PECI design and manage program details, and have developed algorithms for calculating measure savings and determining measure and customer eligibility.

Avista staff fields inquiries from potential participants and contractors, and maintains a tracking database for projects. Throughout the program, Avista manages projects by: reviewing and approving applications at all stages of the process; calculating project savings; and populating the database with relevant information.

2.2 Methodology

Cadmus designed the impact evaluation to verify tracked program participation and to estimate energy savings. The evaluation determined gross savings using the following: engineering calculations, desk reviews, verification site visits, and some project-level billing analysis.

For a sample of sites, Cadmus reviewed Avista's tracked gross energy savings and available documentation, such as audit reports and savings calculation work papers, particularly focusing on calculation procedures and documentation for savings estimates. The review also verified the

appropriateness of Avista's analyses for calculating savings, and the analyses' operating and structural parameters. Through site visits or desk reviews for a sample of projects, Cadmus also collected data and evaluated gross energy savings through engineering calculations.

Cadmus collected baseline, tracking, and program implementation data through on-site interviews with facility staff. The visits included verifying measure installations and determining changes to the operating parameters following measure installation. Facility staff interviews included questions regarding the installed systems' operating conditions, additional benefits, or shortcomings. Using the savings realization rates from the sample sites, savings could be estimated and recommendations developed for future studies.

2.2.1 Sampling

Table 40 presents the rigor levels of precision targets for Idaho and Washington, combined. Cadmus developed a sampling calculation tool to estimate the number of on-site visits required to achieve these levels, using preliminary program population data provided by Avista. Meeting the levels required metering 52 projects and verifying 66 projects across the combined PY 2012 and 2013 program populations. By meeting targets for each stratum, the evaluation will achieve 90/10 precision at the overall nonresidential program level. Calculated following the PY 2013 evaluation, the final precision will be based on the combined program populations for both years.

Table 40. Proposed PY 2012-2013 Nonresidential Evaluation Activities

Stratum	Precision Target	Proposed Metering Projects	Proposed Site Visits
Prescriptive	90/20	23	14
ESG	90/20	6	7
SSHVAC	90/20	8	18
SSL	90/20	10	10
SSO	90/20	5	10
SSS	90/20	0	7
Total	90/20	**52**	**66**

Cadmus selected both a census and random sample for each stratum. The census projects represented a small number of participants with large savings impacts for the stratum. Table 41 presents the cutoff for the census savings for each stratum. We visited all sites with reported savings above this census level. From the remaining population of projects, the study also randomly selected additional participants in each stratum. Subsequent sections of this report will explain the differences between the initially proposed and the actual sampling plans for evaluation activities. Table 42 and Table 43 show final samples for 2012 projects. Cadmus will evaluate the remaining portions of the proposed sample shown in Table 40 for 2013 projects. Sample sizes will be modified, as appropriate based on final population sizes, to meet the expected confidence and precision levels.

Table 41. Census Level Cutoff by Stratum

Stratum	Reported Savings (kWh)
Prescriptive	1,000,000
ESG	no census level cutoff
SSHVAC	500,000
SSL	1,000,000
SSO	1,000,000
SSS	no census level cutoff

Table 42. Final PY 2012 Electric Evaluation Activity Sample—Washington and Idaho Combined

Stratum	Completed Metering Projects	Completed Site Visits
Prescriptive	9	6
ESG	0	7
SSHVAC	0	12
SSL	5	5
SSO	4	6
SSS	0	5
Total	**18**	**41**

Table 43. Final PY 2012 Electric Evaluation Activity Sample—Idaho Only

Stratum	Completed Metering Projects	Completed Site Visits
Prescriptive	3	1
ESG	0	4
SSHVAC	0	5
SSL	0	1
SSO	1	1
SSS	0	2
Total	**4**	**14**

The database extract provided information at the program-level but not at the measure level (e.g., chillers, anti-sweat heater controls, LED lighting fixtures). Therefore, the study sought to verify savings for every incented measure at each site, regardless of whether it achieved gas or electric savings. Cadmus could not, however, determine whether the study evaluated an accurate distribution of specific measure types within each program. Establishing this distribution would have required an exhaustive review of project files, which fell outside of the evaluation's scope.

2.2.2 Data Collection

Cadmus collected data from four metered projects and 14 on-site verifications in Idaho for PY 2012 (though the full sample with both states was used for extrapolation). The process began with a document review to determine measure types, quantities, operational parameters, and the calculation methodology.

Document Review

Avista provided Cadmus with documentation on the sample sites' energy-efficiency projects, including:

- Program forms;
- The tracking database;
- Audit reports; and
- Savings calculation work papers for each rebated measure.

The review of calculation spreadsheets and energy simulation models emphasized calculation procedures and documentation for savings estimates.

Cadmus reviewed each application for the following information:

- Equipment replaced: descriptions, schematics, performance data, and other supporting information.
- New equipment installed: descriptions, schematics, performance data, and other supporting information.
- Savings calculation methodology: the methodology type used, specifications of assumptions, sources for these specifications, and correctness of calculations.

Short-Term Metering

Cadmus performed short-term metering, lasting two to four weeks, for lighting projects in the Prescriptive Lighting and Site-Specific Lighting programs. This involved installing light loggers to estimate annual operating hours for each lighting measure. Cadmus developed a light logger plan to capture representative lighting operations for each site, basing the number and location of loggers for the site on the number of space types and the magnitude of savings by space and fixture-type.

The effort also installed power meters on a chiller retrofit that was part of an industrial process energy savings project. Meters recorded power data over a period of one month to characterize retrofit performance and power consumption.

Site Visits

On-site visits completed the following primary tasks:

1. Verifying the implementation status of all measures for which customers received incentives. This required verifying the energy-efficiency measures had been installed correctly and functioned properly. It also included verifying the operational characteristics of installed equipment, such as temperature set points and operating hours.
2. Collecting physical data, such as boiler capacities or operational temperatures, and analyzing the energy savings realized from installed improvements and measures.
3. Conducting interviews with facility personnel to obtain additional information regarding the installed system, thus supplementing data from other sources.

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2.2.3 Engineering Analysis

Prescriptive and site-specific programs required significantly different methods of analysis.

Overview

Procedures used for verifying savings through an engineering analysis depended on the type of measure analyzed. A list below presents analytical methods used in this evaluation, with descriptions in the following sections:

- Prescriptive deemed savings
- Short-term metering
- Calculation spreadsheets
- Energy simulation modeling

Prescriptive Deemed Savings

For most prescriptive measures, Cadmus verified the deemed savings estimates that Avista used for savings calculations. Verification activities focused on:

- The installed quantity;
- Equipment nameplate data;
- Proper equipment installation; and
- Operating hours.

Where appropriate, Cadmus used data from site verification visits to reanalyze prescriptive measure savings using Avista's Microsoft Excel calculation tools, ENERGY STAR calculation tools, RTF-deemed savings, and other secondary sources.

Short-Term Metering

Depending on the site and measure, Cadmus determined short-term light logging over a period of two to four weeks presented the most effective method for achieving precision on four lighting projects' energy-saving calculations.

Calculation Spreadsheets

Avista developed calculation spreadsheets to analyze energy savings for a variety of measures, including building envelope measures, such as ceiling and wall insulation. Calculation spreadsheets required input of relevant parameters (e.g., square footage, efficiency values, HVAC system details, and location details). From these data, energy savings could be estimated using algorithms programmed by Avista. Cadmus reviewed input requirements and output estimates for each spreadsheet and determined if the approach proved reasonable.

Energy Simulation Modeling

Avista determined savings for several site-specific HVAC and shell projects with energy simulation modeling (using eQuest software). Avista chose this method due to the complex interactions between

heating and cooling loads and building envelopes. Implementation staff provided the original energy simulation models, and Cadmus reviewed the models to determine relevant parameters and operating details (such as temperature set points) for the applicable measure, and then updated the models as necessary, based on on-site verification data.

2.3 Results and Findings

2.3.1 Overview

Cadmus adjusted gross savings estimates based on evaluated findings. The following sections discuss further details by program. The Idaho evaluation sample included 18 projects, divided into the following program subsectors:

- Prescriptive: four projects
- Energy Smart Grocer: four projects
- Site Specific: 10 projects

2.3.2 Prescriptive

Cadmus evaluated savings for a sample of sites across nine prescriptive programs for the combined Idaho and Washington sample. The Idaho sample only included projects from two programs—Lighting and PCN. Table 44 shows evaluated results by program. Further evaluation details for each program follow.

Table 44. Evaluated Results for PY12 Nonresidential Electric Prescriptive Sample—Idaho

Program	Number of Measure Installations	Evaluated Sample	Gross Reported Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate
PL	1,214	3	1,616,027	1,552,599	96%
PNC	1	1	21,000	0	0%
Total	**1,280**	**4**	**1,637,027**	**1,552,599**	**95%**

Table 45 shows the combined Idaho and Washington prescriptive results, which the study used for final extrapolation (as the sample derived from a combined sampling methodology).

Table 45. Evaluated Results for PY12 Nonresidential Electric Prescriptive Sample—Washington and Idaho

Program	Number of Measure Installations	Evaluated Sample	Gross Reported Savings (kWh)	Gross Evaluated Savings (kWh)	Realization Rate
PL	3,225	13	1,916,128	1,843,984	96%
PNC	3	1	21,000	0	0%
PSG	18	1	1,849	1,849	100%
Total	**3,420**	**15**	**1,939,067**	**1,845,743**	**95%**

Cadmus identified several discrepancies between the evaluated results and Avista's savings calculations. These often relied on reported equipment and operations data which could vary from parameters identified during on-site verification visits and metering.

Applied adjustments decreased savings by 5% for Idaho projects, described as follows:

- Cadmus used lighting logging and verification data to confirm or adjust operating hours for three projects. These adjustments, in addition to those made from verified fixture counts, reduced energy savings by 4%.
- The evaluation addressed one PCN project. The participant installed the system in 2009 and applied for an incentive in December 2009. Project files indicated Avista continued to seek output reports from the control system to verify savings in 2011 and 2012. The incentive was approved in early 2012. Cadmus contacted the facility in October 2012 and learned the participant had deactivated the PC network control system. Consequently, savings could not be assigned for this project.

2.3.3 Energy Smart Grocer

Cadmus performed on-site visits to four Energy Smart Grocer program projects in Idaho: two refrigeration case lighting projects and two walk-in case ECM projects. The study calculated an overall realization rate for all projects in Idaho and Washington, and then applied the resulting realization rate to savings for each state. Table 46 shows evaluated program results for Idaho, and Table 47 shows combined results for both states.

Table 46. Evaluated Results for PY12 Nonresidential Energy Smart Grocer Sample—Idaho

State	Total PY12 Measure Installations	Evaluated Sample	Gross Reported Sample Savings (kWh)	Gross Evaluated Sample Savings (kWh)	Sample Realization Rate
Idaho	90	4	96,193	95,556	99%

Table 47. Evaluated Results for PY12 Nonresidential Energy Smart Grocer Sample—Combined Washington and Idaho

State	Total PY12 Measure Installations	Evaluated Sample	Gross Reported Sample Savings (kWh)	Gross Evaluated Sample Savings (kWh)	Sample Realization Rate
Combined	339	7	176,332	188,849	107%

Adjustments decreased Idaho savings by 1%. Cadmus applied a calculation algorithm from the Pennsylvania TRM for ECMs, which resulted in saving slightly below the reported values.

2.3.4 Site Specific

Cadmus performed site visits for 10 site-specific program projects, representing a variety of measure types. The study included calculating an overall realization rate for all projects in Idaho and Washington, and then applying the resulting realization rate to savings for each state.

Table 48 lists the different measure types evaluated as well as the number of projects and reported savings. Table 49 shows the combined Idaho and Washington site-specific results. The final extrapolation used these results as the sample drew upon a combined sampling methodology.

Table 48. Evaluated Results for PY12 Nonresidential Electric Site-Specific Sample—Idaho

Program	Total PY12 Measure Installations	Evaluated Sample	Gross Reported Sample Savings (kWh)	Gross Evaluated Sample Savings (kWh)	Sample Realization Rate
SSHVAC	20	5	520,254	520,254	100%
SSL	69	1	148,071	151,006	102%
SSO	15	2	1,079,628	1,438,795	133%
SSS	15	2	35,460	35,460	100%
Total	**119**	**10**	**1,783,413**	**2,145,515**	**120%**

Table 49. Evaluated Results for PY12 Nonresidential Electric Site-Specific Sample—Washington and Idaho

Program	Total PY12 Measure Installations	Evaluated Sample	Gross Reported Sample Savings (kWh)	Gross Evaluated Sample Savings (kWh)	Sample Realization Rate
SSHVAC	57	12	2,951,169	2,371,550	80%
SSL	209	10	4,199,785	4,132,698	98%
SSO	78	10	3,150,716	3,561,253	113%
SSS	28	5	381,275	315,085	83%
Total	**372**	**37**	**10,682,945**	**10,380,586**	**97%**

The reported savings methodology and estimates proved accurate for eight of Idaho's 10 site-specific projects. Site-specific projects tend to be more complex, making energy-savings parameters and impacts more difficult to estimate. The calculations also often rely on participant-supplied building, equipment, and operations data, which may vary from parameters identified during on-site verification visits. Cadmus found it notable that such a large portion of the projects achieved the reported savings.

Two adjustments increased Idaho savings by 20%, driven primarily by the high realization rate for a census-level Site Specific Other project: an industrial process measure. Cadmus conducted power metering for several months on the project, with metering data showing retrofit power consumption less than the reported estimate, resulting in higher energy savings.

The other adjustment involved a Site Specific Lighting project, where Avista's documentation listed energy savings of 151,181 kWh. The tracking database reported a value of 148,071 kWh. Cadmus calculated energy savings of 151,006 kWh, based on the on-site verification results. Comparing Cadmus' those results with those from the tracking database resulted in a 102% realization rate.

2.3.5 Extrapolation to Program Population

In evaluating the nonresidential electric programs, Cadmus selected sites that could provide the most significant impacts. As discussed, site visits sought to achieve a statistically valid sample for the major strata. For measures in the random (non-census) sample, Cadmus calculated realization rates to apply to programs at the remaining non-sampled sites. These realization rates were weighted averages, based on the random verification sample, and using the following four equations:

$$RR_{ij} = \frac{Evaluated_{ij}}{Tracked_{ij}}; \text{ for measure } j \text{ at site } i \quad (1)$$

$$RR_{j} = \frac{\sum_{i} Evaluated_{i}}{\sum_{i} Tracked_{i}}; \text{ for measure } j \text{ across all sample sites} \quad (2)$$

$$\sum_k Evaluated_k = RR_j x \sum_k Tracked_k ; \text{ for measure } j \text{ across all sites in measure population} \quad (3)$$

$$RR_l = \frac{\sum_k Evaluated_k}{\sum_k Tracked_k} ; \text{ for the population (all sites and measures)} \quad (4)$$

Where:

RR = the realization rate

i = the sample site

j = the measure type

k = the total population for measure type 'j'

l = the total program population

Cadmus calculated realization rates for each individual site in the sample based on the measure type (Equation 1). The realization rates could then be calculated for the measure types using the ratio of the sum of evaluated savings to the sum of tracked savings from the randomly selected sample for each measure type (Equation 2). Non-census population evaluated savings could be determined by multiplying the measure type realization rate from the random sample by the tracked savings for the non-census population of each measure type (Equation 3). Adding the tracked and evaluated savings from census stratum measures produced the total tracked and evaluated savings for each program. The program realization rate derived from the ratio of all evaluated savings to all tracked savings (Equation 4).

Table 50 summarizes the results for all prescriptive and site-specific programs in Idaho. The state achieved a 95% overall nonresidential electric portfolio gross realization rate.

Table 50. PY 2012 Gross Electric Program Realization Rates

Program	Gross Program Reported Savings (kWh)	Gross Program Evaluated Savings (kWh)	Realization Rate*
Prescriptive	12,778,400	11,746,328	92%
ESG	1,586,096	1,698,686	107%
SSHVAC	1,679,069	1,455,208	87%
SSL	2,735,976	2,570,650	94%
SSO	1,124,082	1,487,938	132%
SSS	256,296	211,803	83%
Total	**20,159,919**	**19,170,631**	**95%**

*Full program realization rates vary from the sample realization rates above because of sample extrapolation of the non-census level projects.

2.3.6 HVAC/Lighting Interactive Impacts

The Avista portfolio results did not account for gas heating penalties caused by increased lighting efficiency. Lighting systems convert a large portion of their input energy to useful light output, but a substantial portion also converts to heat. Any reduction in lighting input energy also reduces waste heat. Reducing waste heat lowers the site's required cooling load, but increases its heating load.

Cadmus noted that Avista tracked and recorded these HVAC interactive effects for many projects to determine program cost-effectiveness. Most interactive effects involved prescriptive or site-specific lighting projects, although some therm penalties resulted from the Energy Smart Grocer (in Avista's electric portfolio) and site-specific HVAC program projects.

Typically, Cadmus applies interactive factors, based on values supplied by the Northwest Power and Conservation Council's RTF. Those values vary by fixture savings, building types, and HVAC systems. Such information, however, could not be procured for most of the affected projects evaluated. Avista acknowledged it did not use as robust of a methodology for calculating interactive effects as that used for its energy-savings methodology.

2.4 Conclusions

Cadmus evaluated 18 of 1,491 measures installed through the program in Idaho, representing 17% of reported savings. Extrapolation was based on the combined, Idaho and Washington sample.

Generally, the evaluation results indicated that Avista implemented the programs well. The overall nonresidential electric portfolio achieved a 95% realization rate, upon comparing gross evaluated savings to gross reported savings.

Cadmus identified the following key issues that adjusted energy savings:

- Power metering on one industrial process measure indicated lower-than-expected post-installation power consumption, which increased energy savings.
- Light logging on three projects identified a slight decrease in operating hours from the reported values.
- Cadmus applied algorithms different from those used by PECI to determine energy savings for ECMs. This resulted in a slight decrease in energy savings.

Cadmus identified an implementation issue affecting the impact evaluation:

- One project installed PCN in 2009, but did not provide the final data demonstrating reduced consumption until 2012. Avista paid the incentive in 2012, but the participant reported deactivating the system soon after.

2.5 Recommendations

Cadmus recommends that Avista continue to offer incentives for measure installations through the evaluated programs. Based on results from the Idaho projects, the following recommendation has been designed for improving program energy-savings impacts and the effectiveness of evaluation:

- Avista should work with participants to accelerate the process for claiming energy savings and paying the project incentive. Preferably, this should occur within one year of measure installation, depending on Avista's requirements for post-installation data for a particular project.

3. LOW INCOME ELECTRIC IMPACT REPORT

3.1 Introduction

In 2011, Cadmus conducted a statistical billing analysis of 2010 low income participants, determining adjusted gross savings and realization rates for energy-efficient measures installed through Avista's low income weatherization program. The study examined analysis and results at the household or participant level, rather than the measure level.

This report section addresses the following:

- Application of the 2010 billing analysis savings estimates to the 2012 participant population; and
- Reporting total electric impacts associated with the 2012 program year in Idaho.

In the first quarter of 2014, Cadmus will perform a new billing analysis on 2012 participants, using pre-period data from 2011 and post-period data from 2013. In the interim, this evaluation extrapolates results from the recent 2010–2011 electric impact analysis to 2012 participants.

To estimate 2010–2011 energy savings resulting from the program, Cadmus used a pre- and post-installation, combined Conditional Savings Analysis (CSA) and Princeton Score-Keeping Method (PRISM) approach, utilizing monthly billing data. This approach involved:

- Analyzing savings estimates for Idaho and Washington;
- Running a series of diagnostics (such as a review of savings by pre-consumption usage quartile); and
- Conducting outlier analysis.

Avista's *2010–2011 Multi-Sector Electric Impact Evaluation Report* presents a detailed discussion of the regression model and methodology used for this analysis.

3.1.1 Program Description

Five programs, listed in Table 51, make up Avista's Low Income Weatherization Program. Local Community Action Partners (CAPs) within Avista's Idaho and Washington service territories implement these low income programs. CAPs holistically evaluate homes for energy-efficiency measure applicability, combining funding from different programs to apply appropriate measures to a home, based on the results from a home energy audit.

Table 51 also describes measures installed under each program component, along with counts of electric measures installed in PY 2012 and included in our electric impact analysis (a separate report contains findings on evaluated gas measures).[26]

[26] Cadmus. *Avista 2012 Idaho Gas Portfolio Impact Evaluation Report*. July 30, 2013.

Table 51. 2012 Electric-Efficiency Installations by Program Component

Low Income Program Component	Measure Description	Measure Installations
Shell/Weatherization	Insulation, window/door, air infiltration, programmable thermostat	180
Fuel Conversion*	Electric furnace, heat pump, or water heater replacement with gas units	28
Hot Water Efficiency	High-efficiency water heater replacement	6
ENERGY STAR Appliance	High-efficiency refrigerator replacement	N/A
HVAC Efficiency	High-efficiency gas furnace replacement	N/A

*The Avista portfolio considers (and reports) fuel conversion measures as electric-saving measures.

3.2 Data Collection and Methodology

Cadmus primarily drew impact evaluation data from the program participant database. Avista provided information regarding program participants and installed measures for Idaho. Specifically, these data included:

- Lists of measures installed per home; and
- Expected savings from each completed measure installation.

The data, however, did not include the quantity of measures installed (such as the square footage of installed insulation) or per-unit savings estimates.

Starting in 2012, Avista incorporated TRM savings estimates, developed by Cadmus and specific to Avista's low income customer segment. These measure-specific savings estimates incorporated data from regional and secondary research (e.g., RTF, DOE) as well as input assumptions derived from analysis of low income weatherization program participant consumption (e.g., pre-period heating consumption).

3.2.1 Documentation Review/Database Review

Cadmus used the 2012 Idaho and Washington program participant database, provided by Avista, to develop a complete population for applying the 2010–2011 billing analysis results. Participant data included:

- Customer information;
- Account numbers;
- Types of measures installed;
- Rebate amounts;
- Measure installation costs;
- Measure installation dates; and
- TRM savings per measure.

3.2.2 Sampling

In applying the 2010–2011 electric billing analysis results, Cadmus used a census of 2012 program participants, containing 81 electric accounts, including 16 electric participants receiving conversion measures.

3.2.3 Billing Analysis—CSA Modeling Approach

To estimate energy savings from this program, Cadmus used a pre-post CSA fixed-effects modeling method, which utilized pooled monthly time-series (panel) billing data.

The fixed-effects modeling approach corrected for differences between pre- and post-installation weather conditions as well as for differences in usage consumption between participants (i.e., including a separate intercept for each participant). The modeling approach ensured model savings estimates would not be skewed by unusually high-usage or low-usage participants. Pairing monthly consumption between pre- and post-months maintained the same time frame for evaluating unique participants.

Additional details regarding the 2010–2011 billing analysis can be found in the *Avista 2010–2011Multi-Sector Electric Impact Evaluation Report*.

3.2.4 Estimating Conversion Participant Savings

While the program historically installed electric to gas fuel-conversion measures in Washington, Avista introduced these measures to Idaho participants starting in 2012. Given the 2010–2011 analysis of conversion measures only addressed Washington installations, this study scaled these savings estimates using average heating degree days to apply to Idaho customers. This approach assigned savings to conversion participants (n = 16), based on the specific electric to gas conversion measures installed. Table 52 provides energy savings estimates assigned to Idaho conversion measures.

Table 52. Idaho Electric Conversion Energy Savings

Conversion Measure	Total Participants	Model Savings (kWh)
Furnace Only*	2	8,506
DWH Only	2	4,162
Combo	12	12,668

*Given the low precision in modeling furnace-only impacts in the 2010–2011 study, reported savings represent the difference between modeled combination participant savings (those receiving both furnace and water heater conversions) and water-heater only participant savings.

3.3 Results and Findings

3.3.1 Summary of Program Measures

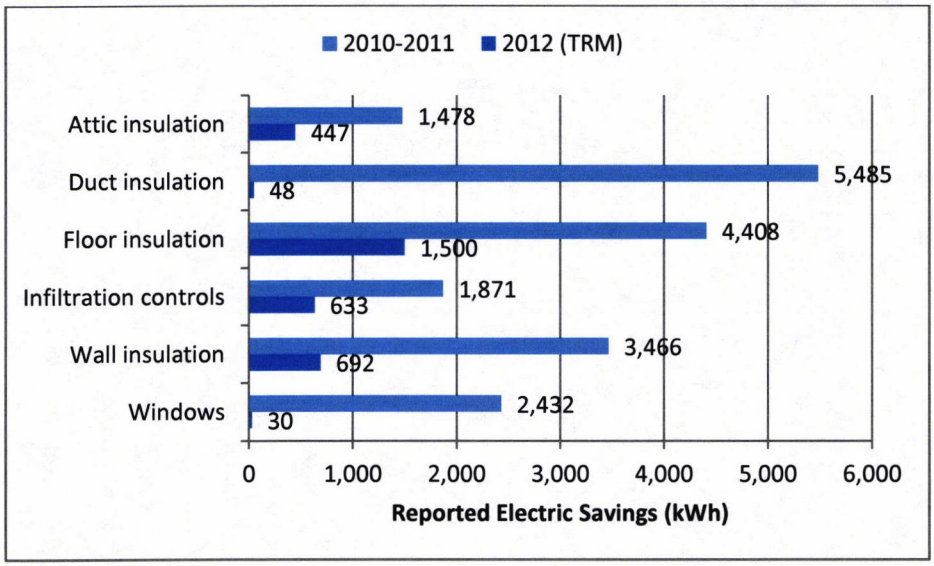
Table 53 shows the count and average reported TRM savings for 2012 electric-saving measure installations in Idaho (including non-conversion and conversion participants). Infiltration measures exhibited the highest count, followed by windows and floor insulation. Duct insulation achieved the highest average reported TRM savings.

Table 53. Average Reported Savings and Installation Count by Measure

Measures	Count	Ave. Reported TRM Savings (kWh)
Attic insulation	20	1,478
Doors	29	287
Duct insulation	6	5,485
Floor insulation	32	4,408
Furnace replacement (conversion)	14	N/A
Infiltration controls	57	1,871
Refrigerator replacement	N/A	N/A
Wall insulation	2	3,466
Water heater replacement	6	299
Water heater replacement (conversion)	14	N/A
Windows	34	2,432

To highlight some distinctions in Avista's reported savings that contributed to changes in realization rates, Cadmus compared average expected measure savings from the 2010–2011 period to the 2012 TRM estimates. Figure 10 highlights the differences between reported average savings.

Figure 10. Comparison of 2010–2011 and 2012 Average Reported Savings by Measure



A number of measures reported considerably lower savings in 2012 using TRM estimates than the 2010–2011 average savings, most notably: insulation measures, windows, and infiltration controls. The different years, however, generally offered a relatively similar mix of measure installations, with infiltration controls and window replacements the most frequently installed measures for electric-saving participants.

Non-Conversion Participant Results

Applying savings estimates from the billing analysis to the electric-saving participant program population produced total savings of 1,602 kWh per participant. Cadmus applied these modeled savings estimates

to electric-savings participants not receiving conversion measures, and calculated average reported TRM savings by: summing measure savings at each household; and then taking the mean household savings across individual participants. Table 54 compares average participant TRM savings and modeled savings for non-conversion customers.

Table 54. Non-Conversion Gas Savings

Total Non-Conversion Participants	Average Reported TRM Savings (kWh)	Model Savings (kWh)	Realization Rate	Total Non-Conversion Savings
65	1,593	1,602	101%	104,130

Conversion Participant Results

Of the 81 total Idaho gas-savings participants, 16 received electric-to-gas conversion measures, including electric-to-gas furnace and water heater replacements. The analysis considered these participants separately, as the methodology for estimating evaluated savings differed slightly different from the non-conversion participant group. Table 55 provides a distribution of all Avista-funded conversion measure installations and their associated energy savings. Each group of conversion participants exhibited a high realization rate, with an overall realization rate of 103%.

Table 55. Measure Installations for Conversion Participants

Group	Total Participants	Total Reported TRM Savings (kWh)	Model Savings Per Participant (kWh)	Total Savings (kWh)	Realization Rate
Furnace Only	2	16,428	8,506	17,012	104%
DWH Only	2	8,026	4,162	8,324	104%
Combo	12	146,938	12,668	152,017	103%
Total	**16**	**171,392**		**177,353**	**103%**

3.3.2 Overall Participant Results

Table 56 provides overall electric savings, including savings attributed to fuel conversion participants.

Table 56. Overall 2012 Idaho Electric Savings

Evaluated Savings			Total Reported TRM Savings (kWh)	Realization Rate
Total Non-Conversion Participant Model Savings (kWh)	Total Conversion Participant Savings (kWh)	Total Savings (kWh)		
104,130	177,353	281,483	274,913	102%

3.4 Conclusions

Upon comparing the 2010–2011 and 2012 results, changes in Avista's expected savings calculations led to differences in realization rates. Average reported electric savings per (non-conversion) participant

decreased by 56% between the examined periods, falling from 3,626 kWh in 2010–2011 to 1,593 kWh in 2012 (based on the TRM). This appeared to primarily drive shifting realization rates for non-conversion participants, from 27% for Idaho in 2010–2011 to 101% in 2012.

As shown in Figure 10, all measure-level estimates observed significant changes in kWh savings between the 2010–2011 reporting and the 2012 TRM estimates, with these decreases in average savings ranging from three to approximately 100 times the previously reported estimates, most notably for windows and duct insulation measures.

3.5 Recommendations

Cadmus' recommends the following enhancements to improve program impact results:

- **In future billing analyses, use a control or comparison group**. For upcoming impact evaluations revisiting the billing analysis, Cadmus suggests using 2013–2014 participants as a control group to analyze the treatment group of 2012 participants. For such analysis, 2011 and 2013 annual participant consumption histories would serve as the pre- and post-periods. Using a control or comparison group of nonparticipants would allow analysis to control for exogenous factors (e.g., macroeconomic, rate changes, technological trends) that could result in trends affecting consumption. Controlling for these trends using a control/comparison group reflects a more robust experimental design and defensible methodology for estimating accurate energy-savings impacts.
- **Work with Idaho agencies to provide refrigerator replacements.** Refrigerator replacements can result in significant electric savings. Avista should work with local CAP agencies and other Idaho stakeholders to identify the best ways to encourage integrating these measures into program delivery.
- **Include high-use customers in program targeting.** While prioritization guidelines for targeting low income weatherization participants are set at the federal level, some utilities, for targeting purposes, actively track customer usage and provide agencies with lists of customers experiencing particularly high energy consumption.
    - Notably, DOE protocols list high-energy consumption as a factor allowed in participant prioritization. In such cases, along with other targeting criteria (e.g., families with children, senior citizens), agencies may incorporate energy-consumption characteristics into their program participant prioritization. Not only would weatherizing high-use customers likely result in higher energy savings, but the program could provide some financial relief for customers overly burdened with energy bills due to their housings' characteristics.
    - Methods exist for identifying high-usage customers while controlling for factors contributing to consumption (e.g., square footage, income, numbers of people per household). Avista should utilize such approaches.
    - Given reductions in federal funding for weatherization and associated reduced agency capacities resulting in more limited leveraging opportunities, Avista has an opportunity to

lead new efforts for continued delivery of energy-savings resources to low income residential customers. By considering high-usage targeting, potential exists to secure cost-effective energy savings through one segment of this population, while continuing to support weatherization for income-qualified customers, which may result in lower savings and prove less cost-effective. Efficient targeting can aid in balancing these efforts to provide whole-house weatherization, while continuing to leverage the agency network as a resource for outreach and delivery.

- **Track and compile additional data from agency audits.** These data include information on primary and secondary heating and cooling, and on the size of a home. As an inexpensive alternative to gas heat, gas customers may turn to electric room heaters and wood stoves, reducing the impacts of weather-sensitive measures installed through weatherization (e.g., insulation). Collecting information on customers' primary heating usage during weatherization would provide more reasonable savings estimates.

  Cadmus recommends Avista work with agencies to develop explicit, on-site tracking protocols for collecting information on participant heating sources. Agencies should collect the following information to better inform heating (and cooling) sources:

  - Visual inspections of all heating equipment found on site;
  - Participant-reported primary and supplemental heating sources used;
  - Quantities of secondary heating, if applicable (e.g., numbers of electric room heaters); and
  - Any indicators suggesting discrepancies between actual and reported primary heating.

- **Consider performing quantitative, nonenergy benefit analyses.** With respect to ongoing, Advisory Group discussions that address quantifying non-energy benefits, Cadmus recommends Avista consider pursuing additional analyses, aimed at quantifying nonenergy benefits associated with low income weatherization and applicable to the TRC test. In particular, analyses of economic impacts and payment pattern improvements (including reduced arrearages and collections costs) can provide program stakeholders with the monetized values of benefits. Other utilities have used such analyses in reporting low income weatherization cost-effectiveness in the Northwest (e.g., Idaho, Washington). Standard cost-effectiveness testing, using the TRC test, accounts for all program costs (only including energy savings as program benefits), but clearly omits some genuine nonenergy benefits experienced by participants (as discussed in greater detail in the *2010 Process Evaluation*).

4. CFL CONTINGENCY PROGRAM

4.1 Introduction

Cadmus' previous evaluation[27] estimated the percentage of bulbs installed by the end of calendar year 2011 and only provided the savings associated with these bulbs. This report provides total energy savings achieved by the program in the first year and calculates energy savings installed in 2012 as the difference between the total program savings and evaluated PY 2011 savings.

4.1.1 Program Description

The CFL Contingency program's design intended to deliver highly cost-effective, energy-efficiency resources to Avista's customer base (both residential and small commercial), while simultaneously maintaining the utility's flexibility to meet anticipated energy acquisition targets at a lower ratepayer cost and with a minimum of uncertainty.

Starting in July 2011 and continuing through November 2011, Avista sent residences and small businesses within the utility's territory a box of eight ENERGY STAR CFLs of varying sizes, accompanied by literature on the benefits of their use and instructions on proper disposal and bulb placement.

Customers also received information about returning the CFLs, at no cost to the customer, should they decide not to keep them. Customers also could request additional bulbs.

4.2 Methodology

For evaluating the savings achieved by the CFL Contingency Program, Cadmus completed an engineering review, based on the previous evaluation analysis, but updated to include recent evaluation results and expected regional decisions.

Six parameters informed the calculation of gross savings for the lighting component:

Where:

CFL Watts =	Wattage of the mailed ENERGY STAR CFL
DWM =	The difference in wattage between baseline bulb and the CFL, divided by the wattage of the CFL
HOU =	Daily lighting operating hours

[27] Cadmus. *Avista 2010–2011 Multi-Sector Electric Impact Evaluation Report*. May 2012.

DAYS = Days per year (365)

WHF = An adjustment representing the interactive effects of lighting measures on heating and cooling equipment operations

ISR = The percentage of units installed

The annual savings algorithm derived from industry-standard engineering practices, consistent with the methodology used by the Northwest RTF. Discussions of each input follow.

4.2.1 CFL Wattage

This assumption did not change from the previous analysis. The program delivered over 2.3 million CFLs to residential and commercial customers in Avista's territory, with the distribution shown in Table 57. The CFL wattage derived from the weighted average of delivered units to each sector. The residential sector had an average delivered CFL wattage of 18.30 watts, and the commercial sector had an average delivered CFL wattage of 18.25 watts.

Table 57. Total Units of Delivered CFLs by State and Sector Type

CFL Wattage	Residential			Commercial			Total Delivered
	WA Units	ID Units	Total Units	WA Units	ID Units	Total Units	
13	389,006	170,774	559,780	18,960	15,590	34,550	**594,330**
19	55,116	-	55,116	-	-	-	**55,116**
20	1,056,786	512,322	1,569,108	56,880	46,770	103,650	**1,672,758**
23	55,116	-	55,116	-	-	-	**55,116**
Total	**1,556,024**	**683,096**	**2,239,120**	**75,840**	**62,360**	**138,200**	**2,377,320**

4.2.2 DWM

This assumption did not change from the previous evaluation. Cadmus relied on the RTF (for residential) and the 6th Power Plan (for commercial) to determine the DWM. Adjusting the RTF's residential DWM allowed incorporation of Avista's survey results that documented the room distribution of installed bulbs. Thus, the DWM for residential installation changed from the RTF's 2.60 to 2.63.[28] The commercial DWM was 2.70, based on the 6th Power Plan lighting workbook.

This analysis did not consider EISA's potential impact. EISA could only impact the baseline for the 55,116 23-Watt CFLs mailed to Washington residents. Only the first round of packages included these bulbs, which appeared to have almost achieved the maximum ISR by the end of 2011 according to surveys.

4.2.3 HOU

This residential assumption has been updated, based on recent evaluation results. Cadmus estimated the CFL HOU for residential installations using: Avista's survey of room types; and a multistate modeling approach, built on light logger data collected from five states (Missouri, Michigan, Ohio, Maine, and

[28] The RTF DWM represents the 2011 baseline, and does not include federal EISA impacts starting in 2012.

Maryland).[29] The Maine HOU study, completed in the past year, was added to the model used for the previous evaluation. The average HOU was calculated using a regression statistical model that combined multistate, multiyear data. Cadmus used the multistate model's estimate of HOU by room type, weighting this based on Avista's survey results to determine an overall HOU average of 2.38, a 3% reduction from the 2.45 estimated previously.

For commercial HOU, Cadmus used the 6th Power Plan's documented lighting hours of operating for each building. After gathering building type information from Avista's survey of commercial participants, Cadmus weighted the 10.16 lighting hours from the 6th Power Plan to calculate 10.02 for Avista's commercial HOU. The assumed commercial HOU did not change from the previous analysis.

4.2.4 WHF

This assumption did not change from the previous evaluation. The WHF accounts for changes in annual HVAC energy (lost or gained) due to reductions in facility lighting energy. Cadmus based the WHF on SEEM building models, developed by the Northwest Power and Conservation Council. These SEEM building models estimated the change in HVAC equipment energy use due to a change in lighting technology (e.g., incandescent lamps to CFLs). In general, the models accounted for interactions using load-shape profiles of the HVAC and lighting equipment, based on dwelling occupancy.

The Northwest Power and Conservation Council uses an inherently conservative method that assumes a closed shell (i.e., all interior lamps, including ceiling recessed cans would be contained in a closed system, hence any heat generated by the bulbs would go into the building). In reality, waste heat could transfer out of the conditioned space.

Cadmus based the WHF calculation on Avista's share of electric heating equipment,[30] along with its associated efficiencies and its surveys of interior and exterior distribution, to obtain a WHF of 89.8%.[31]

Cadmus used the commercial WHF of 85.5% provided in the 6th Power Plan.

4.2.5 ISR

An update to this assumption allowed estimates of the percentage of bulbs installed. The ISR used in this analysis represented the percentage of bulbs believed to be installed within one calendar year of the receipt of the CFL package.

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29 The Cadmus Group, Inc. *2010 Evaluation, Measurement, and Verification Report*. Dayton Power and Light. March 15, 2011.

30 Saturations of Avista equipment types are based on the 2011 participant survey for the CFL Contingency Program.

31 The RTF WHF is 86.4%; the adjusted Avista WHF is 89.8%.

In December 2012, the RTF approved the *Residential: Lighting—Specialty CFLs* workbook,[32] the only residential CFL workbook reviewed by the RTF since the Northwest Energy Efficiency Alliance (NEEA) RBSA data became available. Based on the RBSA results, the approved workbook assumed a 24% storage rate for residential specialty CFLs. Cadmus assumed that, since the data used to develop this storage rate was not specific to specialty CFLs, the RTF will update its storage rate assumption for all CFLs to this value upon updating the *Residential: Lighting—CFLs* workbook later this year. When combined with an assumed 3.57% removal rate, a 73.6% first-year ISR results for direct mail CFLs.

4.3 Overall Program Savings

Cadmus calculated PY 2012 savings by subtracting the PY 2011 evaluated savings, calculated in the previous evaluation, from the total program savings calculated in this evaluation. Table 58 shows achieved annual savings by year, state, and sector.

Table 58. CFL Contingency Program Evaluated and Expected Savings by State and Year

Sector	Region	Total Program Savings (kWh)	PY 2011 Evaluated (kWh)	PY 2012 Evaluated (kWh)
Residential	WA	42,951,931	23,347,564	19,604,367
	ID	18,698,660	10,143,973	8,554,687
	Total	**61,650,591**	**33,491,536**	**28,159,054**
Commercial	WA	8,609,893	3,826,229	4,783,664
	ID	7,079,548	3,146,145	3,933,403
	Total	**15,689,441**	**6,972,374**	**8,717,067**
Total			**77,340,032**	**40,463,910**

[32] http://rtf.nwcouncil.org/measures/measure.asp?id=142

5. PORTFOLIO GROSS AND NET SAVINGS

5.1 Gross Portfolio Savings

The 2012 Idaho electric portfolio consisted of several sectors and many program delivery streams. In total, the programs achieved a 98.7% gross realization rate and total gross savings of 37,483,952 kWh (Table 59).

Table 59. 2012 Idaho Gross Savings

Sector	Reported Savings (kWh)	Gross Verified Savings (kWh)	Realization Rate
Residential*	13,627,696	14,098,455	103.5%
Nonresidential*	24,093,322	23,104,034	95.9%
Low Income	274,913	281,483	102.4%
Total	**37,995,931**	**37,483,952**	**98.7%**

*Includes CFL Contingency savings.

5.2 NTG Adjustment

Cadmus evaluated NTG through customer self-reports, utilizing different methodologies and data sources for the different programs, as detailed below.

5.2.1 Residential NTG

NTG values were updated for the 2012 residential population. Freeridership and participant spillover was determined from participating customer self-reports from 274 phone surveys performed during Q2 2013. The methodology is consistent with that described in detail in a full NTG report published last year.[33]

Non-participant spillover was calculated from 1,051 completed surveys (380 in Idaho) from our multi-method General Population survey. 3,000 paper surveys were mailed to randomly selected residential customers in both ID and WA. These mailings included a website to complete the survey online, and finally, a subset of the sample was called with a traditional phone survey. This multi-media method helps reduce survey bias. The Second Refrigerator and Freezer Recycling program has a specific NTG methodology that is discussed in detail in Section 1. Table 60 outlines the NTG components and resulting program level NTG.

Table 60. Residential NTG

Program	Freeridership	Participant Spillover	Non-Participant Spillover	NTG
ENERGY STAR Products	77%	0%	0%	23%
Heating and Cooling Efficiency	61%	0%	1.9%	41%
Weatherization/Shell	59%	1.4%	4.6%	47%
Water Heater Efficiency	77%	0%	0%	23%
Space and Water Conversions	63%	0.1%	0%	37%

[33] Cadmus. *Net-to-Gross Evaluation of Avista's Demand-Side Management Programs*. June 2012.

Table 61 shows the NTG values and resulting net savings for Avista's residential downstream programs.

Table 61. Residential NTG and Net Savings

Program	Verified Gross Savings (kWh)	NTG	Net Savings (kWh)
Second Refrigerator and Freezer Recycling	350,968	44%	154,811
ENERGY STAR Products	193,963	23%	44,611
Heating and Cooling Efficiency	671,428	41%	274,413
Weatherization/Shell	37,373	47%	17,535
Water Heater Efficiency	8,861	23%	2,038
Space and Water Conversions	341,977	37%	127,010
ENERGY STAR Homes	24,698	74%	18,277
Total	**1,629,268**	**39%**	**638,695**

5.2.2. Nonresidential NTG

To reduce survey fatigue for Avista's nonresidential customers, Cadmus did not perform any data collection with 2012 program participants, and does not have updated NTG information. Surveys, planned for the 2013 participant population, will be performed in Q1 2014. This report uses NTG values from the 2011 analysis,[34] which can be found in Table 62, along with the resulting net savings. The nonresidential sector exhibited a weighted nonresidential NTG of 75%.

Table 62. Nonresidential NTG

Program	Verified Gross Savings (kWh)	NTG	Net Savings (kWh)
Energy Smart Grocer	1,698,686	96%	1,630,739
Prescriptive	11,746,328	67%	7,917,025
Site-Specific	5,725,617	83%	4,769,439
Total	**19,170,631**	**75%**	**14,317,203**

5.2.3 No NTG Adjustment

The following programs did not receive a NTG adjustment as the original savings analysis methodology accurately reflected net market characteristics: Low Income, Simple Steps, and CFL Contingency.

Low Income

Commonly, low income programs receive a 100% NTG, as the energy-efficient upgrades are performed at no cost to the home owner, and are considered a social good.

Simple Steps

The savings analysis methodology for Avista's upstream lighting program follows the RTF—an organization that does not differentiate between gross and net savings in favor of using an adjusted market baseline approach. As discussed in Section 1, the various inputs to the savings calculation either

[34] Cadmus. *Net-to-Gross Evaluation of Avista's Demand-Side Management Programs*. June 2012.

used direct RTF values or RTF methods with Avista-specific data. To assign an additional NTG value to this program would, in effect, be double counting.

CFL Contingency

The CFL Contingency program sent bulbs at no cost to Avista customers. As consistent with the 2011 evaluation, no NTG adjustment is applied to these bulbs.

5.3 Net Portfolio Savings

The portfolio achieved an overall NTG ratio of 84% and 31,639,951 kWh of net savings. Table 63 shows verified gross and resulting net savings for Idaho's 2012 DSM programs. Note that the residential and nonresidential NTG values are higher here because of the inclusion of the CFL Contingency savings that receive 100% NTG.

Table 63. 2012 Idaho Net Savings

Sector	Gross Verified Savings (kWh)	NTG	Net Verified Savings (kWh)
Residential*	14,098,435	93%	13,107,862
Nonresidential*	23,104,034	79%	18,250,606
Low Income	281,483	100%	281,483
Total	**37,483,952**	**84%**	**31,639,951**

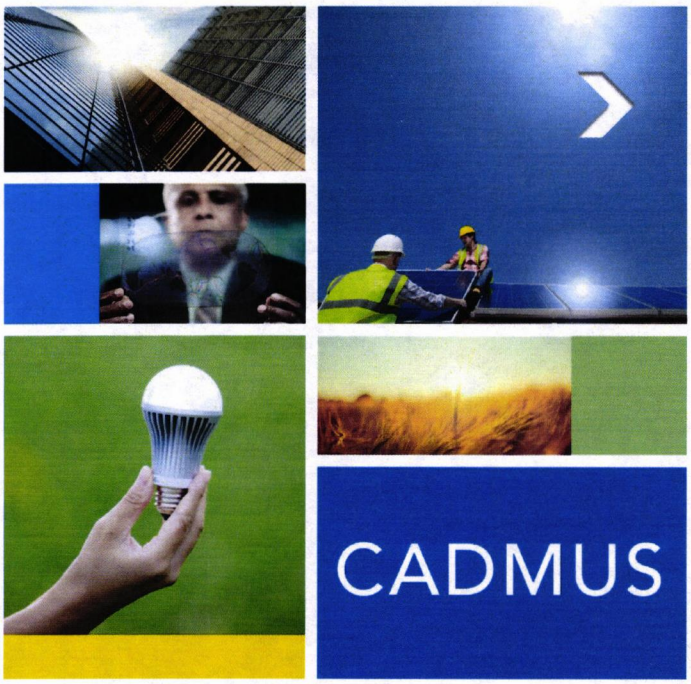
*Includes CFL Contingency savings.

5.4 IRP Goals Achievement

Table 64 shows net verified savings, as compared to the Integrated Resource Plan (IRP) goal of 17,115,000 kWh. The IRP states its goal as a portfolio-level target; so, for purposes of sector-level comparison, Cadmus adopted the Avista Business Plan goals by sector, and applied those proportions to the IRP target. The 2012 program year achieved 184.9% of the IRP target in Idaho with 31,639,951 kWh. Even excluding the CFL Contingency savings, Idaho still surpassed the IRP goal, at 111.9% with 19,151,861 kWh.

Table 64. 2012 Reported and Gross Verified Savings for Idaho

Sector	Savings Goal (kWh)	Net Achieved (kWh)	Achievement Rate
Residential	7,495,108	13,107,862	174.9%
Nonresidential	8,423,000	18,250,606	216.7%
Low Income	1,196,892	281,483	23.5%
Total	**17,115,000**	**31,639,951**	**184.9%**



FINAL REPORT

Avista 2012 Idaho Gas Portfolio Impact Evaluation Report

July 30, 2013

Avista Corporation
1411 E Mission Ave
Spokane, WA 99220

Prepared by:
Danielle Côté-Schiff Kolp, MESM
Andrew Wood
Jeff Cropp, P.E.
Scott Reeves
M. Sami Khawaja, Ph. D.
Cadmus

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Portfolio Executive Summary

Avista Corporation contracted with Cadmus to complete process and impact evaluations of the company's 2012 gas demand-side management (DSM) programs. Avista has been administering DSM programs to reduce energy use of electricity and natural gas for its portfolio of customers for several decades. Most programs are implemented in-house, but a few utilize external implementers. This report presents our impact findings for the PY 2012 gas portfolio in the state of Idaho.

Evaluation Activities

For each of the three sectors—residential, nonresidential, and low income—we employed a variety of evaluation methods and activities, as shown in Table 1.

Table 1. 2012 Gas Programs Evaluation Activities

Sector	Program	Document/ Database Review	Metering	Verification Site Visit	Survey	Billing Analysis	Modeling
Residential	ENERGY STAR Products	✓			✓		
	Heating and Cooling Efficiency	✓			✓		
	Weatherization/Shell	✓			✓		
	Water Heater Efficiency	✓			✓		
	ENERGY STAR Homes	✓					
Nonresidential	Prescriptive Programs	✓	✓	✓			
	Site-Specific	✓	✓	✓		✓	✓
Low Income	Low Income Programs	✓			✓	✓	

Savings Results

Table 2 presents sector-level reported and gross verified savings values and realization rates. Overall, the Idaho portfolio achieved a 94.4% realization rate, and acquired 216,766 in annual therm savings.

Table 2. 2012 Reported and Gross Verified Savings for Idaho

Sector	Reported Savings (Therms)	Gross Verified Savings (Therms)	Realization Rate
Residential	123,696	121,978	98.6%
Nonresidential	96,452	83,729	86.8%
Low Income	9,363	11,059	118.1%
Total	**229,508**	**216,766**	**94.4%**

Table 3 shows the gross verified savings, compared to the Integrated Resource Plan (IRP) goal of 746,728 therms. The IRP states its goal as a portfolio level target; so, for purposes of sector-level comparison, Cadmus adopted the Avista Business Plan goals by sector, and applied those proportions to the IRP target. The 2012 program year achieved 29.0% of the IRP target in Idaho.

Table 3. 2012 IRP Goals and Gross Verified Savings for Idaho

Sector	Savings Goal (Therms)	Gross Achieved (Therms)	Achievement Rate
Residential	281,039	121,978	43.4%
Nonresidential	440,478	83,729	19.0%
Low Income	25,212	11,059	43.9%
Total	**746,728**	**216,766**	**29.0%**

Key Findings and Conclusions

Residential

For PY2012, Avista's residential gas programs produced 121,978 therms in savings, yielding an overall realization rate of 98.6%. Residential gas savings achieved 43% of Residential IRP goals.

The evaluation produced the following, major, residential program conclusions:

- Overall, residential gas customers responded well to the programs, and often installed several measures within the same year.
- Avista's program and tracking databases were adequate for evaluation purposes, providing sufficient contact information, and measure and savings information. The database review confirmed the information was reliable and accurate.
- All measures rebated through the program had been installed and continued operating. With one exception, all measures reviewed met the program qualification standards.

Nonresidential

Cadmus evaluated 11 of 77 measures installed through the nonresidential energy-efficiency programs, representing 39% of reported savings. For PY2012, Avista's nonresidential gas programs produced 83,729 therms in savings, which yielded an 86.8% overall realization rate. Nonresidential gas savings achieved 19% of Nonresidential IRP goals.

Though Cadmus determined that Avista generally implemented the programs well, the following key issues reduced the evaluated energy savings below the reported value:

- At times, the programs provided incentives for measures that may not have been appropriate, such as a night-time temperature setback for a laboratory operating at consistent temperatures.
- Post-installation inspection process may not have always identified operational issues with rebated equipment. An example is the Site-Specific HVAC census project, for which Avista staff verified the lighting measure but performed only cursory review of the HVAC measure.

Low Income

For PY2012, Avista's low income gas programs produced 11,059 therms in savings, yielding an overall realization rate of 118.1%. Low income gas savings achieved 44% of Low Income IRP goals.

When state-level Idaho savings estimates from the 2010 gas billing analysis were applied to 81 gas-saving 2012 program participants (not receiving fuel-conversion measures), 123 therms per home resulted.

An additional 16 participants received fuel conversions for electric heating and/or water heating equipment, along with bundles of other gas-saving weatherization measures (e.g., insulation). We assigned savings to three categories for these conversion participants: full model savings; partial model savings; and no model savings (only technical reference manual pass-through savings). In total, we estimated an additional 1,096 therms in savings for gas-saving conversion participants.

Recommendations and Further Analysis

Residential

Based on the evaluation results, Cadmus offers the following recommendations to Avista:

- List energy factors (or, at least, model numbers) for appliances. Including more information about the actual efficiency of equipment installed allows for greater accuracy in estimating gross energy savings achieved.
- If possible, include existing equipment information.
- If the measure is reinstated, consider moving all ENERGY STAR Clothes Washer rebates to the electric program.

The following research recommendations draw upon this impact evaluation's results and from known future changes to program requirements:

- Perform a targeted billing analysis on weatherization participants who use both electricity and gas to heat their homes.
- Perform a billing analysis on ENERGY STAR homes using a nonparticipant comparison group once enough homes have participated under the new requirements to justify conducting the work.

Nonresidential

Cadmus offers the following recommendations for improving program energy-savings impacts and evaluation effectiveness:

- Review whether reported HVAC measures are appropriate for facilities with consistent space conditioning requirements, such as laboratories.
- Consider focusing post-installation inspections on projects with the highest level of tracked energy savings.

Low Income

The impact evaluation revealed several areas where program performance and savings calculation accuracy could be improved. Consequently, we recommend that Avista consider the following:

- Include a control/comparison group in future billing analyses.
- Consider targeting high-use customers.
- Track and compile additional data from agency audits.
- Consider analyzing easy-to-quantify, non-energy benefits, which can be added to program cost-effectiveness reporting.

1 2012 Residential Gas Impact Report

1.1 Introduction

During the 2012 program year, Avista's residential gas demand-side management (DSM) programs in Idaho reported savings of 123,693 therms for 1,802 measures. Avista's 2012 DSM residential gas programs included:

- ENERGY STAR Products
- ENERGY STAR Homes
- Heating and Cooling Efficiency
- Water Heating
- Weatherization Measures

This report explains the methods used to qualify and verify these savings.

1.1.1 Evaluation Methodology

We designed our impact evaluation to verify tracked program participation and energy savings using:

- Data collected in the tracking database;
- Online application forms;
- Phone surveys; and
- Applicable deemed values developed for Avista's technical reference manual (TRM).[1]

As shown in Table 4, Cadmus employed up to two evaluation methods and activities for each program.

Table 4. Evaluation Methodology

	Program	Document/Database Review	Survey
Residential	ENERGY STAR Products	✓	✓
	Heating and Cooling Efficiency	✓	✓
	Weatherization/Shell	✓	✓
	Water Heater Efficiency	✓	✓
	ENERGY STAR Homes	✓	

1.1.2 Energy Savings

Table 5 shows aggregated adjusted gross savings and resulting realization rates by program.

[1] In 2011's first quarter, Cadmus created a TRM for use in deemed measure savings calculations, and updated it where necessary for the 2012 program year.

Table 5. Reported and Adjusted Gross Savings

Program Name	Reported Savings (Therms)	Adjusted Gross Savings (Therms)	Realization Rate
ENERGY STAR Products	3,256	2,490	76.5%
Heating and Cooling Efficiency	106,691	105,837	99.2%
Weatherization/Shell	11,448	11,357	99.2%
Water Heater Efficiency	468	465	99.2%
ENERGY STAR Homes	1,829	1,829	100.0%
Total	**123,693**	**121,978**	**98.6%**

Table 6 shows reported measure counts. We verified savings of 121,978 therms through the installation of 1,802 measures during PY 2012. Overall, residential gas programs achieved an adjusted gross realization rate of 98.6%.

Table 6. Avista 2012 DSM Programs Reported Measure Counts

Program	Idaho Measure Count
ENERGY STAR Products	532
Heating and Cooling Efficiency	1,037
Weatherization/Shell	172
Water Heater Efficiency	52
ENERGY STAR Homes	9
Total	**1,802**

1.2 Methodology

1.2.1 Sampling

Cadmus randomly sampled program participants to complete surveys. Cadmus also randomly sampled participant applications to be reviewed for this evaluation. The following subsections describe methods used to select the required samples.

Record Review Sampling

To determine the percentage of measures incented that qualified for the program, Cadmus designed sample sizes to yield significance at the 90% confidence and ±10% precision levels for each application type, across both states and fuels. Cadmus randomly selected participant measures for a record qualification review from the 2012 gas and electric program populations. We sampled participants using a single measure record. However, if a customer applied for multiple rebates on the same application form during the program year, the record review checked all measures included in the application for qualification, whether for electric or gas.

Table 7 shows the number of record reviews completed for unique accounts and unique measures.

Table 7. Measure Level Record Review Completes

Total Participants Reviewed	217
Total Measures Reviewed	260

Survey Sampling

For program-level survey results, Cadmus designed participant survey sample sizes to yield significance at the 90% confidence and ±10% precision levels for each program within each Idaho and Washington. The participant survey sampling plan drew upon on multiple factors, including:

- The feasibility of reaching customers;
- The program participant population; and
- Research topics of interest.

Customer fuel types did not factor in survey sampling.

Cadmus did not survey home buyers for the ENERGY STAR New Homes program because home builders received the rebates. The evaluation completed a total of 274 surveys with Idaho participants. Table 8 shows: the number of surveys achieved; and the resulting absolute precision for each program. Note that the absolute precision achieved did not always meet the ±10% goal, but is safely within the portfolio precision goal of 90/10.

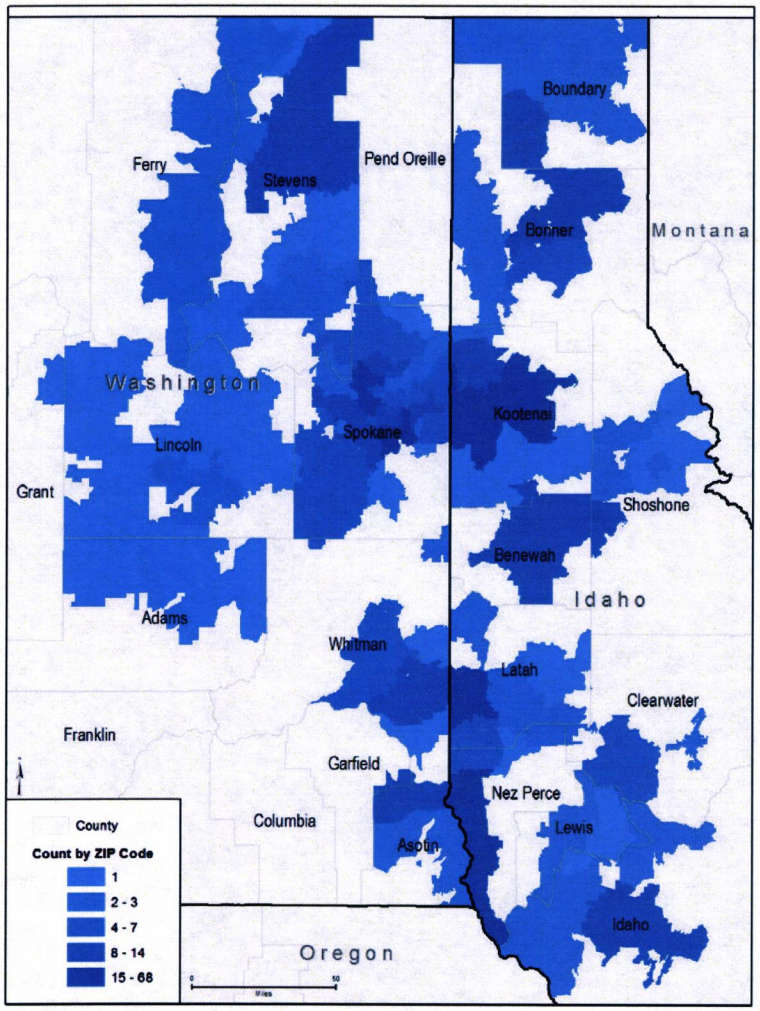
Table 8. Participant Survey Sample Sizes and Savings-Weighted Precision Estimates by Program

Programs	Rebate Population	Proposed Survey Target	Percent of Population	Completes	Absolute Precision at 90% Confidence
Idaho					
Space and Water Conversions	38	30	78.9%	11	±20%
Water Heating	127	50	39.4%	26	±13%
ENERGY STAR Products	2,323	70	3.0%	73	±9 %
Heating and Cooling Efficiency	1,806	70	3.9%	71	±10%
Second Refrigerator and Freezer Recycling*	346	60	17.3%	62	±9%
Weatherization and Shell Measures	221	60	27.1%	31	±13%

*This program did not claim therms savings.

Cadmus randomly called program participants included in survey sample frames. Geographic distributions of survey respondents clustered around urban centers within Avista's service territory (for both states); specifically the cities of Spokane, Pullman, Moscow, and Lewiston, as shown in Figure 1.

Figure 1. Geographic Distribution of Participant Survey Completes



1.2.2 Data Collection and Analysis

Record Review

Cadmus reviewed all records for the selected sample of accounts, checking them for completeness and program compliance using the data they contained. Measures qualified if all data found in the application complied with the program specifications. As the evaluation randomly sampled customers by application type (several measures can be found on different application forms), we tracked qualification rates at the application type level.

The review revealed one improperly issued insulation rebate on a Home Improvement application, as it had an existing R-value above the participation requirements (the applied qualification rates include this result).

Surveys

Cadmus contracted with Discovery Research Group (DRG), a market research firm, to conduct surveys with sampled participants. To minimize response bias, DRG called customers during various hours of days and evenings (including weekends), and made multiple attempts to contact individual participants. Cadmus monitored survey phone calls to ensure accuracy, professionalism, and objectivity. We analyzed the survey data at the program level rather than the measure level, and weighted survey results at the portfolio level by program participation to ensure proper representation.

Database Analysis

Cadmus reviewed the participant database Avista provided to check for inconsistencies in tracked savings and measure duplications. This review did not identify inconsistencies in data tracking. All tracked savings were based on the 2012 Avista TRM.

Unit Energy Savings Analysis

Cadmus updated the unit energy savings achieved by ENERGY STAR Clothes Washers, based on new survey data of Avista participants. We did not update other unit energy savings in the TRM.

1.2.3 Verification Rates

Cadmus determined verification rates for each program, but not for each measure. Where applicable, the review covered the following topics:

- Checking that the database tracked the correct measures;
- Accounting for correct quantities; and
- Determining whether units remained in place and were operable.

All measures researched remained in place and were operable, resulting in a 100% verification rate.

1.2.4 Measure Qualification Rates

Cadmus considered a measure qualified if it met the various requirements particular to its category, such as receiving an ENERGY STAR certification or achieving program minimum efficiency standards. When necessary, we conducted online database searches for model numbers, and noted necessary characteristics to verify achievement of all qualifications.

Out of the entire verification sample, we identified one nonqualified measure:

- An attic insulation project had a base case condition that should have prevented it from qualifying.

1.3 Program Results and Findings

1.3.1 Overview

End results from the review produced total adjusted gross savings for each measure and program as well as overall realized savings for each program. The following sections describe each program, explain analysis steps taken, and discuss results and findings.

Calculating the measures' adjusted gross measure savings required the following steps:

1. Reviewing the database to determine whether adjusted measure counts correctly represented the number of measures installed.
2. Conducting a phone survey with a sample of customers to verify measure installations.
3. Reviewing records to determine measure qualification.
4. Calculating verification and qualification rates.
5. Calculating deemed measure savings for rebated products.
6. Determining adjusted gross savings for each measure by applying the above-calculated rates and deemed savings to measure counts.

1.3.2 ENERGY STAR Products

Program Description

The ENERGY STAR Products program included the following gas measures:

- Clothes washer (gas)
- Dishwasher (with gas water heater)

The program offered direct financial incentives to motivate customers to use more energy-efficient appliances. The program indirectly encouraged market transformation by increasing demand for ENERGY STAR products. The program included electric and gas measures, though this report focuses on gas savings.[2]

Analysis

Energy savings credited to the ENERGY STAR Products program had to meet multiple criteria:

- Measures had to remain in place and operate properly at the time of verification;
- Numbers of installed equipment pieces and their corresponding model numbers in the applications had to match the database; and
- Units must have been ENERGY STAR-qualified at the time of the program offering.

[2] See Appendix 1B for the electricity savings achieved through the gas program.

Clothes Washers

Energy saving calculations drew upon a 2009 Cadmus metering study,[3] which metered more than 100 clothes washers in California homes for three weeks; the largest *in situ* metering study on residential clothes washers and dryers conducted in the last decade. The study indicated higher consumption and savings values than those often estimated.

Dryers produced the majority of energy consumption and savings, as high-efficiency washing machines removed more moisture from clothes, allowing shorter drying times. As most energy savings resulted from decreased dryer use, the study had to estimate the percentage of homes using gas domestic hot water heaters and electric dryers. The Regional Technical Forum (RTF) advocates an 82% assumption, which this analysis used. Consequently, 82% of installations of ENERGY STAR clothes washers in homes with a gas domestic hot water heaters achieved significant amounts of electricity savings.

Determining adjusted gross savings required using the following, additional input assumptions:

- Recent independent evaluation surveys from the Residential Building Stock Assessment (RBSA) and 2012 Avista Participant surveys estimated 262 washing cycles per year. Unit energy savings values have been adjusted accordingly, as reflected in the realization rate for this measure.[4]
- Cadmus utilized the California metering study to estimate consumption per wash and dry cycle for the base and efficient equipment.

Dishwashers

Cadmus estimated dishwasher savings based on methods currently used in the ENERGY STAR Calculator[5] (the only calculator available providing consistent energy-savings estimates in the presence of a gas or electric domestic hot water heater). The following input assumptions were applied:

- Cadmus calculated the average base case and efficient case Energy Factor (EF), with both based on data utilized by the RTF. The baseline EF equaled the average market efficiency of units not qualifying for the program. The efficient EF equaled the average market efficiency of units qualifying for the program at the time of their rebate.
- Recent evaluation surveys conducted in the region estimated 245 washing cycles per year.[6,7]

[3] The Cadmus Group, Inc. 2010. "Do the Savings Come Out in the Wash? A Large Scale Study of In-Situ Residential Laundry Systems." http://www.cadmusgroup.com/pdfs/Do_the_Savings_Come_Out_in_the_Wash.pdf

[4] Ecotope Inc. 2012. 2011 *Residential Building Stock Assessment: Single-Family Characteristics and Energy Use*. Seattle, WA: Northwest Energy Efficiency Alliance.

[5] http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDishwasher.xls?7182-1c92

[6] *Pacific Power Washington 2009-2010 Residential Home Energy Savings Evaluation.*, January 2012.

[7] *Rocky Mountain Power 2009-2010 Idaho Residential Home Energy Savings Evaluation.*, February 2012.

- Water heating consumed 56% of electricity required to run a dishwasher connected to an electric domestic hot water heater.[8]

Results and Findings

Table 9 shows: total reported and qualified counts, savings, and realization rates of gas ENERGY STAR Products measures in Idaho.

Table 9. ENERGY STAR Products Program Results

Program Name	Reported Measure Count	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualifi-cation Rate	Verifi-cation Rate	Adjusted Gross (Therms)	Reali-zation Rate
G Clothes Washer-Nat Gas H20	383	3,064	2,298	100.0%	100.0%	2,298	75.0%
G Dishwasher-Nat Gas H20	149	192	192	100.0%	100.0%	192	100.0%
Program Total	**532**	**3,256**	**2,490**	**100.0%**	**100.0%**	**2,490**	**76.5%**

Appendix 1B addresses electricity savings achieved by the installation of ENERGY STAR products in homes with a gas domestic hot water heater.

The program achieved a 76.5% realized adjusted gross savings rate, a result driven by the reduction in assumed clothes washer cycles per year.

1.3.3 Heating and Cooling Efficiency

Program Description

The Heating and Cooling Efficiency program included the following gas measures:

- Gas Boiler
- Gas Furnace

The program offered a $400 direct financial incentive to motivate customers to use more energy-efficient heating and cooling equipment. Participants could receive the incentive for installing a high-efficiency natural gas furnace of 90% AFUE (heating efficiency) or greater, or a natural gas boiler of 90% AFUE or greater.

Analysis

The PY 2010 gas impact evaluation report documented a census billing analysis Cadmus performed to determine the change in energy consumption due to the installation of a high-efficiency gas furnace. As

[8] http://www.energystar.gov/ia/business/bulk_purchasing/bpsavings_calc/CalculatorConsumerDishwasher.xls?7182-1c92

the billing analysis provided the best information on this measure, Cadmus continued tracking results for the 2012 program year.[9]

We calculated energy savings achieved through installations of high-efficiency gas boilers by adjusting the billing analysis results to the typical participant home installing a high-efficiency boiler.

Results and Findings

Table 10 shows total tracked and qualified counts, savings, and realization rates of gas Heating and Cooling Efficiency measures in Idaho.

Table 10. Heating and Cooling Efficiency Program Results

Program Name	Reported Measure Count	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualifi-cation Rate	Verifi-cation Rate	Adjusted Gross (Therms)	Reali-zation Rate
G Nat Gas Boiler	12	1,116	1,116	99.2%	100%	1,107	99.2%
G Nat Gas Furnace	1,025	105,575	105,575	99.2%	100%	104,730	99.2%
Program Total	**1,037**	**106,691**	**106,691**	**99.2%**	**100%**	**105,837**	**99.2%**

The program achieved a 99.2% realized adjusted gross savings rate, reduced slightly due to qualification.

1.3.4 Weatherization/Shell

Program Description

This program incented five categories of measures, available to residential electric and gas customers with homes heated with fuel provided by Avista:

- Insulation—Ceiling/Attic
- Insulation—Floor
- Insulation—Wall

The program incented qualifying ceiling and attic insulation (both fitted/batt and blown-in), which increased the R-value by 10 or more, at $0.25 per square foot of new insulation, and up to 50% of installation costs. Homes qualified if they had existing attic insulation less than R-19.

The program incented floor and wall insulation (both fitted/batt and blown-in), which increased the R-value by 10 or more, at $0.50 per square foot of new insulation, up to 50% of the installation cost. Homes qualified if they had existing floor and/or wall insulation less than R-5.

Analysis

The PY2011 gas impact evaluation report documented a census billing analysis Cadmus performed to determine the change in energy consumption resulting from installation of weatherization and window

[9] *Avista 2010 Multi-Sector Gas Impact Evaluation Report*. August 2011.

measures. As the billing analysis continued to provide the best information on this measure, results were maintained for the 2012 program year.[10]

Table 11 shows total reported and qualified counts, savings, and realization rates of gas Weatherization program measures.

Table 11. Weatherization Program Results

Program Name	Reported Measure Count	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualification Rate	Verification Rate	Adjusted Gross (Therms)	Realization Rate
G Insulation	172	11,448	11,448	99.2%	100.0%	11,357	99.2%
Program Total	**172**	**11,448**	**11,448**	**99.2%**	**100.0%**	**11,357**	**99.2%**

1.3.5 Water Heater Efficiency

Program Description

The Water Heater Efficiency program includes the following gas measures:

- High-Efficiency 40-Gallon Water Heater
- High-Efficiency 50-Gallon Water Heater

Through this program, Avista offered a $50 incentive to residential customers installing eligible high-efficiency water heaters. To qualify for the program, natural gas water heaters with tanks had to have a 0.60 EF or greater for a 50-gallon tank, and a 0.62 EF or greater for a 40-gallon tank.

Analysis

Deemed unit energy savings remained consistent with those used in the 2011 program year, thus no changes were necessary.

Results and Findings

Table 12 shows total tracked and qualified counts, savings, and realization rates of gas Water Heater Efficiency measures in Idaho.

[10] *Avista 2011 Multi-Sector Gas Impact Evaluation Report*. May 2012.

Table 12. Water Heater Efficiency Program Results

Program Name	Reported Measure Count	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualification Rate	Verification Rate	Adjusted Gross (Therms)	Realization Rate
G 40 Gallon Nat Gas Hot Water	7	62	62	99.2%	100.0%	61	99.2%
G 50 Gallon Nat Gas Hot Water	45	407	407	99.2%	100.0%	404	99.2%
Program Total	**52**	**468**	**468**	**99.2%**	**100.0%**	**465**	**99.2%**

1.3.6 ENERGY STAR Homes

Program Description

The ENERGY STAR Homes program offered incentives to builders constructing single-family or multifamily homes complying with ENERGY STAR criteria (and verified as ENERGY STAR Homes). Avista provided a $900 incentive for homes that have Avista electric or electric and natural gas service for space and water heating. Avista provided a $650 incentive for homes that only have natural gas service (both hot water and space heating had to be natural gas).

Analysis

The PY2011 gas impact evaluation report documented the simulation modeling Cadmus performed to determine the energy savings achieved by these measures. As the simulation results continue to provide accurate estimates of savings, results were maintained for the 2012 program year.[11]

Results and Findings

Table 13 shows total tracked and adjusted counts, savings, and realization rates for gas measures within ENERGY STAR Homes. The electric and gas programs funded participating homes using both Avista electric and gas. The associated electric impact evaluation report will address electric savings associated with these homes.

Table 13. ENERGY STAR Home Program Results

Program Name	Reported Measure Count	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualification Rate	Verification Rate	Adjusted Gross (Therms)	Realization Rate
Home-Gas Only	7	1,423	1,423	100.0%	100.0%	1,423	100.0%
Elec/Gas (Gas)	2	406	406	100.0%	100.0%	406	100.0%
Program Total	**9**	**1,829**	**1,829**	**100.0%**	**100.0%**	**1,829**	**100.0%**

[11] *Avista 2011 Multi-Sector Gas Impact Evaluation Report*. May 2012.

1.3.7 Residential Programs Confidence and Precision

Cadmus determined the overall precision of the adjusted gross savings by estimating the standard error associated with each measure. For measures only based on deemed savings estimates, error in the deemed savings resulted from error in each of the input assumptions.

Typically, the error for each savings estimate results from the sampling error associated with the research into each savings equation input. To simplify this analysis, Cadmus conservatively estimated a standard error associated with each deemed measure as 20% of the unit energy savings, unless recent evaluation research developed a more accurate estimate. Though a greater estimate than the values Cadmus typically determines, this provided a conservative estimate of program precision.

Two programs used more accurate estimates of error, based on recent research. The standard error for the Heating and Cooling efficiency program drew upon the billing analysis performed in 2011.[12] The standard error for the Weatherization/Shell program drew upon the billing analysis performed in 2012.[13] Following determination of program measure savings-based error, Cadmus applied the verification error determined through this year's surveys to each program, except for the two using billing analysis results. We did not apply verification survey error to savings determined through a billing analysis as their results included homes where installations were stated to have occurred, but did not occur. Table 14 shows the program level error and precision for the portfolio's residential portion. Overall, the residential programs achieved 3.6% relative precision at the 90% confidence interval.

Table 14. Program Savings Precision at the 90% Confidence Interval

Program	Adjusted Gross Savings (Therms)	Standard Error (Therms)	Relative Precision at 90% Confidence
ENERGY STAR Products	9,547	2,381	41.0%
Heating and Cooling Efficiency	335,775	8,082	4.0%
Weatherization/Shell	50,369	2,754	9.0%
Water Heater Efficiency	3,164	564	29.3%
ENERGY STAR Homes	4,469	634	23.4%
Total	**403,324**	**8,905**	**3.6%**

1.4 Conclusions

Overall, the 2012 residential gas programs in the state of Idaho produced 121,978 therms in savings. As shown in Table 15, the evaluation yielded a realization rate of 98.6%.

[12] *Avista 2010 Multi-Sector Gas Impact Evaluation Report.* August 2011.

[13] *Avista 2011 Multi-Sector Gas Impact Evaluation Report.* May 2012.

Table 15. Program Reported and Verified Gross Verified Savings and Realization Rates—Idaho

Program Name	Reported Savings (Therms)	Adjusted Savings (Therms)	Qualifi-cation Rate	Verifi-cation Rate	Adjusted Gross (Therms)	Reali-zation Rate
ENERGY STAR Products	3,256	2,490	100.0%	100.0%	2,490	76.5%
Heating and Cooling Efficiency	106,691	106,691	99.2%	100.0%	105,837	99.2%
Weatherization/Shell	11,448	11,448	99.2%	100.0%	11,357	99.2%
Water Heater Efficiency	468	468	99.2%	100.0%	465	99.2%
ENERGY STAR Homes	1,829	1,829	100.0%	100.0%	1,829	100.0%
Total	**123,693**	**122,927**	**99.2%**	**100.0%**	**121,978**	**98.6%**

Table 16 shows the achievement rates for gross savings compared to the IRP goals for the residential sector.

Table 16. Overall Evaluated Gas Savings and IRP Goals

IRP Goal (Therms)	Evaluated Gas Savings (Therms)	Goal Achievement
281,039	121,978	43.4%

1.5 Recommendations

Cadmus offers the following recommendations, based on evaluation results:

- Avista should collect and record equipment efficiency information in the database tracking system, or at least record the model numbers for appliances. Including equipment-specific information addressing the actual efficiency of the equipment installed would allow greater accuracy in estimating the gross energy savings achieved. Future evaluations could use collected information to determine savings, rather than relying on regional market average estimates, which do not account for the self-selection inherent in rebate programs.
- If the Clothes Washer measure is reinstated, Avista should consider moving all rebates to the electric program, as the majority of savings will likely result from a reduction in consumed electricity from the dryer. Qualifying for the program should be based on the presence of an electric dryer in the home. Given the large percentage of savings achieved through reduced dryer energy, and because of the high likelihood that most participants have an electric dryer, this measure predominantly produces electric energy savings.

1.5.1 Future Research Areas

The following research recommendations draw upon this impact evaluation's results and on known future changes in program requirements:

- Perform a targeted billing analysis for weatherization participants using both electricity and gas to heat their homes.

- Perform a billing analysis for ENERGY STAR homes using a nonparticipant comparison group, once enough homes have participated under the new requirements to justify the work.

2 2012 Nonresidential Gas Impact Report

2.1 Introduction

Avista's nonresidential portfolio of programs promotes the purchase of industry-proven, high-efficiency equipment for its commercial customers. Avista provides rebates to partially offset cost differences between high-efficiency equipment and standard equipment, reducing first-cost barriers and making high-efficiency equipment a more viable option for commercial customers.

Six programs make up the nonresidential gas portfolio, divided into two major categories:

- Prescriptive (five programs)
- Site-Specific (one program)

2.1.1 Prescriptive

Prescriptive Commercial Clothes Washer (PCW)

To encourage customers to select high-efficiency clothes washers, this program targets nonresidential electric and natural gas customers in multifamily or commercial Laundromat facilities. The program's streamlined prescriptive approach, designed to reach customers quickly and effectively, promotes ENERGY STAR or Consortium for Energy Efficiency (CEE) listed units.

Prescriptive Commercial HVAC (PCH)

Beginning in January 2011, installations of efficient HVAC systems have been processed through a prescriptive program rather than through the site-specific program. The prescriptive program limits eligible measures to the following:

- Furnaces under 225 kBtu, with an efficiency greater than 90% AFUE.
- Furnaces between 225 kBtu and 300 kBtu, with an efficiency greater than 85% AFUE.

Prescriptive Commercial Windows & Insulation (PCS)

Beginning in January 2011, installation of commercial insulation has been processed through a prescriptive program, in addition to the site-specific program. Projects qualify for the prescriptive program if they meet the following, pre-existing qualities:

- Wall insulation levels of less than R4, improved to R11 or better.
- Attic insulation of less than R11, improved to R30 or better.
- Roof insulation of less than R11, improved to R30 or better.

Prescriptive Food Service Equipment (PFS)

Applicable to nonresidential electric and gas customers with commercial kitchens, this program provides direct incentives to customers choosing high-efficiency kitchen equipment. To qualify for an incentive, the equipment must meet ENERGY STAR or CEE tier levels (depending on the unit).

Energy Smart Grocer (ESG)

Though refrigeration offers potentially high energy savings, the technical aspects of the equipment often cause it to be overlooked. The Energy Smart Grocer program assists nonresidential grocery store customers with the technical aspects of their refrigeration systems, while clearly presenting the savings they can achieve. A field energy analyst provides customers with technical assistance, produces a detailed report of potential energy savings at a facility, and guides customers through the process, from inception through the payment of incentives for qualifying equipment.

2.1.2 Site-Specific

The site-specific program addresses nonresidential measures that do not fit the prescriptive applications; thus, they must be considered based on their project-specific information. Measure eligible for consideration must produce demonstrable kWh and/or therm savings, and are available to commercial, industrial, or pumping customers: receiving electric or natural gas service from Avista; and seeking to make cost-effective, energy-efficiency improvements to their businesses. The program includes the following electric- and gas-saving measures:

- Site-specific HVAC (SSHVAC)
  - HVAC combined
  - HVAC heating
- Site-specific other (SSO)
  - Appliances
  - Motors (demand controlled ventilation)
- Site-specific shell (SSS)

Avista designs, manages, and implements the prescriptive and site-specific programs. It has also developed algorithms it uses to calculate measure savings and to determine measure and customer eligibility.

Avista staff fields inquiries from potential participants and contractors, and maintains a tracking database for projects. Throughout the program, Avista manages projects by reviewing and approving applications at all stages of the process, calculating project savings, and populating the database with relevant information.

2.2 Methodology

Cadmus designed the impact evaluation to verify tracked program participation and to estimate energy savings. We determined gross savings using: engineering calculations, desk reviews, verification site visits, and some project-level billing analysis.

Cadmus reviewed Avista's tracked gross energy savings and available documentation, such as audit reports and savings calculation work papers, for a sample of sites, particularly focusing on calculation procedures and documentation for savings estimates. We also verified the appropriateness of Avista's

analyses to calculate savings, and the operating and structural parameters of the analyses. Through site visits or desk reviews of a sample of projects, we collected data and evaluated gross energy savings through engineering calculations.

Cadmus collected baseline, tracking, and program implementation data through on-site interviews with facility staff. During on-site visits, we verified measure installations and determined changes to the operating parameters occurring since measure installation. Facility staff interviews included questions regarding the installed systems' operating conditions, additional benefits, or shortcomings. We used the savings realization rates from sample sites to estimate savings and to develop recommendations for future studies.

2.2.1 Sampling

Avista reported planning to phase out the gas programs due to cost-effectiveness concerns associated with the declining price of natural gas in 2011. Consequently, Cadmus and Avista found it appropriate to apply a lower rigor level for sampling than that used in the 2010 and 2011 evaluations. Cadmus selected a precision target of 80% confidence and a 20% confidence interval for the 2012 program sample. We developed a sampling calculation tool to estimate the number of site verifications and desk reviews required to achieve the precision target's rigor levels.

Using program population data provided by Avista, we determined 43 sites would require evaluations across Washington's and Idaho's program populations for both years. Cadmus will calculate the combined 2012 and 2013 evaluation precision following the 2013 program evaluation.

Table 17 shows the proposed precision targets for the site verification and desk review evaluation activities.

Table 17. Proposed PY 2012-2013 Nonresidential Idaho and Washington Gas Evaluation Sample

Measure Category	Precision Target	Evaluated Projects
Prescriptive	80/20	24
SSHVAC	80/20	7
SSO	80/20	8
SSS	80/20	4
Total	**80/20**	**43**

We assigned a census and a random sample for each stratum. The census stratum represented the six projects with the highest overall gas savings, with one of the six census sites located in Idaho. Each census site reported over 10,000 therms in savings and combined to represent 24% of total program reported savings. For the non-census stratum, we randomly selected additional participants from the remaining project population.

Cadmus found the database extract from Avista provided program-level but not measure-level information (e.g., boilers, chillers, LED lighting fixtures). Therefore, we sought to verify savings for every incented measure at each site, regardless of whether it achieved gas or electric savings. Establishing

whether we evaluated an accurate distribution of specific measure types within each program would have required an exhaustive review of project files, which fell outside of the evaluation's scope.

2.2.2 Data Collection

Cadmus collected data from one on-site verification in Idaho and conducted 10 desk reviews. For each, we first conducted a document review to determine measure types, quantities, operational parameters, and calculation methodologies.

Document Review

Avista provided Cadmus with documentation on the sample sites' energy-efficiency projects, including: program forms, the tracking database, audit reports, and savings calculation work papers for each rebated measure. Our review of calculation spreadsheets and energy simulation models paid particular attention to calculation procedures and documentation for savings estimates.

Cadmus reviewed each application for the following information:

- Equipment replaced: descriptions, schematics, performance data, and other supporting information.
- New equipment installed: descriptions, schematics, performance data, and other supporting information.
- Savings calculation methodology: the methodology type used, specifications of assumptions, sources for these specifications, and correctness of calculations.

Site Visits

Cadmus performed on-site visits to verify the three primary tasks that follow:

1. Verifying the implementation status of all measures for which customers received incentives. This required verifying energy-efficiency measures had been installed correctly and functioned properly. We also verified the operational characteristics of the installed equipment, such as temperature set points and operating hours.
2. Collecting the physical data, such as boiler capacities or operational temperatures, and analyzing the energy savings realized from the installed improvements and measures.
3. Conducting interviews with facility personnel to obtain additional information regarding the installed system, thus supplementing data from other sources.

Desk Reviews

For some prescriptive and site specific projects, we analyzed and evaluated energy savings by reviewing calculation spreadsheets and documentation submitted with the rebate application. These 10 projects experienced smaller therm savings compared to census-level projects we selected for site visits. For the analysis, Cadmus verified the equipment efficiency, based on equipment model numbers provided in the rebate applications and the savings calculation methodology.

2.2.3 Engineering Analysis

Nonresidential prescriptive and site-specific programs required significantly different methods of analysis.

Overview

Procedures used for verifying savings through an engineering analysis depended on the type of measure being analyzed. This evaluation used the following analytical methods, with descriptions included in their respective sections:

- Prescriptive deemed savings
- Billing analysis
- Calculation spreadsheets
- Energy simulation modeling

Prescriptive Deemed Savings

For most prescriptive measures, we verified the deemed savings estimates that Avista used for savings calculations, and then compared these with the values we developed for the TRM. We focused our verification activities on:

- The installed quantity;
- Equipment nameplate data;
- Proper installation of equipment; and
- Operating hours.

Where appropriate, we used data from site verification visits to reanalyze prescriptive measure savings with Avista's Microsoft Excel calculation tools, ENERGY STAR calculation tools, RTF deemed savings, and other secondary sources.

Billing Analysis

Cadmus analyzed Avista's metered billing data for two site-specific HVAC projects. Using a pre- and post-modeling approach, we developed retrofit savings estimates for each site. This modeling approach accounted for differences in heating degree days (HDDs), and determined savings based on normalized weather conditions, as actual weather conditions may have been milder or more extreme than the TMY3's (typical meteorological year) 15-year normal weather averages from 1991–2005, obtained from the National Oceanic and Atmospheric Administration (NOAA).

NOAA also provided daily weather data for each weather station associated with the participant projects, and we calculated the base 65 reference temperature HDDs. We matched participant billing data to the nearest weather station by ZIP code, and matched each monthly billing period to the associated base 65 HDDs.

In developing the analysis models, we followed a modified PRISM approach, which normalized all dependent and independent variables for the days in each billing period, and allowed model coefficients to be interpreted as average daily values. This methodology accounted for differences in the length of billing periods. For each project, we modeled average daily consumption in kWh as a function of some combination of the average standing base load, HDD, and (where appropriate) daily consumption.

For each site, Cadmus estimated two demand models: one for the pre-period; and one for the post-period. We chose this methodology over a single standard treatment effects model to account for structural changes in demand that might occur due to retrofits.

After estimating model coefficients for each site, Cadmus calculated three scenarios:

- We estimated a reference load for the previous 12 billing cycles, using the pre-period model. This scenario extrapolated the counterfactual consumption (i.e., what the consumption would have been in the program's absence). We calculated energy savings as the difference between the counterfactual scenario and the actual consumption.
- We estimated two normalized scenarios: one using the pre-model; and one using the post-model. Both scenarios used 15-year TMY3 data as the annual HDD and mean annual values for the usage data. The difference between these two scenarios represented the long-term expected annual savings.

Calculation Spreadsheets

Avista developed calculation spreadsheets to analyze energy savings for a variety of measures, including the construction of envelope measures (such as ceiling and wall insulation). The calculation spreadsheets required entering relevant parameters, such as square footage, efficiency values, HVAC system details, and location details. From these data, energy savings could be estimated using algorithms programmed by Avista. For each spreadsheet, we reviewed input requirements and output estimates, and determined if the approach proved reasonable.

Energy Simulation Modeling

Avista determined savings for many site-specific HVAC and shell projects using energy simulation modeling (chosen due to the complex interactions between heating and cooling loads and the building envelope). Avista provided the original energy simulation models, which we reviewed to determine the relevant parameters and operating details (such as temperature set points) for the applicable measures. We updated the models as necessary, based on our on-site verification data.

2.3 Results and Findings

2.3.1 Overview

Cadmus adjusted gross savings estimates based on our evaluated findings. The following sections discuss further details, by program.

2.3.2 Prescriptive Programs

We evaluated savings for a sample of sites across five prescriptive programs. Table 18 shows the savings and realization rates by program. Further evaluation details for each program follow. Table 19 shows the combined Idaho and Washington prescriptive results. These results were used for final extrapolation because the sample was chosen from a combined sampling methodology.

Table 18. Evaluated Results for PY2012 Nonresidential Gas Prescriptive Sample—Idaho

Program	Total PY12Measure Installations	Evaluated Sample	Gross Reported Savings (therms)	Gross Evaluated Savings (therms)	Realization Rate
PCW	0	0	N/A	N/A	N/A
PCH	24	2	598	670	112%
PCS	21	2	96	153	159%
PFS	8	0	N/A	N/A	N/A
ESG	1	1	900	1053	117%
Total	**54**	**5**	**1,594**	**1,876**	**118%**

Table 19. Evaluated Results for PY2012 Nonresidential Gas Prescriptive Sample—Combined Washington and Idaho

Program	Total PY12 Measure Installations	Evaluated Sample	Gross Reported Savings (therms)	Gross Evaluated Savings (therms)	Realization Rate
ESG	1	1	900	1,053	117%
PCW	2	0	N/A	N/A	N/A
PCH	65	6	2,224	2,304	104%
PCS	90	8	1,736	1,728	100%
PFS	26	2	5,136	4,677	91%
Total	**184**	**17**	**9,996**	**9,762**	**98%**

Cadmus identified several discrepancies between the rebate application information and inputs used in Avista's savings calculations. The calculations often relied on reported equipment and operations data, which could vary from parameters identified during on-site verification visits and metering.

Our adjustments increased savings by 18% for Idaho projects. The combined adjustments reduced savings by 2%. Typical adjustments corrected equipment efficiencies, fuel types, operating schedules, and operating parameters, as described below:

- For one prescriptive boiler replacement project, Cadmus found the proposed efficiency used in the Avista savings algorithm was lower than the installed unit (90% versus 93%). By adjusting the efficiency, the realization rate for that project increased to 121%.
- For one prescriptive window replacement project, the proposed solar heat gain coefficient (SHGC) used in the savings calculation did not match the actual SHGC. The revised SHGC resulted in higher gas savings (186% realization rate), but decreased electric savings (38%).

- One prescriptive EnergySmart project installed doors on medium-temperature refrigerated display cases in a store. Cadmus used an industry standard tool to calculate savings based on the linear feet of case retrofitted with doors. Avista savings calculations are hardcoded in the spreadsheet and do not reference any savings algorithm. By using the Cadmus algorithm, the realization project's rate increased to 117%.

2.3.3 Site-Specific

Cadmus evaluated the savings for six site-specific program projects, which represented a variety of measure types. We evaluated the projects through on-site verification and desk reviews. We also calculated an overall realization rate for all randomly selected (non-census) projects in Idaho, and then applied the resulting realization rate to the non-census savings for each state and major measure type. Table 20 shows our evaluated results for the program. Table 21 shows the combined Idaho and Washington site-specific results. These results were used for final extrapolation because the sample was chosen from a combined sampling methodology.

Table 20. Evaluated Results for PY2012 Nonresidential Gas Site Specific Sample—Idaho

Program	Total PY2012 Measure Installations	Evaluated Sample	Gross Tracked Savings (Therms)	Gross Evaluated Savings (Therms)	Realization Rate
SSHVAC—Census	1	1	18,267	3,196	17%
SSHVAC	9	3	10,535	11,749	112%
SSO	7	1	9	6	69%
SSS	6	1	7,344	7,344	100%
Total	**23**	**6**	**36,155**	**22,295**	**62%**

Table 21. Evaluated Results for PY2012 Nonresidential Gas Site-Specific Sample—Combined Washington and Idaho

Program	Total PY2012 Measure Installations	Evaluated Sample	Gross Tracked Savings (Therms)	Gross Evaluated Savings (Therms)	Realization Rate
SSHVAC—Census	6	6	96,999	77,298	80%
SSHVAC	35	7	24,950	26,504	106%
SSO	33	8	8,363	8,187	98%
SSS	26	3	26,673	26,818	101%
Total	**100**	**24**	**156,985**	**138,807**	**88%**

Cadmus identified several adjustments to tracked savings from site-specific program project. Site-specific projects tend to be more complex, making energy-savings parameters and impacts more difficult to estimate. In addition, the calculations often rely on participant-supplied building, equipment, and operations data, which may vary from parameters identified during an on-site verification visit.

In aggregate, the site-specific program performed fairly well, achieving an overall combined realization rate of 88%. The only census project in Idaho did not achieve savings. Though this reduced the overall realization rate for Idaho projects significantly, higher-than-tracked savings for Washington site-specific projects offset the project's losses. We made the following specific adjustments, based on our review of rebate application and billing data:

- The Idaho Site-Specific HVAC census-level project (Table 20) retrofitted existing lighting and installed a digital direct control system on the facility's HVAC system. During the on-site verification, Cadmus verified the lighting retrofit had been installed as reported, but found several discrepancies in the HVAC project's implementation. Cadmus's findings on the HVAC system upgrade include the following:
  - Nighttime temperature setback: The majority of the gas savings from this project derived from implementation of a nighttime temperature setback strategy, but we found this strategy had not been implemented. The building houses several laboratories, with material testing stations and hood vents in every space, and sets its temperature to 72°F during occupied and unoccupied hours due to controlled environment requirements and to maintain the comfort of its occupants.
  - HVAC system commissioning: Cadmus found the primary contractor performed ineffective commissioning on the HVAC system. Consequently, the building still experiences major air balancing issues. The participant currently is working with a new contractor to re-commission the HVAC system to resolve the balancing issues. The new contractor conducted a thorough investigation of the HVAC system issues, reporting to Cadmus that the building currently runs at a slightly negative pressure, an indication of poor balance between supply air and exhaust. However, the new contractor's work is not yet complete, and these results did not factor into Cadmus' analyses.
  - Billing analysis: Cadmus performed a linear regression with pre- and post-installation utility billing data to determine the savings level for this project, as shown in Figure 2 and Figure 3. This analysis confirmed the project realized a lower level of savings than was reported. The slope for the regression equation represents the heating-dependent load, which is nearly identical for the pre- and post-installation period. We noted the facility received a lighting retrofit, which reduced the waste heat from inefficient lighting. This increased the heating load for the facility, which is one reason why the post-installation regression analysis is larger than expected. Cadmus calculated the additional heating load required as a result of the lighting retrofit using values determined by the RTF. We added that value to the difference between pre and post-installation linear regression to determine the evaluated energy savings for the project. The project achieved a 17% realization rate.

Figure 2. Pre-Installation Linear Regression for Census-Level Project

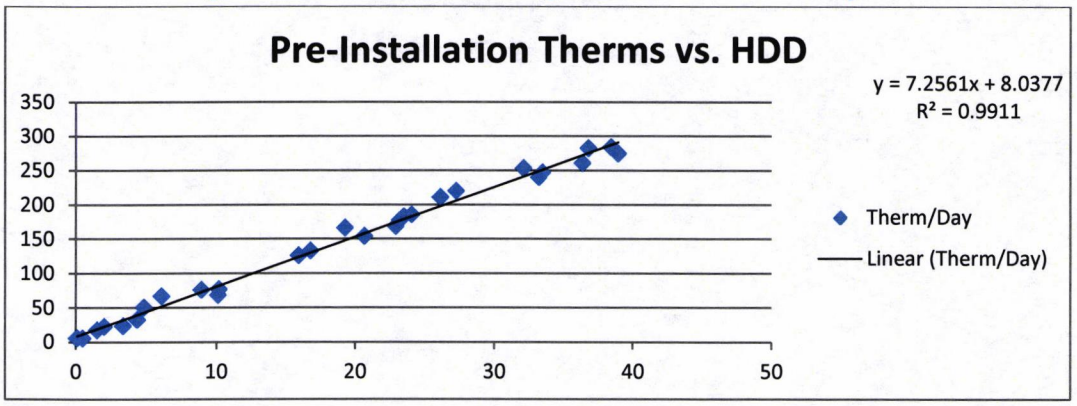
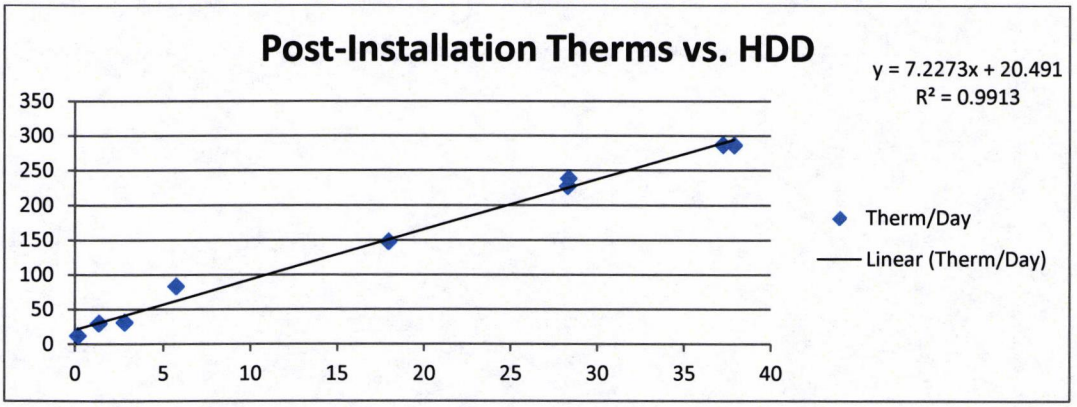


Figure 3. Post-Installation Linear Regression for Census-Level Project



As a result, Cadmus did not award gas savings to the project, which accounted for 40% of the tracked savings for the site-specific HVAC program in Idaho.

Cadmus also revised gross energy savings for residential clothes washers installed at multi-family facilities as a Site-Specific Other measure, as follows:

- Cycle: In the previous evaluation, the washing cycles per year (377) were derived from Pacific Power and Rocky Mountain Power Home Energy Savings participant surveys. Recent independent evaluation surveys from the Residential Building Stock Assessment (RBSA) and 2012 Avista Participant surveys estimated 262 washing cycles per year. Unit energy savings values have been adjusted accordingly, as reflected in this measure's realization rate.
- Consumption: Cadmus utilized the California metering study to estimate consumption per wash and dry cycle for the base and efficient equipment.

- A 69% realization rate resulted for one Idaho clothes washer project. This was the only Site-Specific Other measure that Cadmus evaluated for Idaho. Cadmus evaluated the overall Site-Specific realization rate based on the combined Idaho and Washington sample.

2.3.4 Extrapolation to Program Population

In evaluating the nonresidential gas programs, we selected sites that could provide the most significant impacts. We designed the site visits to achieve a statistically valid sample for the major strata, as discussed. For measures in the random (non-census) sample, we calculated realization rates (the ratio of tracked-to-evaluated savings) to apply to the programs at the remaining non-sampled sites. These realization rates were weighted averages, based on the random verification sample, and using the following four equations:

$$RR_{ij} = \frac{Evaluated_{ij}}{Tracked_{ij}}; \textit{for measure } j \textit{ at site } i \quad (1)$$

$$RR_j = \frac{\sum_i Evaluated_i}{\sum_i Tracked_i}; \textit{for measure } j \textit{ across all sample sites} \quad (2)$$

$$\sum_k Evaluated_k = RR_j x \sum_k Tracked_k; \textit{for measure } j \textit{ across all sites in measure population} \quad (3)$$

$$RR_l = \frac{\sum_k Evaluated_k}{\sum_k Tracked_k}; \textit{for the population (all sites and measures)} \quad (4)$$

Where:

RR = the realization rate

i = the sample site

j = the measure type

k = the total population for measure type 'j'

l = the total program population

We calculated realization rates for each individual site in the sample based on measure type (1). We then calculated the realization rates for the measure types using the ratio of the sum of evaluated savings to the sum of tracked savings from the randomly selected sample for each measure type (2). We calculated the non-census population evaluated savings by multiplying the measure type realization rate (RR_j) from the random sample by the tracked savings for the non-census population of each measure

type (3). We then added the tracked and evaluated savings from census stratum measures to calculate the total tracked and evaluated savings for each program. The program realization rate derived from the ratio of all evaluated to all tracked savings (4).

Table 22 summarizes the results for all prescriptive and site-specific programs in Idaho. The state realized an 87% overall portfolio gross realization rate. Notably, during extrapolation of gas savings to the total gas measure population, the census-level site-specific HVAC project's realization rate was excluded because it was not part of the random sample.

Table 22. PY 2012 Gas Gross Program Realization Rates – Idaho

Measure Category	Gross Program Reported Savings (Therms)	Gross Program Evaluated Savings (Therms)	Gross Program Realization Rate
Prescriptive	32,615	31,852	98%
SSHVAC	47,951	35,923	75%
SSO	2,499	2,451	98%
SSS	13,387	13,504	101%
Total	**96,452**	**83,729**	**87%**

2.3.5 Fuel Conversion and HVAC / Lighting Interactive Impacts

The Avista natural gas portfolio reported savings do not include increases in gas consumption due to fuel conversions from electric heating to gas heating, or from increased lighting efficiency. Lighting systems convert a large portion of their input energy to useful light output, but a substantial portion also converts to heat. Any reduction in lighting input energy also reduces waste heat. Reducing waste heat lowers the site's required cooling load, but increases the site's heating load.

Cadmus noted that Avista tracked and recorded these gas consumption effects for many projects to determine electric program cost-effectiveness. Most tracked interactive effects involved prescriptive or site-specific lighting projects, although some therm penalties resulted from the Energy Smart Grocer (in Avista's electric portfolio) and site-specific HVAC program projects.

In addition, Avista did not factor interactive effects into its portfolio energy-savings goals (which would have reduced goals).

2.4 Conclusions

Cadmus evaluated 11 of 77 measures installed through the Idaho program, representing 39% of reported savings.

The evaluation determined that Avista generally implemented the programs well. Cadmus identified the following key issues that reduced evaluated energy savings below the reported values:

- Programs sometimes provided incentives for measures that may not have been appropriate, such as installing night-time temperature setbacks for a laboratory with consistent temperature requirements.

- Post-installation inspection process may not have always identified operational issues. An example is the Site-Specific HVAC census project, for which Avista staff verified the lighting measure but performed only cursory review of the HVAC measure.

2.5 Recommendations

Cadmus offers the following recommendations, based on evaluation results:

- Review whether reported HVAC measures are appropriate for facilities with consistent space conditioning requirements, such as laboratories.
- Consider focusing post-installation inspections on the projects with the highest tracked energy savings.

3 2012 Low Income Gas Impact Report

3.1 Introduction

In 2010, Cadmus conducted a statistical billing analysis, determining adjusted gross savings and realization rates for energy-efficient measures installed through Avista's Low Income Weatherization Program. We performed analysis and calculated savings at the household or participant level, rather than the measure level.

This report:

- Applies these 2010 billing analysis savings estimates to the 2012 participant population; and
- Reports total gas impacts associated with the 2012 program year.

Cadmus anticipates collecting a full year of post-period consumption data to perform a billing analysis of the 2012 participant population. In the interim, this evaluation report extrapolated results from the recent 2010 gas impact analysis to 2012 participants. The new billing analyses will take place in the first quarter of 2014.

To estimate 2010 energy savings resulting from the program, Cadmus used a pre- and post-installation, combined CSA and PRISM approach that utilized monthly billing data. We analyzed savings estimates for Idaho and Washington, and ran a series of diagnostics (such as a review of savings by pre-consumption usage quartile), and outlier analysis. Avista's *2010 Gas Impact Report* presents a detailed discussion of the regression model and methodology used for this analysis.

3.1.1 Program Description

Five programs, listed in Table 23, make up Avista's Low Income Weatherization Program. Local Community Action Partners (CAPs), within Avista's Idaho and Washington service territories, implement these low income programs. CAPs holistically evaluate homes for energy-efficiency measure applicability, combining funding from different programs to apply appropriate measures to a home, based on results of a home energy audit.

Table 23 also describes the measures installed under each program component, along with counts of gas measures installed in PY 2012 and included in our gas impact analysis (a separate report contains findings on evaluated electric measures).

Table 23. 2012 Gas Efficiency Installations by Program Component

Low Income Program Component	Measure Description	Measure Installations
Shell/Weatherization	Insulation, window/door installation, air infiltration, programmable thermostat	240
HVAC Efficiency	High-efficiency gas furnace replacement	17
Hot Water Efficiency	High-efficiency water heater replacement	0
Fuel Conversion*	Electric furnace, heat pump, or water heater replacement with gas units	N/A
ENERGY STAR Appliance	High-efficiency refrigerator replacement	N/A

*The Avista portfolio considers (and reports) fuel conversion measures as electric-saving measures.

3.1.2 Data Collection

Cadmus primarily drew impact evaluation data from the program participant database. Avista provided information regarding program participants and installed measures for Idaho. Specifically, these data included:

- Lists of measures installed per home; and
- Expected savings from each completed measure installation.

The data, however, did not include the quantity of measures installed (such as the square footage of installed insulation) or per-unit savings estimates.

Starting in 2012, Avista incorporated TRM savings estimates that Cadmus developed specific to Avista's low income customer segment. These measure-specific savings estimates incorporated data from regional and secondary research (e.g., RTF, U.S. Department of Energy [DOE]) as well as input assumptions derived from analysis of low income weatherization program participant consumption (e.g., pre-period heating consumption).

3.2 Methodology

3.2.1 Sampling

In applying the 2010 gas billing analysis results, we used a census of program participants, comprised of 81 gas accounts, but excluding the 16 gas participants receiving conversion measures.

3.2.2 Data Collection Activities

Documentation Review/Database Review

Cadmus used the 2012 Idaho and Washington program participant database, provided by Avista, to develop a complete population for applying the 2010 billing analysis results. Participant data included:

- Customer information;
- Account numbers;

- Types of measure installed;
- Rebate amounts;
- Measure installation costs;
- Measure installation dates; and
- TRM savings per measure.

Billing Analysis—CSA Modeling Approach

To estimate energy savings from this program, we used a pre-post CSA fixed-effects modeling method, which utilized pooled monthly time-series (panel) billing data.

The fixed-effects modeling approach corrected for differences between pre- and post-installation weather conditions as well as for differences in usage consumption between participants, and included a separate intercept for each participant. Our modeling approach ensured model savings estimates would not be skewed by unusually high-usage or low-usage participants. Monthly consumption was also paired between pre- and post-months to maintain the same time frame for evaluating unique participants.

Additional details regarding the 2010 billing analysis can be found in the *Avista 2010 Gas Impact Report*.

3.2.3 Estimating Conversion Participant Savings

The evaluation team used a similar approach for calculating gas savings for Idaho conversion participants as used in the 2011 evaluation report. This approach assigned savings to conversion participants (n = 16), based on three distinct customer categories:

1. **Full model savings** (123 therms), assigned to participants (n = 1) receiving three or more distinct gas-saving measures (including a high efficiency furnace).
2. **Partial model savings** (61 therms), specific to participants that installed a high-efficiency gas furnace in place of a standard efficiency electric furnace.[14] These participants received the high-efficiency furnace replacement and no more than one additional gas-saving measure (n = 13). For participants in this group with one additional gas-savings measure, we passed through the TRM savings associated with the non-furnace measures.
3. **No model savings**, for customers receiving at most one gas-saving measure (n = 2) and not a high-efficiency furnace. For these customers, we passed through TRM savings if they received a gas-savings measure.

[14] The program participant database did not indicate that water heater conversions were replaced with efficient units; therefore, no additional gas savings were applied.

To account for gas savings experienced through high-efficiency furnace replacements, we used savings calculated through the 2010 evaluation of Avista's residential furnace replacement program (84 therms), scaling this value to reflect low income participant home square footage, which resulted in 61 therms.[15]

3.3 Results and Findings

3.3.1 Overall Program Results

Non-Conversion Participant Results

Applying savings estimates from the billing analysis to the gas-saving participant program population produced total savings of 123 therms per participant. We applied these modeled savings to gas-savings participants not receiving conversion measures, and we calculated average reported TRM savings by summing measure savings at each household, then taking the mean household savings across individual participants. Table 24 provides a comparison between average participant savings TRM and modeled savings for non-conversion customers.

Table 24. Non-Conversion Gas Savings

Total Non-Conversion Participants	Average Reported TRM Savings Per Participant (Therms)	Model Savings Per Participant (Therms)	Realization Rate	Total Non-Conversion Savings
81	95	123	129%	9,963

Table 25 shows the count of 2012 gas-saving measure installations (including both non-conversion and conversion participants). Air infiltration has the highest distribution of installations, followed by attic and duct insulation.

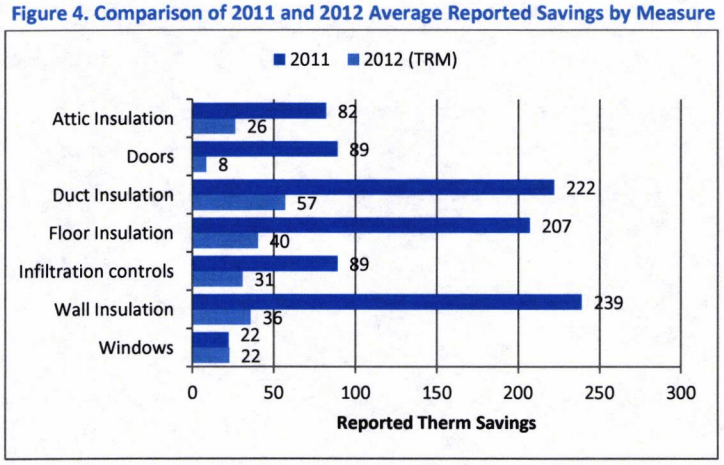
Table 25. Average Reported Savings and Installation Count by Measure

Measures	Count	Avg Reported TRM Savings (Therms)
Attic insulation	42	26
Doors	16	8
Duct insulation	31	57
Floor insulation	23	40
High-efficiency furnace replacement	17	103
High-efficiency water heater replacement	N/A	N/A
Infiltration controls	72	31
Thermostat (AC)	1	14
Thermostat (No AC)	7	14
Wall insulation	21	36
Windows	27	22

[15] Low income participants averaged 1,250 square feet per home, while single-family participants averaged 1,728 square feet per home.

To highlight some distinctions in Avista's reported savings, we compared average expected measure savings from 2011 to the 2012 TRM estimates. Figure 4 highlights differences between average savings.

Figure 4. Comparison of 2011 and 2012 Average Reported Savings by Measure



Savings reported in 2012 using TRM estimates were lower for a number of measures than 2011 average savings, most notably for infiltration controls, doors, and insulation measures. Generally, the two years offered a relatively similar mix of measure installations, with infiltration controls and insulation the most frequently installed measures for gas-saving participants.

Conversion Participant Results

Of the 97 total Idaho gas-savings participants, 16 received electric-to-gas conversion measures, including electric-to-gas furnace and water heater replacements. This analysis considered these participants separately, as the methodology for estimating evaluated savings differed slightly from the non-conversion participant group. Table 26 provides a distribution of all Avista-funded measure installations for conversion participants.

Table 26. Measure Installations for Conversion Participants

Measure Type	Measure Description	2012 Count
Electric-Saving Conversion Measures	Electric-to-gas furnace replacement	14
	Electric-to-gas water heater replacement	14
Gas-Saving Measures	Doors	1
	Duct insulation	1
	High-efficiency furnace replacement	14
	Infiltration controls	1
	Thermostat (No AC)	7
	Thermostat (AC)	1
	Windows	1

Of the 14 participants receiving a gas furnace conversion, all had high-efficiency gas furnaces installed, and none of the 14 water heater conversion participants received high-efficiency gas water heaters.

In total, we estimated an additional 1,096 therms savings for gas conversion participants, as shown in Table 27.

Table 27. Conversion Participant Gas Savings – Idaho

Conversion Customer Tier	Count	Average Model Savings Applied (Therms)	Total Savings (Therms)
Full model savings	1	123	123
Partial savings (high-efficiency furnace)*	13	61	906
No model savings*	2	N/A	67
Total	**16**		**1,096**

*Total evaluated savings may include instances of pass-through TRM measure-level savings.

A net increase in therm usage occurred for all conversion customers. However, based on Avista's approach to correcting for these impacts through its cost-effectiveness analysis, this report calculated therm savings associated with the following:

1. Installation of gas-savings weatherization measure bundles.
2. Furnace conversion replacements, using high-efficiency gas equipment, compared to standard gas equipment.[16]

Overall Participant Results

Table 28 provides overall gas savings, including savings attributed to fuel conversion participants receiving gas-saving measures.

Table 28. Overall Gas Savings

Evaluated Savings			Total Reported TRM Savings (Therms)	Realization Rate
Total Non-Conversion Participant Model Savings (Therms)	Total Conversion Participant Savings (Therms)	Total Savings (Therms)		
9,963	1,096	11,059	9,363	118%

3.3.2 Goals Comparison

Cadmus compared evaluated savings for the 97 Idaho gas participants against Avista's IRP goals. Table 29 summarizes: overall evaluated savings, IRP savings goals, and achievement rates. In all, the low income weatherization program achieved approximately 44% of its gas savings goals.

[16] Electric savings associated with conversion measure installations will be addressed in the *2010–2011 Avista Electric Impact Report*.

Table 29. IRP Program Goals Comparison

Total Participants*	IRP Goal (Therms)	Evaluated Gas Savings (Therms)	Goal Achievement
97	25,212	11,059	44%

*Includes 81 participants receiving model savings and 16 conversion customers.

3.4 Conclusions

Upon comparing 2011 and 2012 results, changes in Avista's expected savings calculations led to differences in realization rates. Average reported gas savings per (non-conversion) participant decreased by 62% between the years, falling from 305 therms in 2011 to 116 therms in 2012 (based on the TRM). This appears to primarily drive shifting realization rates, from 41% for Idaho in 2011 to 118% in 2012.

As shown in Figure 4 (above), except windows, all measure-level estimates observed significant changes in therm savings between 2011 reporting and the 2012 TRM estimates, with these decreases in average savings ranging between 3 to 10 times the previously reported estimates, most notably for infiltration and insulation measures.

3.5 Recommendations

The following section outlines our suggestions for enhancements to help improve program impact results.

- **Use a control or comparison group in future billing analyses**. For upcoming impact evaluations that employ billing analysis, we suggest using 2013–2014 participants as a control group to analyze the treatment group of 2012 participants. For such analysis, 2011 and 2013 annual participant consumption histories would be used as the pre- and post-periods. Using a control or comparison group of nonparticipants allows analysis to control for exogenous factors (e.g., macroeconomic, rate changes, technological trends) that may result in trends affecting consumption. Controlling for these trends using a control/comparison group reflects a more robust experimental design and defensible methodology for estimating accurate energy-savings impacts.
- **Include high-use customers in program targeting.** While prioritization guidelines for targeting low income weatherization participants are set at the federal level, some utilities, for targeting purposes, actively track customer usage and provide agencies with lists of customers that experience particularly high energy consumption. In fact, DOE protocols list high-energy consumption as a factor allowed in participant prioritization. In such cases, along with other targeting criteria (e.g., families with children, senior citizens), agencies may incorporate energy-consumption characteristics into their program participant prioritization. Not only would weatherizing high-use customers likely result in higher energy savings, but some customers may be overly burdened with energy bills due to their housings' characteristics, and the program could provide some financial relief.

Methods exist for identifying high-usage customers while controlling for factors contributing to consumption (e.g., square footage, income, number of people per household). Using such an approach would allow Avista to identify high-use customers.

Given reductions in federal funding for weatherization and associated reduced agency capacities resulting in more limited leveraging opportunities, Avista has an opportunity to lead new efforts for continued delivery of energy-savings resources to low income residential customers. By considering high-usage targeting, potential exists to secure cost-effective energy savings through one segment of this population, while continuing to support weatherization for income-qualified customers, which may result in lower savings and prove less cost-effective. Efficient targeting can aid in balancing these efforts to provide whole-house weatherization, while continuing to leverage the agency network as a resource for outreach and delivery.

- **Track and compile additional data from agency audits.** These data include information on primary and secondary heating and cooling and on the size of a home. As an inexpensive alternative to gas heat, gas customers may turn to electric room heaters and wood stoves, thereby reducing impacts of weather-sensitive measures installed through weatherization (e.g., insulation). Collecting information on customers' primary heating usage at the time of weatherization will provide more reasonable savings estimates.

  We recommend working with agencies to develop explicit, on-site tracking protocols for collecting information on participant heating sources. Agencies should collect the following information to better inform heating (and cooling) sources:

  - Visual inspections of all heating equipment found on site;
  - Participant-reported primary and supplemental heating sources used;
  - Quantities of secondary heating, if applicable (e.g., numbers of electric room heaters); and
  - Any indicators suggesting discrepancies between actual and reported primary heating.

- **Consider performing quantitative, non-energy benefit analyses.** With respect to ongoing Advisory Group discussions surrounding quantifying non-energy benefits, we recommend Avista consider pursuing additional analyses, aimed at quantifying non-energy benefits associated with low income weatherization and applicable to the TRC test. In particular, analyses of economic impacts and payment pattern improvements (including reduced arrearages and collections costs) can provide program stakeholders with monetized values of benefits. Other utilities have used such analyses in reporting low income weatherization cost-effectiveness in the northwest (e.g., Idaho, Washington). Standard cost-effectiveness testing, using TRC test accounts for all program costs (only including energy savings as program benefits), clearly omits some genuine non-energy benefits experienced by participants (as discussed in greater detail in the *2010 Process Evaluation*).

Appendix 1A: Residential ENERGY STAR Home Model Inputs

The following table summarizes the inputs used to simulate homes in Idaho.

Table 1A. ENERGY STAR, and Idaho Construction Standards for New Homes

Measure	Type	ENERGY STAR® Home	ID Code—IECC 2006 Zone 5
Insulation	Ceiling	R-38	R-38
	Wall	R-19	R-19
	Floors Over Unconditioned Space	R-30	R-30
	Slab Floors	R-10	R-10
Windows & Doors	Windows	0.35	0.35
	Max Glazing Area	0.21	Set to ENERGY STAR standards
	Doors	R-5	Set to ENERGY STAR standards
Ducts	Insulation	R-8	R-8
	Sealing	Mastic only	Tapes allowed
	Max Leakage	<0.06 CFM/sq. ft. or 75 CFM total @50Pa	Set to ENERGY STAR standards
Ventilation & Air Sealing	Ventilation System	Exhaust ventilation	Exhaust ventilation
	Envelope Tightness	0.35 normal ACH	0.35 normal ACH
Heating & Cooling Equipment	Gas Furnace	90 AFUE	80 AFUE
	Air Conditioner	SEER 13	SEER 13

Appendix 1B: Electricity Savings Achieved by Residential Gas Programs

The following table shows the electricity saved in kWh by the 2012 gas energy efficiency programs. The believed high penetration of electric dryers in homes with gas domestic hot water heating is the reason for the significant savings achieved. The electricity saved through the installation of an efficient dishwasher is associated with the machine operation, not water savings. The 2010 gas furnace billing analysis showed that a portion of participants are choosing to install an air source heat pump at the same time they install a new high efficiency furnace. This switch from all gas heating to dual fuel heating results in an electric penalty.

The values shown in the table are for all measure installations in Idaho, both inside and outside Avista's electric service territory.

Table 1B. Electricity Savings for Gas Program in Idaho

Measure Name	Measure Count	UES (kWh)	Total Savings (kWh)
G Clothes Washer-Nat Gas H20	383	223	85,409
G Dishwasher-Nat Gas H20	149	27	4,035
G Nat Gas Furnace	1,025	-165	-169,258
Total	1,557	NA	-79,814