Updated August 31, 2011

Revisions:

- Executive Summary ¶1
- Non-residential Sector Overview, Page 21 ¶3
- Table 21 (Site-specific lighting and totals)

DEMAND SIDE MANAGEMENT
2010 ANNUAL REPORT

AVISTA®

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I. EXECUTIVE SUMMARY

Avista's Demand-Side Management (DSM) services provide over 30 energy efficiency programs (representing over 300 measures) to the Company's Idaho and Washington electric and natural gas customers funded through the DSM Tariff Rider, a "non-bypassable" system benefit charge. Avista's DSM programs delivered 77,839 MWh and 1.9 million therms in efficiency savings in 2010. This achieved 119% of the Company's electric Integrated Resource Planning (IRP) goal and 85% of Avista's natural gas IRP goal. Approximately 77% of the 2010 local program expenditures of $23 million were returned to ratepayers in the form of rebates toward energy efficiency measures installed. In addition to these local programs, Avista funds regional programs, in partnership with other utilities, through the Northwest Energy Efficiency Alliance (NEEA) to deliver additional savings to the Company's customers. Including NEEA, 2010 energy efficiency funding was over $24.8 million.

Several metrics are applied to determine the costs and benefits of these programs. The primary cost-effectiveness test is the Total Resource Cost (TRC) test while the Program Administrator Cost (PAC) is also a key determinant of program efficacy. Ratios over 1.0 illustrate that benefits exceed costs. For 2010, the Company's DSM portfolios were cost-effective with TRC and PAC ratios of 2.30 and 4.90, respectively, for its electric portfolio, and 1.60 and 3.54, respectively, for its natural gas portfolio.

The savings shown in this report are non-verified by third-party evaluators at the time of this filing, however, realization rates from recent Impact and Verification reports have been applied. The Cadmus Group has been retained to evaluate these savings with partial results expected in mid-2011.

As is standard for Pacific Northwest energy efficiency reporting, these savings are gross savings, or the total of all savings not netted by customers who would have elected to adopt energy efficiency measures in the absence of utility programs. Avista engaged a third party evaluator to perform a Net-To-Gross" (NTG) study. The results of this NTG study are included in this report.

Highlights for 2010 energy efficiency activity included:

- The aggregated Tariff Riders (Washington and Idaho, electric and natural gas Schedules 91 and 191) were returned to a "zero balance" at the time of filing this report, having begun January of 2010 with an underfunded balance of $11.9 million.
- Two "economic stimulus" (or American Recovery and Reinvestment Act, or ARRA) projects—home energy audits and a revolving loan fund—were launched in partnership with three Spokane area jurisdictions, a community based organization, an independent contractors network, educational institutions and eastern Washington banks and credit unions.
- Avista's Ten-year Achievable Conservation Potential and Biennial Conservation Target Report ("Conservation Resource Report") filing, pursuant to WAC 480-109 (and also known as "I-937") was approved by the Washington Commission at its April 29th Open Meeting.
- Avista, with multiple interested parties, concluded an extensive EM&V and Low Income Weatherization Collaborative with filings to the Commissions on September 1st, 2010.
- Avista introduced a new approach, in January 2011, for stakeholder input to, in essence, reconfigure its External Energy Efficiency (or "Triple E") Board.
- In August, 2010, the Company restructured Avista's energy efficiency program delivery into two separate teams, Implementation and Policy.
- Avista filed its 2011 DSM Business Plan on November 1st, 2010, with its 2011 EM&V Plan.

II. COST-EFFECTIVENESS

Cost-effectiveness is the primary metric for the Company's Demand-Side Management (DSM) program planning and implementation process. During the planning process, programs are evaluated on a Total Resource Cost (TRC) and Program Administrator Cost (PAC) basis. Furthermore, all programs are evaluated annually using four of the five California Standard Practice Tests – Total Resource Cost (TRC), Program Administrator Cost (PAC), Participant and Ratepayer Impact Measure (RIM). Unless otherwise noted, all savings are gross. The Company recently retained a third-party evaluator to perform a net-to-gross study at the request of the Idaho Public Utilities Commission (IPUC) Staff, consequently, cost-effectiveness will be provided on a net basis as well.

The following tables show system electric, natural gas and combined fuel cost effectiveness. Detail by individual state is provided in Appendix A.

System Electric Cost Effectiveness

Table 1: Total Resource Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric avoided cost	$67,370,148	$1,508,252	$68,878,400
Natural Gas avoided cost	($1,220,687)	$0	($1,220,687)
Non-Energy Benefits	$1,214,220	$0	$1,214,220
TRC benefits	$67,363,681	$1,508,252	$68,871,933
Non-incentive utility cost	$3,701,101	$209,921	$3,911,022
Customer cost	$25,097,425	$981,941	$26,079,366
TRC costs	$28,798,526	$1,191,862	$29,990,388
TRC ratio	**2.34**	**1.27**	**2.30**
Net TRC benefits	**$38,565,155**	**$316,390**	**$38,881,546**

Table 2: Program Administrator Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric avoided cost	$67,370,148	$1,508,252	$68,878,400
Natural Gas avoided cost	($1,220,687)	$0	($1,220,687)
PAC benefits	$66,149,461	$1,508,252	$67,657,713
Non-incentive utility cost	$3,701,101	$209,921	$3,911,022
Incentive cost	$8,904,819	$981,941	$9,886,760
PAC costs	$12,605,920	$1,191,862	$13,797,782
PAC ratio	**5.25**	**1.27**	**4.90**
Net PAC benefits	**$53,543,541**	**$316,390**	**$53,859,932**

Table 3: Participant

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric Bill Reduction	$38,784,868.33	$1,826,784.33	$40,611,652.66
Gas Bill Reduction	$5,261,093.89	$0.00	$5,261,093.89
Non-Energy benefits	$1,214,220.14	$0.00	$1,214,220.14
Participant benefits	$45,260,182.36	$1,826,784.33	$47,086,966.70
Customer cost	$25,097,425.39	$981,940.80	$26,079,366.19
Incentive received	($8,904,819.15)	($981,940.80)	($9,886,759.95)
Participant costs	$16,192,606.24	$0.00	$16,192,606.24
Participant ratio	**2.80**	**NA**	**2.91**
Net Participant benefits	**$29,067,576**	**$1,826,784**	**$30,894,360**

Table 4: Rate Impact Measure

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric avoided cost savings	$67,370,148	$1,508,252	$68,878,400
Non-Participant benefits	$67,370,148	$1,508,252	$68,878,400
Electric Revenue loss	$38,784,868	$1,826,784	$40,611,653
Non-incentive utility cost	$5,051,173	$209,921	$5,261,094
Customer incentives	$8,904,819	$981,941	$9,886,760
Non-Participant costs	$52,740,860	$3,018,646	$55,759,507
RIM ratio	**1.28**	**0.50**	**1.24**[1]
Net RIM benefits	**$14,629,288**	**($1,510,394)**	**$13,118,894**

[1] The RIM calculation determines the present value of the retail rate impact, a cost within the RIM test, to be fixed at current nominal levels. In contrast, the avoided cost impact, a benefit within the RIM test, escalates based upon the avoided cost stream define in the most recently filed Integrated Resource Plan. This is an inconsistency attributable to the lack of a retail rate forecast for use within this test. The Company may open a discussion with the Technical Advisory Group regarding alternative approaches.

System Natural Gas Cost Effectiveness

Table 5: Total Resource Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Natural gas avoided cost	$23,456,361	$151,823	$23,608,184
Electric avoided cost	$3,860,834	$639	$3,861,473
Non-Energy Benefits	$420,037	$0	$420,037
TRC benefits	$27,737,233	$152,462	$27,889,695
Non-incentive utility cost	$1,499,324	$142,519	$1,641,843
Customer cost	$15,247,542	$533,022	$15,780,564
TRC costs	$16,746,866	$675,541	$17,422,406
TRC ratio	**1.66**	**0.23**	**1.60**
Net TRC benefits	**$10,990,367**	**($523,078)**	**$10,467,289**

Table 6: Program Administrator Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Natural gas avoided cost	$23,456,361	$151,823	$23,608,184
Electric avoided cost	$3,860,834	$639	$3,861,473
PAC benefits	$27,317,195	$152,462	$27,469,658
Non-incentive utility cost	$1,499,324	$142,519	$1,641,843
Incentive cost	$5,586,196	$533,022	$6,119,218
PAC costs	$7,085,520	$675,541	$7,761,061
PAC ratio	**3.86**	**0.23**	**3.54**
Net PAC benefits	**$20,231,675**	**($523,078)**	**$19,708,597**

Table 7: Participant

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Natural gas bill reduction	$7,811,488	$544,910	$8,356,397
Electric bill reduction	$3,129,571	$1,040	$3,130,611
Non-energy benefits	$420,037	$0	$420,037
Participant benefits	$11,361,096	$545,949	$11,907,045
Customer cost	$15,247,542	$533,022	$15,780,564
Incentive received	($5,586,196)	($533,022)	($6,119,218)
Participant costs	$9,661,346	$0	$9,661,346
Participant ratio	**1.18**	**NA**	**1.23**
Net Participant benefits	**$1,699,751**	**$545,949**	**$2,245,700**

Table 8: Rate Impact Measure

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Natural gas avoided cost savings	$23,456,361	$151,823	$23,608,184
Non-Participant benefits	$23,456,361	$151,823	$23,608,184
Natural gas revenue loss	$7,811,488	$544,910	$8,356,397
Non-incentive utility cost	$2,988,092	$142,519	$3,130,611
Customer incentives	$5,586,196	$533,022	$6,119,218
Non-Participant costs	$16,385,776	$1,220,450	$17,606,226
RIM ratio	**1.43**	**0.12**	**1.34**[2]
Net RIM benefits	**$7,070,585**	**($1,068,627)**	**$6,001,958**

[2] See footnote 1 above.

System Combined Electric and Natural Gas Cost Effectiveness

Table 9: Total Resource Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric avoided cost	$90,826,509	$1,660,076	$92,486,585
Natural Gas avoided cost	$2,640,147	$639	$2,640,786
Non-Energy Benefits	$1,634,257	$0	$1,634,257
TRC benefits	$95,100,914	$1,660,714	$96,761,628
Non-incentive utility cost	$5,200,424	$352,440	$5,552,864
Customer cost	$40,344,967	$1,514,963	$41,859,930
TRC costs	$45,545,392	$1,867,403	$47,412,794
TRC ratio	**2.09**	**0.89**[3]	**2.04**
Net TRC benefits	**$49,555,522**	**($206,688)**	**$49,348,834**

Table 10: Program Administrator Cost

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric avoided cost	$71,230,982	$1,508,891	$72,739,873
Natural Gas avoided cost	$22,235,674	$151,823	$22,387,498
PAC benefits	$93,466,657	$1,660,714	$95,127,371
Non-incentive utility cost	$5,200,424	$352,440	$5,552,864
Incentive cost	$14,491,015	$1,514,963	$16,005,978
PAC costs	$19,691,440	$1,867,403	$21,558,842
PAC ratio	**4.75**	**0.89**	**4.41**
Net PAC benefits	**$73,775,217**	**($206,688)**	**$73,568,529**

[3] The 0.89 TRC includes realization rates from recent Impact and Process reports. The TRC would be >1.0 without the realization rates applied.

Table 11: Participant

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Electric Bill Reduction	$41,914,439	$1,827,824	$43,742,263
Gas Bill Reduction	$13,072,582	$544,910	$13,617,491
Non-Energy benefits	$1,634,257	$0	$1,634,257
Participant benefits	$56,621,279	$2,372,734	$58,994,012
Customer cost	$40,344,967	$1,514,963	$41,859,930
Incentive received	($14,491,015)	($1,514,963)	($16,005,978)
Participant costs	$25,853,952	$0	$25,853,952
Participant ratio	**2.19**	**NA**	**2.28**
Net Participant benefits	**$30,767,327**	**$2,372,734**	**$33,140,060**

Table 12: Rate Impact Measure

	Regular Income portfolio	Limited Income portfolio	Overall portfolio
Avoided cost savings	$90,826,509	$1,660,076	$92,486,585
Non-Participant benefits	$90,826,509	$1,660,076	$92,486,585
Electric Revenue loss	$46,596,356	$2,371,694	$48,968,050
Non-incentive utility cost	$8,039,265	$352,440	$8,391,705
Customer incentives	$14,491,015	$1,514,963	$16,005,978
Non-Participant costs	$69,126,636	$4,239,097	$73,365,733
RIM ratio	**1.31**	**0.39**	**1.26**[4]
Net RIM benefits	**$21,699,873**	**($2,579,021)**	**$19,120,852**

[4] See footnote 1 above.

Avoided Costs
Since 2007, the Company has applied additional components to the avoided costs that come out of the biennial Integrated Resource Plan (IRP) process in order for conservation resources to be evaluated equally against other supply-side resources.

The avoided cost delivered from the IRP process includes energy and new resource capacity savings as well as a risk premium to account for Renewable Portfolio Standard (RPS) and rate volatility reduction. Outside of this process, the Company applies a 10% Northwest Power and Conservation Council Power Act preference premium, distribution capacity savings (of approximately $10/kW-year) and transmission and distribution loss of 6.12% based on the Company's 5-year average system losses.

Net-to-Gross Study and Impact of Results
The net-to-gross study was conducted in 2011 on 2010 residential and non-residential program participants. Due to the nature of the Company's low-income programs it was assumed that all participants were 'net' participants. The Company's numerous remaining significant programs were then divided into categories of similar measures for ease of surveying participant. A summary of the categories follows.

Residential HVAC includes electric high efficiency A/C Replacement, electric high efficiency air source heat pump, electric new high efficiency ground source heat pump, electric replacement high efficiency ground source heat pump, electric to air heat pump conversion, natural gas high efficiency boiler, natural gas high efficiency furnace, electric variable speed motor and high efficiency ductless heat pumps.

Residential Appliance includes electric/natural gas Energy Star clothes washer, electric/natural gas Energy Star dishwasher, electric Energy Star freezer, electric Energy Star refrigerator, electric high efficiency water heater, natural gas high efficiency water heaters (40 & 50 gallon), natural gas high efficiency tankless water heater, electric to natural gas water heater conversion.

Residential Shell includes electric and natural gas ceiling/attic insulation, electric and natural gas floor insulation, electric and natural gas wall insulation, electric and natural gas window replacements, electric and natural gas fireplace dampers.

Energy Star Homes includes electric and natural gas Energy Star homes.

Non-Residential Energy Smart Grocer is exclusively the Energy Smart program operated through PECI.

Non-Residential Motors includes the Green Motors program, prescriptive motors and site-specific motors.

Non-Residential Prescriptive includes prescriptive clothes washers, prescriptive demand-controlled ventilation, prescriptive food service, prescriptive refrigerated warehouses, prescriptive side-stream filtration, prescriptive steam trap replacement, prescriptive PC network controls, prescriptive lighting, prescriptive LED traffic signals, variable frequency drives, vending machine controllers, and electric to natural gas water heater conversions.

Non-Residential Site-Specific includes site specific compressed air, site specific industrial process, site-specific appliances, site-specific HVAC, site-specific LEED, site specific shell, site-specific lighting.

This study accounted for not only free-riders (i.e. non-net participants), or those who would have installed the efficiency measure in the absence of utility programs, as well as participant spill-over, or consumers influenced by utility programs to adopt program measures without an receiving an incentive. While the net-to-gross measurement generally reduces program accomplishments, it can also be a valuable tool for assessing program performance. Changes to program implementation can be made to reduce this factor to a point, but some amount will always exist due to numerous messages and influences to which customers are exposed.

At the time this Annual Report was submitted, the final net-to-gross report had not been received from The Cadmus Group. The following tables summarize the results of the draft study for the individual segments surveyed.

Table 13: Residential Net-to-Gross Results

Survey Category	Responses	Free-ridership	Spillover	Net to Gross
Residential Appliances	67	48%	0.0%	52.0%
Residential HVAC	67	39%	0.0%	61.0%
Residential Shell	67	45%	0.8%	63.8%
ENERGY STAR Homes	7	26%	0.0%	73.6%

Table 14: Non-Residential Net-to-Gross Results

Survey Category	Responses	Free-ridership	Spillover	Net to Gross
EnergySmart Grocer	30	10%	0.0%	90.0%
Nonresidential Motors	9	41%	0.0%	59.0%
Nonresidential Prescriptive	59	13%	0.0%	87.0%
Nonresidential Site Specific	61	26%	0.2%	74.2%

The Company has applied these net-to-gross results to 2010 accomplishments and the net results on the benefit/cost tests are shown in the tables below.

Table 15: Residential Electric Programs Net-to-Gross Applied

Program	State	TRC ratio	PAC ratio	Part ratio	RIM ratio
Energy Star Homes	ID	0.62	1.99	1.62	0.51
	WA	0.62	2.04	0.34	0.38
Energy Star Products	ID	0.50	1.84	0.11	1.41
	WA	0.48	1.90	0.09	1.51
Heating & Cooling	ID	1.47	3.30	1.08	1.51
	WA	1.51	3.41	1.58	1.48
Home Weatherization	ID	4.79	2.53	0.00	2.11
	WA	4.19	2.49	0.00	1.67
Space & Water Direct Use	ID	1.29	4.33	4.46	0.38
	WA	1.62	5.05	3.65	0.58
Water Heaters	ID	2.52	2.52	0.00	0.31
	WA	2.65	2.60	0.00	0.29
	ID	1.21	2.21	2.37	0.97
	WA	1.13	2.05	2.24	0.98
	System	1.16	2.11	2.28	0.97

Table 16: Residential Natural Gas with Net-to-Gross Applied

Program	State	TRC ratio	PAC ratio	Part ratio	RIM ratio
Energy Star Homes	ID	0.50	1.04	18.07	0.05
	WA	0.52	1.10	13.97	1.10
Energy Star Products	ID	0.20	0.75	0.08	0.54
	WA	0.20	0.77	0.12	0.55
Heating & Cooling	ID	0.86	1.33	0.67	1.33
	WA	0.91	1.45	0.63	1.45
Home Weatherization	ID	3.57	2.10	0.00	0.94
	WA	3.74	2.16	0.00	1.02
Water Heaters	ID	0.28	0.71	2.81	0.17
	WA	0.32	0.72	4.78	0.15
	ID	1.17	1.57	2.38	0.93
	WA	1.40	1.75	2.04	1.11
	System	1.33	1.69	2.16	1.05

III. EVALUATION, MEASUREMENT & VERIFICATION

In 2010, the Company convened an Evaluation, Measurement & Verification (EM&V) Collaborative to expand the Company's evaluation standards and design a consistent and generally-accepted measurement method. On September 1, 2010, the Company filed the EM&V Framework document concluding the Collaborative. This section includes summaries of the Company's EM&V activities for the year.

Ecotope Impact Evaluation
Several impact evaluations occurred during this year. Ecotope was retained by the Company to complete an Audit on 2009 Natural Gas Demand-side Management Programs (see Appendix B) as required for the Company's Washington Natural Gas Decoupling Mechanism. This resulted in an independent estimate of natural gas savings for 2009. Ecotope also provided impact evaluations on all Low Income electric and natural gas programs, Residential electric and natural gas window replacements, Residential natural gas furnace upgrades, Residential natural gas tanked and tankless water heaters, and Residential natural gas weatherization. This report is included in Appendix C.

Following the issuance of the Ecotope Impact Report, the Policy, Planning and Implementation (PPA) team issued a memo that included internal recommendations based on the findings. This memo included general recommendations as well as program-specific recommendations for each segment – residential, low income and non-residential. See Appendix D for the entire memo of recommendations.

The low realization rates coupled with other concerns resulting from this impact evaluation, led to the residential electric and natural gas window program being discontinued. Projects completed with accompanying paperwork received by June 30, 2011 will be eligible for incentive. Another change implemented as a result of the Ecotope evaluation is that customers will no longer be allowed to complete "do-it-yourself" installations and qualify for incentives. Customers will need to complete contractor assisted installations and contractors will need to certify pre and post installation levels as well as square footage.

Moss Adams, LLC Process Evaluation
One settlement stipulation, specifically #17, for the Washington General Rate Case (Dockets UE-100467 and UG-100468) required an independent, external review of the Company's DSM data tracking systems and data strategy for DSM programs. This independent review was performed by Moss Adams, LLP and included a review of the Company's internal operations for data entry, tracking, reporting and controls to ensure data accuracy. Moss Adams issued a final report, which can be found in Appendix E, which includes recommendations of best practices procedures and controls to ensure data accuracy.

The Cadmus Group Impact/Process Evaluation
Per the IPUC 2009 Memorandum of Understanding, the Company committed to providing net in addition to gross results that had been provided in previously years' annual reports. The Company retained The Cadmus Group to conduct a net-to-gross study on the bulk of the 2010 program participants in residential and non-residential programs. Low income was not included in this study as well as some ancillary programs such as CFL specialty buy-downs at the manufacturer level, refrigerator/freezer recycling, and other smaller programs handled through third parties.

The results of the net-to-gross study are discussed in more detail in the cost effectiveness section. The final report was not available at the time this report was due to be filed. The Company will provide the final report when available. Additional questions spurred from the results will be incorporated into 2010-2011 process evaluations and customer surveys that The Cadmus Group will be conducting and will eventually be

incorporated into changes within program implementation to provide better delivery and continue to improve net-to-gross percentages.

Internal Process Evaluations

Process evaluations and program improvements are part of on-going DSM operations and typically cover four areas – employee interviews, participant interviews, contractor interviews and market analysis. The internal process evaluation work completed in 2010 is mainly comprised of reviews of existing programs by Program Managers. With The Cadmus Group being retained for 2010-2011 process and impact evaluation, future process evaluations will be more robust.

Some changes to programs can be fairly minor while other can be substantial. See Attachment I – 2010 DSM Process Reports for detail on the process evaluation for all programs. These reports include a brief overview of the program, data being collected, reasons for and improvements made to individual programs.

IV. PROGRAMS

Residential Sector Overview

The majority of energy efficiency, aka demand-side management (DSM), programs available to Residential customers are offered through prescriptive programs (or standard offer) targeting a range of end-uses. Programs offered through this prescriptive approach by Company infrastructure and during 2010 included space and water conversions, Energy Star appliances, Energy Star homes, space and water equipment upgrades and home weatherization.

The remaining residential energy efficiency programs are offered through various channels. The refrigerator/freezer recycling program is offered through a third-party, JACO. CFL and specialty CFL buy-downs at the manufacturer level provide customers access to lower-priced lamps. Home Energy Audits, newly offered in 2010, subsidized by American Recovery and Reinvestment Act (ARRA), offers home inspections including numerous diagnostic tests and a leave-behind kit of CFLs and weatherization materials. Finally, educational tips and CFLS were provided through various rural and urban events in an effort to reach all areas within the Company's service territory.

During 2010, over 36,000 rebates were processed benefiting approximately 25,000 households. Nearly $6.3 million in rebates were provided directly to customers to offset the cost of implementing energy efficiency upgrades. Residential programs contributed 24,247 MWh and nearly 1.1 million therms in energy savings.

Several modifications to the residential programs are planned for 2011 such as the discontinuation of the windows program, requirement of contractor installed weatherization (eliminating do-it-yourself projects), reducing incentives for electric to natural gas water heater conversion and the inclusion of the rooftop damper program on the residential form. Each of these changes is addressed below.

As identified by Ecotope's January 2011 final "Energy Impact Evaluation Report of select 2008 programs", it has been determined that rebates for window improvements are not a cost-effective measure for Avista and should no longer be part of the residential portfolio The window program ends on April 1, 2011. Similar with past transitions around program changes such as this, customers will be allowed a 90-day transition period to install and submit their rebate form for consideration under the discontinued program.

Another recommendation from the Ecotope report was to no longer allow "self-installed" insulation measures to be eligible for incentives. On April 1, 2011, customers must have their measure installed by a contractor who must also provide certification of the existing R-value of insulation prior to the improvement, the post R-value after the improvement and the square footage of the home. These customers will also be allowed a 90-day transition period to submit their self-installed insulation project under the old program parameters.

As part of general program review, the incentive amount for electric to natural gas water heater conversion will be reduced from $250 to $200 beginning April 1, 2011. As with the two programs above, customers will have 90 days from April 1 to participate under the old program guidelines.

Updates to the residential Home Improvement and New Construction forms will also include additional information gathering about the home size (square footage), year built, and confirmation of other types of heating sources. The form will also contain the rooftop damper program which in the past has been on a separate incentive application. During 2010, the Implementation Team has begun to track New Construction projects separately which will help in billing analysis and other evaluation efforts.

The Implementation Team continues to respond to recent process and impact reports in combination with their internal process reviews in order to improve current programs. The findings from these studies can be applied in future program design as new programs are launches as well.

The following tables show Residential electric and natural gas number of projects (or lamps distributed), MWh saved and interactive therms where applicable.

Table 17: Residential Electric Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (MWh)	Interactive Natural Gas (therms)
CFLs	ID	107,445	$171	2,403	-
	WA	250,706	$329	5,608	-
Energy Star Homes	ID	32	$28	88	4,517
	WA	143	$126	318	22,789
Energy Star Products	ID	3,801	$123	542	-
	WA	7,720	$257	1,128	-
Geographic Saturation	ID	-	$5	130	-
	WA	-	$13	303	-
Heating & Cooling	ID	1,360	$356	2,515	-
	WA	2,387	$537	3,642	-
Home Energy Audit	WA	268	$24	39	-
Home Weatherization	ID	745	$217	1,588	-
	WA	1,361	$385	2,823	-
Refrigerator/Freezer Recycling	ID	392	$12	243	-
	WA	1,451	$44	898	-
Space & Water Direct Use	ID	73	$48	564	-
	WA	177	$93	1,239	-
Water Heaters	ID	113	$6	34	-
	WA	475	$24	142	-
	ID	113,961	$967	8,107	4,517
	WA	264,688	$1,831	16,140	22,789
	System	378,649	$2,798	24,247	27,306

Table 18: Residential Natural Gas Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (therms)	Interactive Electric (MWh)
Energy Star Homes	ID	15	$10	2,955	-
	WA	13	$8	2,561	-
Energy Star Products	ID	1,608	$65	12,028	32
	WA	4,269	$176	32,372	83
Heating & Cooling	ID	1,299	$519	159,685	-
	WA	2,638	$1,054	324,290	-
Home Weatherization	ID	1,240	$357	123,000	468
	WA	4,424	$1,246	430,783	1,480
Water Heaters	ID	171	$12	2,961	-
	WA	603	$39	9,049	-
	ID	4,333	$963	300,629	500
	WA	11,947	$2,524	799,055	1,563
	System	16,280	$3,486	1,099,684	2,064

Low Income Sector Overview

Low Income programs are administered through six Community Action Agencies (CAAs) throughout the Company's service territory. During 2010, these programs targeted a range of end-uses such as space and water conversions, Energy Star refrigerators, space and water equipment upgrades and weatherization which are offered site-specifically through individual home audits. The Company also funds health and human safety which are considered necessary to ensure habitability of homes and protect investments in energy efficiency, as well as administrative fees enabling CAAs to continue to deliver these programs.

During 2010, the Company convened a Low Income Collaborative to explore new approaches to promote low-income conservation, identify barriers to its development and to address the issues raised by The Energy Project. On September 1, 2010, the Company filed the conclusions of the Low Income Collaborative as requested by the WUTC.

The CAAs had 2010 budgets of $1.3 million for Washington and $660,000 for Idaho. The Company processed about 1,500 rebates for low income projects which benefited approximately 550 households. During this year, the Company paid $1.7 million in rebates to the CAAs to provide fully subsidized energy efficiency upgrades, health and human safety as well as administrative costs for the CAAs to provide these programs. The CAAs spent nearly $144,000 on Health and Human Safety which was 8.3 percent of their total expenditures and within their 15 percent allowance for this category of spending. Low Income programs contributed 2,102 MWh and 61,271 therms of energy saved.

In 2011 all of the CAAs received an increase to their funding allocation resulting from recent rate cases in both Washington and Idaho making the total funding $2 million for Washington and $940,000 for Idaho and an additional $40,000 for conservation education.

CAAs submitting for reimbursement in 2011 must include age of home and square footage which will be used to improve billing analysis and other evaluation efforts. Rather than CAAs using various models to estimate their energy savings, energy savings claims are now consistent with the regular residential programs. Impact evaluation led the Company to believe that these models were treating the installation of measures individually, rather than incrementally, resulting in overestimates of savings achieved. This change should provide for higher realization rates since the original estimates should be closer to what can actually be observed in billing analysis. This modification was made in response to Ecotope's 2011 Energy Impact Evaluation Report of Select 2008 Programs.

The CAAs are still required to submit for "pre-approval" marginally cost-effective measures to protect the cost-effectiveness of the portfolio. This process has been in effect for the past three years and has allowed the Company to manage on a monthly basis the overall Total Resource Cost (TRC) for the Low Income Portfolio. Examples of measures that need pre-approval include natural gas furnaces, natural gas water heaters and Energy Star refrigerators.

Table 19: Low Income Electric Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (MWh)	Interactive Natural Gas (therms)
Energy Star Products	ID	-	-	-	-
	WA	132	$96	115	-
Heating & Cooling	ID	-	-	-	-
	WA	1	-	1	-
Home Weatherization	ID	191	$195	292	-
	WA	140	$168	243	-
Space & Water Direct Use	ID	-	-	-	-
	WA	218	$662	1,450	-
Water Heaters	ID	-	-	-	-
	WA	6	$8	2	-
	ID	191	$195	292	-
	WA	497	$934	1,810	-
	System	688	$1,129	2,102	-

Table 20: Low Income Natural Gas Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (therms)	Interactive Electric (MWh)
Heating & Cooling	ID	-	-	-	-
	WA	42	$53	6,300	-
Home Weatherization	ID	225	$185	15,286	-
	WA	387	$359	39,597	1
Water Heaters	ID	-	-	-	-
	WA	8	$16	88	-
	ID	225	$185	15,286	-
	WA	437	$428	45,985	1
	System	662	$613	61,271	1

Non-residential Sector Overview

For commercial, industrial and multi-family applications, energy efficiency programs are offered on a site-specific (or custom) basis. However, when it can be established that treatments result in similar savings and the technical potential is high, a more prescriptive approach can be offered. An example of this would be the prescriptive lighting program. The applications are not purely prescriptive in the traditional sense, such as with residential where homogenous products/offerings are provided for a large, homogeneous population, however, a more prescriptive approach can be applied for these similar applications.

Programs offered through the Company include, but are not limited to, space and water conversions, space and water equipment upgrades, appliance upgrades, cooking equipment upgrades, personal computer network controls, commercial clothes washers, lighting, motors, refrigerated warehouses, traffic signals, vending controls, compressed air, industrial processes and shell. Also included are residential programs such as multi-family direct install through UCONS (which ended in December 2009, however, a handful of projects were reported in 2010) and multi-family market transformation since these projects are implemented site-specifically unlike other residential programs.

During 2010, the Company processed over 2,500 energy efficiency projects resulting in the payment of $9.3 million in rebates paid directly to customers to offset the cost of their energy efficiency projects. These projects contributed 52,358 MWh and 742,559 therms in savings.

In January 2011, two new prescriptive programs, commercial windows and insulation and commercial natural gas HVAC were launched. Another prescriptive program, standby generator block heater program, is currently being evaluated with an anticipated launch date of April 1, 2011. A survey of various municipalities was conducted in 2010 to determine saturation levels of LED traffic signals and as a result, this program is being discontinued. Participants submitting paperwork by December 15, 2011 will be eligible to receive an incentive. The LEED program was ended December 31, 2010. Projects completed by December 31, 2011 with paperwork submitted by March 31, 2012 will be eligible for an incentive.

Energy Smart Grocer is a regional, turn-key program administrated through PECI. UCONS is a multi-family direct-install program that is also administered by a third-party. Even though this program ended in December 2009, a couple of projects weren't actually recorded and paid until early 2010. The remaining programs in the site-specific sector are implemented through the Company's DSM infrastructure.

Table 21: Non-residential Electric Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (MWh)	Interactive Natural Gas (therms)
Energy Smart Grocer	ID	145	$633	4,922	(9,667)
	WA	181	$580	5,646	(16,379)
Green Motors	ID	19	$7	58	0
	WA	4	$2	13	0
Multifamily Direct-use Market Transformation	ID	1	$8	39	(1,848)
	WA	2	$153	571	(27,127)
PC Network Controls	ID	0	$0	0	0
	WA	3	$29	373	0
Prescriptive Appliances	ID	2	$0	0	0
	WA	7	$0	1	0
Prescriptive Clothes Washers	ID	2	$3	10	0
	WA	7	$13	80	0
Prescriptive Demand-Controlled Ventilation	ID	4	$3	24	0
	WA	2	$0	5	0
Prescriptive Food Service	ID	28	$13	111	0
	WA	63	$33	453	0
Prescriptive Lighting	ID	429	$530	4,566	(26,809)
	WA	621	$1,414	12,311	(81,975)
Prescriptive Motors	ID	14	$43	312	0
	WA	38	$38	287	0
Prescriptive Refrigerated Warehouse	ID	0	$0	0	0
	WA	2	$21	214	0
Prescriptive Side-Stream Filtration	ID	0	$0	0	0
	WA	3	$26	195	0
Prescriptive Steam Trap Replacement	ID	0	$0	0	0
	WA	0	$0	0	0
Prescriptive Traffic Signals	ID	8	$24	211	0
	WA	3	$1	6	0
Prescriptive Vending Control	ID	0	$0	0	0
	WA	1	$0	1	0
Renewable	ID	1	$2	8	0
	WA	4	$4	19	0
Site Specific Appliances	ID	3	$6	33	(55)
	WA	6	$11	80	(1,505)
Site Specific Compressed Air	ID	1	$5	133	0
	WA	7	$124	1,061	0
Site Specific HVAC	ID	60	$252	1,697	(7,061)
	WA	105	$679	5,144	(19,025)

Site Specific Industrial Process	ID	4	$63	315	0
	WA	10	$484	2,583	0
Site Specific LEED	ID	0	$0	0	0
	WA	5	$462	0	0
Site Specific Lighting	ID	53	$568	4,099	(4,803)
	WA	87	$761	4,829	(16,231)
Site Specific Motors	ID	1	$3	45	0
	WA	7	$56	606	0
Site Specific Multi-Family	ID	0	$0	0	0
	WA	0	$0	0	0
Site Specific Shell	ID	83	$130	798	(99)
	WA	70	$69	378	0
UCON Multi-Family	ID	2	$2	14	0
	WA	2	$34	106	0
	ID	860	$2,294	17,396	(50,342)
	WA	1,240	$4,994	34,962	(162,242)
	System	2,100	$7,289	52,358	(212,584)

Table 22: Non-residential Natural Gas Program Summary

Program	State	Projects	Incentives (000s)	Energy Savings (therms)	Interactive Electric (MWh)
Energy Smart Grocer	ID	1	$4	2,012	0
	WA	4	$13	15,435	(51)
Prescriptive Appliances	ID	1	$0	8	0
	WA	1	$0	8	0
Prescriptive Clothes Washers	ID	2	$2	414	0
	WA	4	$4	884	0
Prescriptive Demand-Controlled Ventilation	ID	3	$8	1,076	0
	WA	2	$2	882	0
Prescriptive Food Service	ID	7	$12	10,417	0
	WA	24	$34	14,898	0
Prescriptive Refrigerated Warehouse	ID	0	0	0	0
	WA	1	$37	10,886	0
Prescriptive Steam Trap Replacement	ID	1	$6	34,465	0
	WA	1	$5	3,639	0
Site Specific Appliances	ID	6	$15	5,780	0
	WA	26	$27	11,394	0
Site Specific Compressed Air	ID	0	0	0	0
	WA	0	0	0	0
Site Specific HVAC	ID	40	$127	34,145	0
	WA	116	$1,033	326,095	(7)
Site Specific Industrial Process	ID	4	$68	25,351	0
	WA	2	$88	65,100	0
Site Specific Shell	ID	71	$129	42,300	(3)
	WA	135	$392	135,114	27
UCON Multi-Family	ID	1	$3	534	0
	WA	1	$11	1,723	0
	ID	137	$374	156,502	(3)
	WA	317	$1,646	586,057	(31)
	System	454	$2,020	742,559	(34)

V. DSM EXPENDITURES

The Company expended $24.8 million to fund local energy efficiency programs and Northwest Energy Efficiency Alliance (NEEA) during 2010. Sixty-eight percent of these expenditures funded electric programs while the remainder funded natural gas programs. Of total 2010 expenditures, seventy-seven percent was returned to shareholders in the form of rebates toward energy efficiency projects. In addition, the Company is one of several participating and funding members of NEEA. During this particular year, the Company contributed over $1.7 million to NEEA and their regional market transformation efforts. These programs extend beyond individual service territories and therefore require regional cooperation to succeed. Seventy-seven percent of the Company's local DSM expenditures are returned to rate-payers via energy efficiency rebates and three percent was spent on EM&V. Approximately $638,000 was spent on the Company's energy efficiency outreach which includes education of energy efficiency and available rebates through television and print as well as brochures for the promotion of individual programs. No savings are attributed specifically to the Company's outreach as it increases awareness of programs drives increases to participation, this increase in savings will be evident within individual programs.

The following tables show the distribution of electric and natural gas expenditures by spending category.

Table 23: Electric DSM Expenditures

Segment	State	Incentives	Implementation	EM&V	Total
Residential	ID	$999,613	$329,642	$54,502	$1,383,757
	WA	$1,898,462	$764,273	$129,934	$2,792,669
Low Income	ID	$272,845	$31,027	$4,170	$308,042
	WA	$1,042,250	($3,020)	$8,020	$1,047,250
Non-Residential	ID	$2,073,950	$500,540	$0	$2,574,490
	WA	$5,771,024	$674,307	$6,420	$6,451,751
General	ID	$0	$537,441	$67,744	$605,184
	WA	$0	$436,010	$132,124	$568,134
	ID	$3,346,407	$1,398,650	$126,416	$4,871,473
	WA	$8,711,737	$1,871,570	$276,498	$10,859,805
	System	$12,058,144	$3,270,219	$402,914	$15,731,278
		76.7%	20.8%	2.6%	

Table 24: Natural Gas DSM Expenditures

Segment	State	Incentives	Implementation	EM&V	Total
Residential	ID	$938,670	$84,663	$26,381	$1,049,715
	WA	$2,446,956	$194,392	$101,278	$2,742,626
Low Income	ID	$181,987	$26,374	$2,563	$210,924
	WA	$390,964	$20,546	$5,127	$416,637
Non-Residential	ID	$292,539	$64,187	$0	$356,726
	WA	$1,538,062	$114,052	$0	$1,652,113
Regional	ID	$0	$40	$0	$40
	WA	$0	$80	$0	$80
General	ID	$0	$318,012	$21,401	$339,413
	WA	$0	$540,439	$42,806	$583,245
	ID	$1,413,196	$493,277	$50,346	$1,956,819
	WA	$4,375,982	$869,508	$149,211	$5,394,702
	System	$5,789,178	$1,362,786	$199,557	$7,351,520
		78.7%	18.5%	2.7%	

Tariff Rider Balances

In aggregate, Washington and Idaho for both electric and natural gas, the beginning balance as of January 1, 2010 was underfunded by $11.9 million. During this year nearly $33.3 million was collected, as compared with budgeted revenue of $34.7 million, through the tariff rider to fund energy efficiency programs and reduce the underfunded balances. As mentioned above, $24.8 million was expended for the operation of energy efficiency programs. The underfunded aggregate balance was reduced by nearly $8.5 million leaving an underfunded balance of $3.4 million at year end.

The majority of the progress in reducing the underfunded amount occurs during the heating season and this year-end balance only shows the impact of the start of the heating season. Since year end, the Company has continued to reduce this aggregate underfunded balance by another $4.2 million resulting in an overfunded amount of $786,000.

Table 25 illustrates the individual tariff rider activity for 2010 by state and fuel.

Table 25: Tariff Rider Balances

	Idaho Electric	Washington Electric	Idaho Natural Gas	Washington Natural Gas
2010 Beginning Balance *(Underfunded)*	($2,369,075)	($3,795,590)	($1,626,631)	($4,102,951)
2010 Funding	$7,347,700	$16,573,073	$2,769,022	$6,576,850
Total 2010 Funds for Operations	$4,978,625	$12,777,482	$1,142,391	$2,473,899
2010 Expenditures	$5,444,933	$11,954,432	$1,957,130	$5,444,162
2010 Ending Balance *(Underfunded)*	($466,308)	$823,051	($814,739)	($2,970,264)

Actual to Business Plan Comparison

Actual 2010 expenditures compared with the budget from the 2010 Business Plan were fairly close to budget as estimated within the 2010 Business Plan. The Company completed 2010 with a favorable variance of $473,000 (or 1.9%) in aggregate for all states and fuels. This positive variance helped to reduce the underfunded tariff rider balances that existed during this time.

Table 26: DSM Expenditures Actual to Budget Comparison

	Idaho Electric	Washington Electric	Idaho Natural Gas	Washington Natural Gas
Budget per 2010 Business Plan	$5,574,777	$12,385,350	$2,077,627	$5,236,202
2010 Expenditures	$5,444,933	$11,954,432	$1,957,130	$5,444,162
Variance *(unfavorable)*	$129,844	$430,918	$120,497	($207,960)

As shown in the table above, the Washington natural gas tariff rider had nearly a $208,000 unfavorable variance as compared with the budget from the 2010 Business Plan. This unfavorable variance was due to a higher demand in natural gas rebates than was originally budgeted. Even though demand in DSM natural gas rebates were greater than budgeted, the Company continued to fund cost-effective energy efficiency while reducing the Washington natural gas tariff rider underfunded balance by $1.1 million.

Regional Market Transformation

Market transformation is an approach to accelerating and/or enhancing the penetration of cost-effective energy efficiency technologies and practices through an intervention within those markets. The interventions are intended to be of a temporary nature with favorable consequences that exceed the term of the venture itself. Market transformation has a nearly inherent tendency to overlap service territories. As a consequence it is best pursued as part of a regional cooperative effort rather than by a single utility acting in isolation. The Company participates in the funding and governance of the Northwest Energy Efficiency Alliance (NEEA) as a means of augmenting the Company's local energy efficiency programs.

The current five-year NEEA funding contract permits the expenditure of up to $40 million per year, subject to the approval of NEEA's board. Avista's funding share is approximately 5.4% of that amount. During 2010 Avista provided NEEA with $1.7 million in direct funding. The Company actively participates in the governance of NEEA and leverages a number of their regional ventures with local utility delivery efforts. Historically the Company has found NEEA to be a highly cost-effective component of Avista's energy-efficiency efforts, though it is recognized that this success has been heavily reliant upon successes within the residential lighting market that have diminished future potential. Avista remains confident that the tools of market transformation, and the application of those tools through the NEEA infrastructure, will remain a key component of our energy-efficiency portfolio.

The savings represented for 2010 represented within this report do not include an assignment of NEEA savings to the Avista service territory. The process for evaluating those savings and attributing them to utility service territories is generally not completed until the second quarter of the following year.

The Company continues to work with NEEA to pursue limited pilots into the application of proven market transformation approaches to natural gas efficiency opportunities. The technologies, market transformation and funding for the pilot remains under development. The Company has identified the use of market transformation tools as one key action item in improving the cost-effectiveness of the natural gas DSM portfolio.

VI. EXTERNAL STAKEHOLDER INVOLVEMENT

Avista's energy efficiency stakeholder involvement began in 1992. Through these discussions, a variety of parties have been instrumental in the improvement of our demand-side management program delivery and evaluation. Over time, our advisory groups have evolved. Initially it was known as the DSM Issues Group (DIG) which later became the DSM Opportunities Group (DOG). Beginning in the late 1990s, the Company's DSM stakeholder advisory group was the Triple E (or the External Energy Efficiency) Board. In 2010, the Triple E Board segued into (on a temporary basis) the EM&V and Low Income Collaboratives.

On January 26th, 2011 the Company modified its approach to stakeholder input to take into account, among other reasons, a new set of Commission standards—both in Washington and in Idaho. The primary intention is to obtain input from three relatively diverse groups of stakeholders in a manner that is respectful of everyone's time, but also allows for "deeper dives" and sufficient agenda time be devoted to topics in sufficient amount of detail for interested parties. Consequently, the Company will have three separate venues for gaining advisory "counsel" from three distinct groups: customers, technical experts, and regulatory and policy experts. The Company believes this new approach better aligns stakeholder involvement while being respectful of members' resources (e.g., time, travel, and e-mail traffic) while meeting the Company's needs resulting from the increasing complexity of DSM that has developed over the past twenty years.

VII. I-937 ACQUISITION OF CONSERVATION

In April 2010, the Commission approved the Company's ten year Achievable Potential and Biennial Conservation Target Report ("Conservation Report"). The Company elected to use the Northwest Power Planning and Conservation Council's Option #1 of the 6th Power Plan to establish its acquisition target, adjusted to include electric-to-natural gas fuel conversions. The acquisition target was 11% greater than the Company's Integrated Resource Plan's energy efficiency target for the same period. The Company intends to acquire 128,603 MWhs of energy efficiency as described in its approved Conservation Report in 2010 and 2011, the first I-937 two-year compliance period, including a minimum of 125,982 MWhs from non-conversion resources identified in the Company's IRP. The Company's projection of the acquisition over a ten year period, assuming that this same option is selected in future compliance periods, is 873,302 MWhs.

VIII. REORGANIZATION OF DSM PROGRAM DELIVERY AND EVALUATION

Effective August 23, 2010, the Company restructured its DSM program delivery into two separate teams, Implementation and Policy, Planning and Analysis (PPA). The main reason for this restructuring was to provide independent evaluation, measurement and verification (EM&V) on its DSM programs. Previously, the DSM team included three groups: program managers and coordinators, engineers and analysts. Under this new structure, all customer-serving DSM operations are together while analysis and reporting are in a separate, independent group. The Implementation team now includes program managers and coordinators, engineers and Account Executives who promote DSM to commercial and industrial customers. The PPA team has responsibility and accountability for third-party evaluation.

Appendices

Summary of Electric Cost-Effectiveness Tests

Total Resource Cost	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Electric avoided cost	$21,412,058	$153,869	$21,565,927	$45,958,090	$1,354,383	$47,312,473	$67,370,148	$1,508,252	$68,878,400
Natural Gas avoided cost	($316,732)	$0	($316,732)	($903,955)	$0	($903,955)	($1,220,687)	$0	($1,220,687)
Non-Energy Benefits	$866,251	$0	$866,251	$347,969	$0	$347,969	$1,214,220	$0	$1,214,220
TRC benefits	$21,961,576	$153,869	$22,115,446	$45,402,105	$1,354,383	$46,756,488	$67,363,681	$1,508,252	$68,871,933
Non-incentive utility cost	$1,516,351	$65,169	$1,581,520	$2,184,750	$144,752	$2,329,501	$3,701,101	$209,921	$3,911,022
Customer cost	$7,423,245	$169,550	$7,592,795	$17,674,180	$812,390	$18,486,571	$25,097,425	$981,941	$26,079,366
TRC costs	$8,939,596	$234,720	$9,174,316	$19,858,930	$957,142	$20,816,072	$28,798,526	$1,191,862	$29,990,388
TRC ratio	**2.46**	**0.66**	**2.41**	**2.29**	**1.42**	**2.25**	**2.34**	**1.27**	**2.30**
Net TRC benefits	**$13,021,981**	**($80,851)**	**$12,941,130**	**$25,543,175**	**$397,241**	**$25,940,416**	**$38,565,155**	**$316,390**	**$38,881,546**

Program Administrator Cost	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Electric avoided cost	$21,412,058	$153,869	$21,565,927	$45,958,090	$1,354,383	$47,312,473	$67,370,148	$1,508,252	$68,878,400
Natural Gas avoided cost	($316,732)	$0	($316,732)	($903,955)	$0	($903,955)	($1,220,687)	$0	($1,220,687)
PAC benefits	$21,095,326	$153,869	$21,249,195	$45,054,136	$1,354,383	$46,408,518	$66,149,461	$1,508,252	$67,657,713
Non-incentive utility cost	$1,516,351	$65,169	$1,581,520	$2,184,750	$144,752	$2,329,501	$3,701,101	$209,921	$3,911,022
Incentive cost	$2,719,499	$169,550	$2,889,050	$6,185,320	$812,390	$6,997,710	$8,904,819	$981,941	$9,886,760
PAC costs	$4,235,850	$234,720	$4,470,570	$8,370,069	$957,142	$9,327,211	$12,605,920	$1,191,862	$13,797,782
PAC ratio	**4.98**	**0.66**	**4.75**	**5.38**	**1.42**	**4.98**	**5.25**	**1.27**	**4.90**
Net PAC benefits	**$16,859,475**	**($80,851)**	**$16,778,625**	**$36,684,066**	**$397,241**	**$37,081,307**	**$53,543,541**	**$316,390**	**$53,859,932**

Summary of Electric Cost-Effectiveness Tests

Participant	Idaho Regular Income Portfolio	Idaho Limited Income Portfolio	Idaho Portfolio	Washington Regular Income Portfolio	Washington Limited Income Portfolio	Washington Portfolio	System Regular Income Portfolio	System Limited Income Portfolio	System Overall Portfolio
Electric Bill Reduction	$11,689,991	$266,419	$11,956,410	$27,094,878	$1,560,365	$28,655,243	$38,784,868	$1,826,784	$40,611,653
Gas Bill Reduction	$1,400,857	$0	$1,400,857	$3,860,237	$0	$3,860,237	$5,261,094	$0	$5,261,094
Non-Energy benefits	$866,251	$0	$866,251	$347,969	$0	$347,969	$1,214,220	$0	$1,214,220
Participant benefits	$13,957,098	$266,419	$14,223,517	$31,303,084	$1,560,365	$32,863,449	$45,260,182	$1,826,784	$47,086,967
Customer cost	$7,423,245	$169,550	$7,592,795	$17,674,180	$812,390	$18,486,571	$25,097,425	$981,941	$26,079,366
Incentive received	($2,719,499)	($169,550)	($2,889,050)	($6,185,320)	($812,390)	($6,997,710)	($8,904,819)	($981,941)	($9,886,760)
Participant costs	$4,703,746	$0	$4,703,746	$11,488,860	$0	$11,488,860	$16,192,606	$0	$16,192,606
Participant ratio	**2.97**	**NA**	**3.02**	**2.72**	**NA**	**2.86**	**2.80**	**NA**	**2.91**
Net Participant benefits	**$9,253,353**	**$266,419**	**$9,519,772**	**$19,814,224**	**$1,560,365**	**$21,374,589**	**$29,067,576**	**$1,826,784**	**$30,894,360**

Rate Impact Measure	Idaho Regular Income Portfolio	Idaho Limited Income Portfolio	Idaho Portfolio	Washington Regular Income Portfolio	Washington Limited Income Portfolio	Washington Portfolio	System Regular Income Portfolio	System Limited Income Portfolio	System Overall Portfolio
Electric avoided cost savings	$21,412,058	$153,869	$21,565,927	$45,958,090	$1,354,383	$47,312,473	$67,370,148	$1,508,252	$68,878,400
Non-Participant benefits	$21,412,058	$153,869	$21,565,927	$45,958,090	$1,354,383	$47,312,473	$67,370,148	$1,508,252	$68,878,400
Electric Revenue loss	$11,689,991	$266,419	$11,956,410	$27,094,878	$1,560,365	$28,655,243	$38,784,868	$1,826,784	$40,611,653
Non-incentive utility cost	$1,335,687	$65,169	$1,400,857	$3,715,485	$144,752	$3,860,237	$5,051,173	$209,921	$5,261,094
Customer incentives	$2,719,499	$169,550	$2,889,050	$6,185,320	$812,390	$6,997,710	$8,904,819	$981,941	$9,886,760
Non-Participant costs	$15,745,177	$501,139	$16,246,316	$36,995,683	$2,517,507	$39,513,190	$52,740,860	$3,018,646	$55,759,507
RIM ratio	**1.36**	**0.31**	**1.33**	**1.24**	**0.54**	**1.20**	**1.28**	**0.50**	**1.24**
Net RIM benefits	**$5,666,881**	**($347,270)**	**$5,319,611**	**$8,962,407**	**($1,163,124)**	**$7,799,283**	**$14,629,288**	**($1,510,394)**	**$13,118,894**

Summary of Natural Gas Cost-Effectiveness Tests

Total Resource Cost	Idaho			Washington			System		
	Regular Income Portfolio	**Limited Income Portfolio**	**Portfolio**	**Regular Income Portfolio**	**Limited Income Portfolio**	**Portfolio**	**Regular Income Portfolio**	**Limited Income Portfolio**	**Overall Portfolio**
Natural gas avoided cost	$10,493,920	$40,096	$10,534,017	$12,962,441	$111,727	$13,074,168	$23,456,361	$151,823	$23,608,184
Electric avoided cost	$919,158	$0	$919,158	$2,941,676	$639	$2,942,315	$3,860,834	$639	$3,861,473
Non-Energy Benefits	$100,815	$0	$100,815	$319,223	$0	$319,223	$420,037	$0	$420,037
TRC benefits	$11,513,893	$40,096	$11,553,989	$16,223,340	$112,366	$16,335,706	$27,737,233	$152,462	$27,889,695
Non-incentive utility cost	$511,262	$56,437	$567,700	$988,062	$86,081	$1,074,143	$1,499,324	$142,519	$1,641,843
Customer cost	$3,397,879	$160,514	$3,558,393	$11,849,663	$372,508	$12,222,171	$15,247,542	$533,022	$15,780,564
TRC costs	$3,909,141	$216,951	$4,126,092	$12,837,724	$458,590	$13,296,314	$16,746,866	$675,541	$17,422,406
TRC ratio	**2.95**	**0.18**	**2.80**	**1.26**	**0.25**	**1.23**	**1.66**	**0.23**	**1.60**
Net TRC benefits	**$7,604,752**	**($176,855)**	**$7,427,897**	**$3,385,615**	**($346,224)**	**$3,039,392**	**$10,990,367**	**($523,078)**	**$10,467,289**

Program Administrator Cost	Idaho			Washington			System		
	Regular Income Portfolio	**Limited Income Portfolio**	**Portfolio**	**Regular Income Portfolio**	**Limited Income Portfolio**	**Portfolio**	**Regular Income Portfolio**	**Limited Income Portfolio**	**Overall Portfolio**
Natural gas avoided cost	$10,493,920	$40,096	$10,534,017	$12,962,441	$111,727	$13,074,168	$23,456,361	$151,823	$23,608,184
Electric avoided cost	$919,158	$0	$919,158	$2,941,676	$639	$2,942,315	$3,860,834	$639	$3,861,473
PAC benefits	$11,413,078	$40,096	$11,453,175	$15,904,117	$112,366	$16,016,483	$27,317,195	$152,462	$27,469,658
Non-incentive utility cost	$511,262	$56,437	$567,700	$988,062	$86,081	$1,074,143	$1,499,324	$142,519	$1,641,843
Incentive cost	$1,361,152	$160,514	$1,521,665	$4,225,044	$372,508	$4,597,553	$5,586,196	$533,022	$6,119,218
PAC costs	$1,872,414	$216,951	$2,089,365	$5,213,106	$458,590	$5,671,696	$7,085,520	$675,541	$7,761,061
PAC ratio	**6.10**	**0.18**	**5.48**	**3.05**	**0.25**	**2.82**	**3.86**	**0.23**	**3.54**
Net PAC benefits	**$9,540,664**	**($176,855)**	**$9,363,810**	**$10,691,011**	**($346,224)**	**$10,344,787**	**$20,231,675**	**($523,078)**	**$19,708,597**

Summary of Natural Gas Cost-Effectiveness Tests

Participant	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Natural gas bill reduction	$1,831,336	$146,769	$1,978,105	$5,980,151	$398,141	$6,378,292	$7,811,488	$544,910	$8,356,397
Electric bill reduction	$1,163,504	$0	$1,163,504	$1,966,068	$1,040	$1,967,107	$3,129,571	$1,040	$3,130,611
Non-energy benefits	$100,815	$0	$100,815	$319,223	$0	$319,223	$420,037	$0	$420,037
Participant benefits	$3,095,654	$146,769	$3,242,423	$8,265,442	$399,180	$8,664,622	$11,361,096	$545,949	$11,907,045
Customer cost	$3,397,879	$160,514	$3,558,393	$11,849,663	$372,508	$12,222,171	$15,247,542	$533,022	$15,780,564
Incentive received	($1,361,152)	($160,514)	($1,521,665)	($4,225,044)	($372,508)	($4,597,553)	($5,586,196)	($533,022)	($6,119,218)
Participant costs	$2,036,727	$0	$2,036,727	$7,624,618	$0	$7,624,618	$9,661,346	$0	$9,661,346
Participant ratio	**1.52**	**NA**	**1.59**	**1.08**	**NA**	**1.14**	**1.18**	**NA**	**1.23**
Net Participant benefits	**$1,058,927**	**$146,769**	**$1,205,696**	**$640,824**	**$399,180**	**$1,040,004**	**$1,699,751**	**$545,949**	**$2,245,700**

Rate Impact Measure	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Natural gas avoided cost savings	$10,493,920	$40,096	$10,534,017	$12,962,441	$111,727	$13,074,168	$23,456,361	$151,823	$23,608,184
Non-Participant benefits	$10,493,920	$40,096	$10,534,017	$12,962,441	$111,727	$13,074,168	$23,456,361	$151,823	$23,608,184
Natural gas revenue loss	$1,831,336	$146,769	$1,978,105	$5,980,151	$398,141	$6,378,292	$7,811,488	$544,910	$8,356,397
Non-incentive utility cost	$1,107,066	$56,437	$1,163,504	$1,881,026	$86,081	$1,967,107	$2,988,092	$142,519	$3,130,611
Customer incentives	$1,361,152	$160,514	$1,521,665	$4,225,044	$372,508	$4,597,553	$5,586,196	$533,022	$6,119,218
Non-Participant costs	$4,299,554	$363,720	$4,663,274	$12,086,222	$856,730	$12,942,952	$16,385,776	$1,220,450	$17,606,226
RIM ratio	**2.44**	**0.11**	**2.26**	**1.07**	**0.13**	**1.01**	**1.43**	**0.12**	**1.34**
Net RIM benefits	**$6,194,366**	**($323,624)**	**$5,870,742**	**$876,219**	**($745,003)**	**$131,216**	**$7,070,585**	**($1,068,627)**	**$6,001,958**

Summary of Combined Electric and Natural Gas Cost-Effectiveness Tests

Total Resource Cost	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Electric avoided cost	$31,905,978	$193,966	$32,099,944	$58,920,531	$1,466,110	$60,386,641	$90,826,509	$1,660,076	$92,486,585
Natural Gas avoided cost	$602,426	$0	$602,426	$2,037,722	$639	$2,038,361	$2,640,147	$639	$2,640,786
Non-Energy Benefits	$967,065	$0	$967,065	$667,192	$0	$667,192	$1,634,257	$0	$1,634,257
TRC benefits	$33,475,469	$193,966	$33,669,435	$61,625,445	$1,466,749	$63,092,193	$95,100,914	$1,660,714	$96,761,628
Non-incentive utility cost	$2,027,613	$121,607	$2,149,220	$3,172,811	$230,833	$3,403,644	$5,200,424	$352,440	$5,552,864
Customer cost	$10,821,124	$330,064	$11,151,188	$29,523,843	$1,184,899	$30,708,742	$40,344,967	$1,514,963	$41,859,930
TRC costs	$12,848,737	$451,671	$13,300,408	$32,696,654	$1,415,732	$34,112,386	$45,545,392	$1,867,403	$47,412,794
TRC ratio	**2.61**	**0.43**	**2.53**	**1.88**	**1.04**	**1.85**	**2.09**	**0.89**	**2.04**
Net TRC benefits	**$20,626,732**	**($257,705)**	**$20,369,027**	**$28,928,790**	**$51,017**	**$28,979,807**	**$49,555,522**	**($206,688)**	**$49,348,834**

Program Administrator Cost	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Electric avoided cost	$22,331,216	$153,869	$22,485,085	$48,899,767	$1,355,022	$50,254,788	$71,230,982	$1,508,891	$72,739,873
Natural Gas avoided cost	$10,177,188	$40,096	$10,217,285	$12,058,486	$111,727	$12,170,213	$22,235,674	$151,823	$22,387,498
PAC benefits	$32,508,404	$193,966	$32,702,370	$60,958,253	$1,466,749	$62,425,001	$93,466,657	$1,660,714	$95,127,371
Non-incentive utility cost	$2,027,613	$121,607	$2,149,220	$3,172,811	$230,833	$3,403,644	$5,200,424	$352,440	$5,552,864
Incentive cost	$4,080,651	$330,064	$4,410,715	$10,410,364	$1,184,899	$11,595,263	$14,491,015	$1,514,963	$16,005,978
PAC costs	$6,108,264	$451,671	$6,559,935	$13,583,176	$1,415,732	$14,998,907	$19,691,440	$1,867,403	$21,558,842
PAC ratio	**5.32**	**0.43**	**4.99**	**4.49**	**1.04**	**4.16**	**4.75**	**0.89**	**4.41**
Net PAC benefits	**$26,400,140**	**($257,705)**	**$26,142,435**	**$47,375,077**	**$51,017**	**$47,426,094**	**$73,775,217**	**($206,688)**	**$73,568,529**

Summary of Combined Electric and Natural Gas Cost-Effectiveness Tests

Participant	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Electric Bill Reduction	$12,853,494	$266,419	$13,119,913	$29,060,945	$1,561,405	$30,622,350	$41,914,439	$1,827,824	$43,742,263
Gas Bill Reduction	$3,232,193	$146,769	$3,378,962	$9,840,388	$398,141	$10,238,529	$13,072,582	$544,910	$13,617,491
Non-Energy benefits	$967,065	$0	$967,065	$667,192	$0	$667,192	$1,634,257	$0	$1,634,257
Participant benefits	$17,052,753	$413,188	$17,465,941	$39,568,526	$1,959,545	$41,528,071	$56,621,279	$2,372,734	$58,994,012
Customer cost	$10,821,124	$330,064	$11,151,188	$29,523,843	$1,184,899	$30,708,742	$40,344,967	$1,514,963	$41,859,930
Incentive received	($4,080,651)	($330,064)	($4,410,715)	($10,410,364)	($1,184,899)	($11,595,263)	($14,491,015)	($1,514,963)	($16,005,978)
Participant costs	$6,740,473	$0	$6,740,473	$19,113,479	$0	$19,113,479	$25,853,952	$0	$25,853,952
Participant ratio	**2.53**	**NA**	**2.59**	**2.07**	**NA**	**2.17**	**2.19**	**NA**	**2.28**
Net Participant benefits	**$10,312,280**	**$413,188**	**$10,725,468**	**$20,455,047**	**$1,959,545**	**$22,414,592**	**$30,767,327**	**$2,372,734**	**$33,140,060**

Rate Impact Measure	Idaho			Washington			System		
	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Portfolio	Regular Income Portfolio	Limited Income Portfolio	Overall Portfolio
Avoided Cost Savings	$31,905,978	$193,966	$32,099,944	$58,920,531	$1,466,110	$60,386,641	$90,826,509	$1,660,076	$92,486,585
Non-Participant benefits	$31,905,978	$193,966	$32,099,944	$58,920,531	$1,466,110	$60,386,641	$90,826,509	$1,660,076	$92,486,585
Revenue Loss	$13,521,327	$413,188	$13,934,515	$33,075,029	$1,958,506	$35,033,535	$46,596,356	$2,371,694	$48,968,050
Non-incentive utility cost	$2,442,753	$121,607	$2,564,360	$5,596,511	$230,833	$5,827,344	$8,039,265	$352,440	$8,391,705
Customer incentives	$4,080,651	$330,064	$4,410,715	$10,410,364	$1,184,899	$11,595,263	$14,491,015	$1,514,963	$16,005,978
Non-Participant costs	$20,044,731	$864,859	$20,909,591	$49,081,905	$3,374,237	$52,456,142	$69,126,636	$4,239,097	$73,365,733
RIM ratio	**1.59**	**0.22**	**1.54**	**1.20**	**0.43**	**1.15**	**1.31**	**0.39**	**1.26**
Net RIM benefits	**$11,861,247**	**($670,894)**	**$11,190,353**	**$9,838,626**	**($1,908,128)**	**$7,930,499**	**$21,699,873**	**($2,579,021)**	**$19,120,852**

Appendix B

Savings Audit of Avista's 2009 Natural Gas Demand-Side Management Programs

Ecotope, Inc.

Savings Audit of Avista's 2009 Natural Gas Demand-Side Management Programs

ECOTOPE
CONSULTING
RESEARCH
DESIGN

Report

Prepared for:
Avista Corporation

Prepared by:
Ecotope, Inc.

August 2010

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Executive Summary

This report summarizes the process and results of a detailed first-year verification of natural gas savings claims under Avista's 2009 energy efficiency programs. These programs are designed to support the "Decoupling" order providing rate treatment for energy savings programs in both the states of Idaho and Washington. Ecotope was contracted to review these savings claims by assessing the reported accomplishments in each of the Avista programs. While there are several separate programs, the verification divided the energy efficiency into eight separate verifications, each with a separate sampling and engineering review:

1. **Commercial /Industrial Programs**: The commercial/industrial (C/I) programs were largely based on custom engineering calculations applied to each individual account. Even where prescriptive measures were used, the documentation is assembled for each customer and often includes a mix of custom and prescriptive measures. For this verification the entire C/I program was combined into a single program. The individual measures were then collapsed into the customer accounts where they actually occurred. This process resulted in a total of 288 unique sites. These sites were sampled using a random sample with a stratification design. Each site received a detailed engineering analysis of savings and onsite verification.
2. **Residential Limited-Income**: This program was the result of contracts with social service agencies that provide support to limited-income clients. Avista contracts with these agencies to design and manage the programs. The gas savings claims are reported to the utility and have been used as claimed savings for these programs. A separate sample and audit protocol was developed for this set of programs. In addition, the engineering review applied to these programs was largely consistent with the review developed for the Avista operated residential programs.
3. **Residential Weatherization**: This program was designed and administered by the utility. It is composed of several measures designed to upgrade the thermal integrity of single-family homes in the Avista service territory. The program offers incentives to homeowners who insulate components of their homes and/or install replacement or new windows. Private contractors are hired by the homeowners and provide documentation of their work. The documentation is reviewed by the utility and a standardized rebate is returned to the homeowner. Savings from this program are derived from a standard set of calculations developed by the utility and adapted to the particular measures installed in the home.
4. **Residential Products and Appliances**: The utility offers a rebate to certain energy-efficient appliances and equipment. The rebates focus on clothes washing machines and dishwashers certified under the national Energy Star appliance efficiency ratings. The review of these products was focused on the list of certified products corresponding to the actual receipts submitted by the customers. Also included in this program were several Energy Star domestic hot water (DHW) appliances generally installed by plumbers. These receipts were also reviewed to ensure compliance with the standards.
5. **Residential Heating Equipment**: This program offered rebates to condensing furnaces and boilers used in heating single-family residences. The savings for this program were calculated using an assumed space heating load for all homes in the Avista service territory. The review was designed to assess the actual heating load (derived from billing analysis) and apply the documented efficiency of the equipment rebated to that load.
6. **Multi-Family Shell Measures**: This program was operated by an independent contractor. The contract was similar to the contracts used in the Limited-Income program. The gas savings from this

contract were derived from retrofit insulation and windows applied to multi-family clients. The savings claims were developed by the contractor and approved by the utility. These claims were not consistent with the utility's methodology. The review of this program included both the engineering calculations used and the actual measure verification in a sample of the sites affected by this program.

7. **Ground Source Heat Pumps (GSHP)**: This measure is based on the assumption that if an electric GSHP is installed that meets this standard, the savings in gas would be equivalent to the overall gas use for space heating in the home. The verification for this program focused on determining whether the home had, or could have had, gas supplied by the utility. In reviewing a sample of these applications, no conditions were found in which gas heat was offset or could have been offset.
8. **Energy Star New Construction: T**his program is operated regionally by the Northwest Energy Efficiency Alliance (NEEA). The verification rate for this program was taken as the ratio between the evaluated savings done for the entire program (adjusted for Spokane climate), and the claimed savings derived from NEEA tables and use by the utility in its savings claims.

The components of the verification were similar across the program groups:

- A sample of each of these major programs was developed using a 90/10 sampling criteria. Only the Energy Star New Construction program did not involve a sample in the final verification ratio.
- An engineering review was conducted on most programs. Only the appliance rebates and the Energy Star program did not get a custom engineering review.
- Most programs received a field review on virtually all the applications in the sample. The field review typically consisted of verification of the installed measures, and in the C/I program, the veracity of the custom engineering applied to each site. The appliance rebate and heating equipment rebate programs did not receive a field verification review.

Verification ratios were calculated from each of the eight programs. These verifications included all of the claimed natural gas savings under the Avista energy efficiency programs. Table 1 summarizes the results of this review for each program. As shown in the table, the overall verification rate was determined to be 83.4% of the utility's overall claim.

Table 1. Summary of Verification Ratios, All Programs

Program	Verification Ratio	T-statistic	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	-2.76	95,251	64,390
UCONS Multi-Family	1.000	0.00	35,290	35,290
Residential Weatherization	0.792	-2.55	545,180	431,544
Residential Products and Appliances	0.908	-2.99	48,666	44,172
Residential Heating Equipment	0.879	-2.62	395,076	347,018
Energy Star New Construction	0.528		18,124	9,569
Ground Source Heat Pumps, Conversions	0.000		15,740	0
All Residential Programs	0.808		1,153,327	931,983
All Commercial/Industrial Programs	0.868	-2.45	890,313	772,659
Total, All Claims	0.834		2,043,640	1,704,642

Table 2 and Table 3 summarize the verification results for the states of Washington and Idaho respectively. These tables use a single overall verification ratio for each separate program. The overall verification ratio is the weighted average of the separate programs. This weighting results in small differences in the verification ratio between the two states due to differences in the individual program claims between the states.

Table 2. Washington Program Verification

Program	Verification Ratio	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	83,178	56,228
UCONS Multi-Family	1	17,548	17,548
Residential Weatherization	0.792	418,529	331,475
Residential Products and Appliances	0.908	24,669	22,399
Residential Heating Equipment	0.879	269,001	236,452
Energy Star New Construction	0.528	13,002	6,865
Ground Source Heat Pumps, Conversions	0	9,444	0
All Residential Programs	0.803	835,371	670,968
All Commercial/Industrial Programs	0.868	608,004	527,747
Total, All Claims	0.830	1,443,375	1,198,715

Table 3. Idaho Program Verification

Program	Verification Ratio	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	12,073	8,161
UCONS Multi-Family	1	17,741	17,741
Residential Weatherization	0.792	126,651	100,308
Residential Products and Appliances	0.908	9,141	8,300
Residential Heating Equipment	0.879	128,075	112,578
Energy Star New Construction	0.528	5,122	2,704
Ground Source Heat Pumps, Conversions	0	6,296	0
All Residential Programs	0.819	305,099	249,792
All Commercial/Industrial Programs	0.868	282,309	245,044
Total, All Claims	0.842	587,408	494,837

1. Introduction

The purpose of this report is to document the procedures and results of Ecotope's independent, third-party verification of the 2009 Avista gas savings claims filed under Avista's "Decoupling Order" for natural gas efficiency measures in the states of Washington and Idaho. This review focused on the programs themselves without regard for the individual state. It was directed instead on the accomplishments and engineering that produced the energy savings claims filed. The programs evaluated were conducted in all major sectors, and for purposes of this report have been divided into two main sections: residential programs, filed under various program categories, and commercial programs, filed largely in "custom savings" categories.

Each of these programs includes an engineering estimate of, or procedure for arriving at, savings; a set of specifications required to implement any particular program measure; and a set of savings that result from such an implementation among individual customers. This verification is divided into individual sections, and refers to each major component of the savings claims made by Avista under its decoupling programs.

1.1. Goals and Objectives

The goal of this verification was to review the Avista programs that generate savings natural gas savings claims. The approach was based on a rigorous sampling methodology, designed to efficiently review the customers and measures in these programs and determine the veracity of the savings claims made.

To accomplish this goal several steps were implemented:

1. Review the claimed datasets. This review included the development of overall claimed savings and the structure of the individual measures within the Avista savings claim. Included in this review was a review of the database to remove duplicates and related anomalies from the sample frame and the future verification.
2. Develop a statistically-valid sample design aimed at efficiently reviewing the individual programs and assessing, on a customer level, the validity of savings claim. Depending on the program, either a simple random sample or a stratified random sample was used.
3. Using customers sampled and Avista's documentation, assess the engineering calculation used to evaluate the savings. This includes both deemed savings calculations and customized engineering calculations.
4. Conduct a field review on each site to establish the validity of the savings calculations and the presence of the measures as claimed. The field review was implemented to check observed measures against a compiled list of claimed measures from the Avista documentation.
5. Combine the engineering review and the field observations to develop an alternative savings calculation.
6. Using this alternative savings calculation, develop a verification ratio for each site. This ratio is the ratio between the savings claimed for all measures on the site to the savings calculated from the observed measures and the engineering adjustments.
7. Combine these ratios with the sample design to arrive at an overall verification ratio for each program evaluated. This ratio was then combined with the original savings claim to develop a final verified savings for the entire program.

2. Methodology

This section presents Ecotope's approach to providing a complete, third-party verification of Avista's 2009 natural-gas DSM programs. The key components of our audit approach include: a representative random sample; file review and engineering analysis of both the program assumptions and the individual site applications and a customized field verification plan.

The purpose of the audit was to verify savings claims and to develop a verification ratio for gas savings that can be presented to the regulators as part of compliance with the decoupling agreements, and for the utility to assess its progress on program implementation.

2.1. Data Collection and Review

The first step in the audit was to collect and review Avista's natural-gas DSM program designs and engineering calculations. Ecotope collected and reviewed Avista's 2009 claimed savings database and the following Avista program documentation.

2.1.1. Residential Measures

This program design documentation included eligibility criteria, participation requirements, and any assumptions, reasoning, or engineering calculations underlying claimed Therm savings values for prescriptive residential measures, where the claimed savings are either a fixed number per occurrence (H&C, PROD, and WH, ESH), or a per-square-foot value (most weatherization measures). Because most of these savings are based on deemed savings values or on deemed savings calculations, this documentation included those values and procedures.

Requested and reviewed residential measures included:

- Energy star homes (all-gas and elec/gas) (ESH)
- High-efficiency ground-source heat pump (H&C)
- High-efficiency gas boiler (H&C)
- High-efficiency gas furnace (H&C)
- Energy star clothes washer (PROD)
- Energy star dish washer (PROD)
- High-efficiency gas water heater (40G, 50G, tankless) (WH)
- Fireplace damper (WZN)
- Insulation (ceiling/attic, floor, wall) (WZN)
- Window replacement (WZN)
- New Window (WZN)

2.1.2. Limited-Income Residential Measures

Program documentation for the prescriptive, limited-income residential measures included the same information and background files as listed under the prescriptive measures presented above.

Requested and reviewed measures included:

- High-efficiency gas furnace (H&C)
- High-efficiency gas water heater (40G) (WH)
- Air infiltration (WZN)

- Energy Star doors (WZN)
- Energy Star windows (WZN)
- Insulation (ceiling, wall, floor, duct) (WZN)

2.1.3. Multi-Family Shell Insulation Measures

For this program both the measures and the engineering were reviewed as they were developed by the contractor, UCONS.

- MF shell (UCONS)

2.1.4. Commercial and Industrial Measures

The commercial and industrial program is based, in large part, on engineering reviews and custom calculations applicable to the particular customer and facility. There are, however, several prescriptive measures in the C/I program which may be assessed using deemed values or calculations. General documentation for this program included program design files for all prescriptive measures as well as any general design guidelines and/or engineering calculations for custom measures. More specifically, Ecotope requested clarification on the methodology used for developing the savings estimates: using deemed value or a deemed calculator.

Requested and reviewed commercial and industrial measures included:

- Appliances (SSA)
- Energy Smart-industrial process (ESG)
- Energy Star dishwasher (ESP)
- HVAC (SSHVAC)
- Industrial process (SSIP)
- Prescriptive comm clothes washer (PCW)
- Prescriptive demand cont. vent. (PDCV)
- Prescriptive food service (PFS)
- Prescriptive refrigerated warehouse (PRW)
- Prescriptive steam trap replacement (PSTR)
- Shell (SSS)

2.2. Sampling Plan

Based on analysis of the claimed savings database and the program documentation, Ecotope developed a sampling plan for performing file and site verification of a subset of program measures and sites included in Avista's 2009 claimed savings numbers. In the list below, the sampling plan methodologies for Avista's natural gas programs are broken out by sector and program.

In this phase measures listed in Section 2.1 were grouped into like measures so that the verification procedure could be adapted to the individual measure types. For example, retrofit insulation was included in all major residential program groups. These were each sampled separately and similar audit and engineering protocols were used to conduct the verification. Similarly, product rebates of all types were grouped to facilitate a file and engineering review only.

Our basic approach was to select a methodology and a verification sample size which would deliver a verification confidence level of at least 90/10 (90% confidence that the estimate is within 10% of the

actual value) at minimum cost in sample points. For most of the verification groupings, this led us to use a size-stratified sample, where "size" was the claimed Therm savings for a particular sample point. Typically, the unit of sampling was the Avista account number, rather than an individual measure. Because much of our verification was field-based the utility account was the sampling unit as it represented a physical location.

For a given sample, the number of strata and the boundaries for individual strata were determined using Dalenius-Hodges methodology, subject to the constraint that the number of strata should not be permitted to grow so large that the Neyman allocation sample plan called for fewer than four sample points in any given stratum. The various programs we sampled had varying degrees of heterogeneity of claimed therm savings. Since the payoff to increasing stratification varies with the degree of such heterogeneity, the number of strata in each of our statistical samples was not constant, varying from five strata in the case of residential weatherization and C/I samples, to just one in the case of the residential furnace and boiler sample (since claimed savings at each installation site were identical).

2.2.1. Residential Sample

The verification included both a field sample that was implemented at individual customer sites and a paper review that addressed the engineering calculations. In programs that are designed as appliance rebates for retail sales of efficient appliances (furnaces, boilers, and fireplace dampers), a large sample of files was reviewed for compliance with eligible products.

Ecotope developed field samples in several programs. A stratified random sample was drawn for field review of the weatherization programs (including limited-income). In addition, a field sample was drawn for the UCONS multi-family program and the ground source heat pump program.

For the Energy Star new construction program, the program operator evaluates the program for the entire region. For the audit, Ecotope used the results of that evaluation for the small savings attributed to Energy Star in the Avista savings claims.

- **Conventional Weatherization Sample.** This program includes several measures that are accounted independently but are applied to homes in various combinations. These are: insulation for the walls, ceilings, floors, replacement windows, and new windows. A stratified random sample of the accounts was drawn (using a 90/10 criteria, stratified by total savings in weatherization). A request for all available documentation of the measures, and savings calculation for that file, was forwarded to the utility. Non-weatherization measures were not part of the sampling criteria these measures were verified separately with the other furnace rebates. .
- **Limited-Income Weatherization Sample.** This program includes several measures that are combined in each account. These measures include: insulation for the walls, ceilings, floors and ducts; replacement doors and windows; and various appliances including high efficiency furnaces. An optimized stratified random sample of the accounts was drawn (using a 90/10 criteria). The individual accounts were sent with a request for all available documentation of the measures, and savings calculation for that file. In the sample, the furnace and appliance rebates were included in the verification of those programs.
- **High Efficiency Furnaces & Gas Boilers Sample.** Each program includes essentially one measure that is an efficiency upgrade of an existing heating system (increase in AFUE). Every measure has identical attributed savings derived from a single engineering calculation. As a result, the sampling plan was based on a simple random sample with an assumed coefficient of

variation, since all entries have the same claimed savings. Prior to drawing this sample elementary cleaning of the database was conducted to remove duplicates and address other data anomalies. This resulted in a small adjustment in the total savings claimed.

- **Appliance Rebate Sample.** These programs include a wide variety of appliances that are offered as rebates through contractors or other retail processes, including domestic water heaters, clothes washers, dishwashers, and fireplace dampers. Each major category received a data review to remove apparent duplicates and other data problems. A simple random sample was then drawn based on compliance with program specifications. A small variance (assuming at least 90% compliance with the program specifications) was assumed in developing the sample.
- **Other Measures Sample.** There are two programs in this category, including the ground source heat pump conversion from gas furnace or other heating equipment, and the UCONS multi family program. Both of these programs serve a limited number of customers. We drew a random sample for each of these programs separately. In the UCONS program the sample was stratified and designed for the program distribution. In the case of the ground source heat pump, the sample was a simple random sample of three to five cases for the small number of such incentives (about 20).

2.2.2. Commercial and Industrial Sample

The goal of this sample was to verify the savings estimates and measures installed under this program in the 2009 program year. The design was based on a stratified random sample developed using the savings claim from the C/I database. The sample was drawn using a statistical criteria of 90/10 (90% significance level, +/-10% confidence interval for sample means) which is standard practice for a field verification of this type.

To optimize the sample, a stratification design was developed. This strategy resulted in a sample that represents a large fraction of the total savings claim. A random verification sample of C/I applications was drawn for the verification.

2.3. Engineering Review

The engineering review was different for the various programs. Each of these programs was verified using a customized analysis and verification approach:

2.3.1. Residential Weatherization/Insulation

The weatherization program delivers savings from retrofit insulation and window measures. The program is delivered by contractors and incentives are paid to the individual customers as a result of receipts or invoices submitted to the utility.

The engineering review for insulation reviewed the original calculations used by Avista for its programs. These calculations were designed to provide an approximate savings estimate without a direct reference to the variety of homes and climates in the service territory. These calculations were revised based on regional calculation procedures used by the Regional Technical Forum (RTF). Individual sites were reviewed and key parameters of these savings calculations were collected and compared to the values in the Avista tracking system. This procedure resulted in adjustments in the savings in virtually all such measures. The same approach was used in evaluating the Limited-Income program and the UCONS

multi-family program. In the later case a multi-family prototype was used to characterize the savings in this program.

2.3.2. Residential Heating Equipment

Avista supports the installation of condensing gas furnaces, either as a replacement for a conventional furnace or as an upgrade beyond code of a furnace installed as part of an overall conversion from electric heating to gas heating. In both cases the savings are taken from conventional furnace efficiency as set by the Washington State Energy Code. Savings are calculated from a deemed heating base that is applied to all installations. The heating equipment represented a change in efficiency of the heating delivered in each home.

For this program no separate field review was performed. A sample of applications was reviewed to ascertain that the equipment installed met the Avista specifications for this program. A simple billing analysis was developed to assess the base-case heating energy use for each building. This allowed a custom assessment of the savings estimate for each home. Saving verification rates were set using the results of this analysis applied to the observed efficiency specifications of the equipment installed and compared to the claimed savings developed at the outset of this program. By this device the single calculation applied to all homes was modified to account for the size, climate, and occupant behavior appropriate to the actual customers that used this rebate.

In general, this method was only applied to homes where the measure replaced an existing gas furnace. The information developed from this billing analysis was used to calibrate the savings for these applications as well as the conversion applications included in this program.

2.3.3. Residential Appliance and Products

There are several efficient appliances that receive a rebate from Avista. These represent about 5% of the residential sector savings claimed. While there are several types of appliances in the program the applications are dominated by clothes washers and dishwashers (86% of the applications). The verification strategy was to use the same list of Energy Star appliances to verify that a sample of the individual applications qualify for the program and savings. This approach was applied to all appliances, including the various DHW measures as they appear in the sample. The verification ratio was calculated from the ratio of complying and non-complying applications. For these applications the Avista savings calculations were checked and used. All adjustments to these programs were the results of products that were not on the EnergyStar lists.

2.3.4. Commercial and Industrial Sector

All engineering reviews in the C/I programs focused on the individual site and evaluated all the assumptions and calculations used to develop the savings claims for that site. This approach included energy simulations and detailed engineering calculations for individual sites. As the review continued questions and clarifications were developed and discussed with the Avista staff responsible for these calculations. Adjustments were made based on these calculations as necessary. Often these reviews included reassessing the engineering simulation used in developing the savings estimates for the individual site.

2.4. File Review and Field Audit

The file reviews were conducted for each sampled application that would allow a field visit. A small amount of over-sample was drawn to allow for attrition in the recruiting process. In every case (commercial or residential) where a field audit was part of the protocol, the file review identified the measures to be reviewed by the auditors. In the case of the residential audits these measures were almost always insulation or weatherization measures. Audits were aimed at verifying the area of each component for which savings were claimed, the insulation value of the resulting installation, and the initial conditions (that could be observed).

The result of this process was to provide estimates of any changes in the measure specification or treated area. This information was combined with the engineering reviews to develop a verified savings that was compared to the savings claimed for that site.

In the case of the commercial sector some of the cases involved more complex engineering reviews that assessed the applicability of engineering assumptions made in either the Avista review or in the verification analysis. These were combined to arrive at final savings for each site. In the case of this program, when the engineering review and the verification review came to substantive agreement, no adjustment was made in the Avista savings claims.

2.5. Verification Ratio Estimation

In most cases the estimator applied to the resulting sample was the ratio estimator with an assumed underlying common verification ratio across all strata. Where the statistical assumptions of the ratio estimator are appropriate, it has desirable statistical properties and usually delivers tight confidence intervals.

In two cases, where the ratio model assumptions were not met, we used different estimators. In the residential furnace/boiler applications, claimed savings did not vary across sites. As a result it was necessary to draw a simple random sample of accounts. We directly estimated program savings, rather than directly estimating the verification ratio. In the case of our simple random sample of rebated appliances, we avoided the ratio estimator because of a suspicion based on sample results that the verification ratio was not constant across different classes of appliances which had significantly different claimed savings attached to them. We did not believe we had sufficient sample points to separately estimate verification ratios for each separate type of appliance. Our response to the situation was to use a post-stratification estimator with two groupings to estimate program savings directly and at the same time separate accounts containing a rebate for high-savings appliances from accounts containing rebates only for low-savings appliances.

Further details of the sampling plans and verification ratios calculated can be found in the following sections.

3. Audit of Residential Sector Programs

In the residential sector all *ex ante* engineering calculations were pre-calculated based on standardized assumptions, and so the savings are only partly the result of the individual components of the actual installation, and are partly an allocation of "average" or deemed practices used in the original engineering review of these programs. Thus the verification consisted of re-calculating these deemed savings and then applying these values to the results of the field audits.

Table 4 summarizes the residential savings claims verified in this effort. These savings include all of the residential-sector claims noted in the filing, but as can be seen, the UCONS program is included in this allocation as well as the "limited-income" program, even though both are reported in separate categories. These programs are unique in that they are operated by independent groups under contract to Avista. The savings calculations and program specifications are potentially different than other programs operated with the same or similar measures. With the addition of these contract programs the overall residential savings claims are somewhat higher than direct Avista filing for the residential sector.

Table 4. Residential Sector Savings Claims

		Savings Claimed		Applications	
Program	**Description**	Therms	%	N	%
WZN	Residential Weatherization				
	INSULATION - FLOOR	42,711	3.7%	190	1.4%
	INSULATION - WALL	103,011	8.9%	427	3.1%
	INSULATION- CEILING/ATTIC	111,607	9.6%	1,122	8.1%
	REPLACEMENT WINDOWS	287,704	24.8%	3,456	24.8%
	NEW WINDOWS	147	0.0%	3	0.0%
FUR	Heating Equipment				
	HIGH EFF. FURNACE	389,418	33.5%	3,166	22.7%
	HIGH EFF. BOILER	8979	0.8%	73	0.5%
APP	Appliance Rebates				
	ESTAR CLOTHES WASHER	24,336	2.1%	2,704	19.4%
	ESTAR DISHWASHER	8115	0.7%	1,623	11.7%
	ESTAR WATERHEAT TANKLESS	11,700	1.0%	195	1.4%
	ESTAR WATERHEAT 40 Gal	1208	0.1%	151	1.1%
	ESTAR WATERHEAT 50 Gal	3707	0.3%	337	2.4%
	FIREPLACE DAMPER	3724	0.3%	49	0.4%
LI	LIMITED INCOME PROGRAM	95,251	8.2%	268	1.9%
GSHP	NEW GROUND HEAT PUMP	15,740	1.4%	20	0.1%
UCONS	UCONS MULTI-FAMILY Shell	35,290	3.0%	41	0.3%
ESTAR	Energy Star New Construction				
	ESTAR HOME ELEC/GAS	17,336	1.5%	88	0.6%
	ESTAR HOME GAS ONLY	788	0.1%	4	0.0%
TOTAL		**1,160,772**		**13,917**	

3.1. Residential Weatherization

The weatherization programs operated under the Avista gas savings program included five major categories: floor insulation, wall insulation, ceiling/attic insulation, replacement windows, and new windows. This represented a total of 47% of all residential savings claimed by Avista. The engineering procedure for this group was developed using an abbreviated engineering calculation of the savings potential of these residential programs. This procedure resulted in relatively indefensible savings methodologies for the program when compared to the regional practices for residential weatherization programs.

For this verification the savings were recalculated using the procedures used by the Northwest Power and Conservation Council (NPCC) and the Regional Technical Forum (RTF) for developing savings from various residential weatherization programs. The approach was designed around two prototypes developed by the NPCC as part of its Sixth Plan for regional electric utility conservation goals. While this required some adaptation for use in estimating the impacts of weatherization on gas savings, the general approach allowed for whole-building simulations to calibrated models as a basis for estimating savings from these programs. The evaluation was done using the SEEM building simulation program used by the NPCC and the RTF as a standard for estimating savings potential from residential programs.

Table 5 shows the definition of the three residential prototypes used to evaluate Avista's residential programs. The insulation levels in these prototypes were varied to account for different measures with different initial conditions. In general, the savings were calculated using the least-insulated home that could be specified within the limits of the physical properties of the materials. The prototypes were evaluated in two climates: Spokane and Lewiston. These climates were averaged together to get a single estimate for the entire program. We used this method to correspond with the Avista claims as much as possible. In these calculations the assumed distribution of climates was 82% for Spokane and 18% for Lewiston. The same analysis was conducted on both the multi-family and single-family prototypes. Only the single-family results were used to assess the savings claims in the residential weatherization program.

Table 5. Residential Prototypes

Component	Prototype 1	Prototype 2	Multi-Family
Areas (ft^2 unless otherwise noted)			
Heated Area	1,344	2,688	26,400
Attic	1,344	1,344	8,800
Wall (Above Grade)	1,184	1,480	10,512
Wall (Below Grade)		1,036	-
Door	40	40	40
Window	176	376	3,840
Floor	1,344		8,800
Slab Perimeter (Lft)		148	-
Other			
Units	1	1	24
Infiltration	.35 ACH	.35 ACH	.35 ACH
Combustion Eff.	0.78	0.78	0.78
Duct Leakage	25%	16%	-
Duct Insulation	None	None	-

Table 6 shows the changes in measure savings calculated from the prototype analysis for the single-family cases. These are shown in comparison to the savings used in all Avista weatherization programs. We have used these savings estimates to update the savings and generate a new savings estimate for all residential weatherization programs. The ratio between the savings calculated in this analysis and the savings calculated in the Avista deemed calculator are shown in the "Ratio" column of Table 6. These adjustments vary between about 150% and about 20%, and based on this adjustment alone, some reduction in savings claims could be anticipated.

Table 6. Residential Insulation Savings

Measure		Therms Saved / ft^2						Ratio
		Spokane		Lewiston		Weighted	Avista	
	Prototype	1,344	2,688	1,344	2,688			
Ceiling	R0-R38	0.302	0.245	0.256	0.210	0.266	0.195	1.366
	R11-R38	0.093	0.075	0.078	0.064	0.081	0.101	0.807
	R19-R38	0.039	0.032	0.033	0.027	0.035	0.073	0.473
Floor	R0-R30	0.111	-	0.098	-	0.109	0.331	0.329
	R11-R30	0.027	-	0.024	-	0.027	0.144	0.184
	R19-R30	0.011	-	0.010	-	0.011	0.037	0.287
Wall	R0-R11	0.236	0.190	0.196	0.158	0.207	0.263	0.786
Window	1.1-0.35	1.338	1.198	1.099	0.986	1.227	0.810	1.515
	0.8-0.35	0.680	0.600	0.550	0.487	0.618	0.810	0.763
	0.55-0.35	0.178	0.145	0.134	0.110	0.154	0.420	0.368

To construct the residential weatherization sample all the individual applications were combined in the individual accounts. This process developed a population of 4,304 homes with an average of 1.2 measures per home. Subsequently a sample was drawn for the residential weatherization program; a savings claim for each site sampled was developed by combining all the measures claimed (as weatherization measures) in the particular home.

An optimum stratified random sample was developed. Further field evaluation was conducted to verify the areas and insulation values in the individual homes in the weatherization program. For the weatherization program, an initial sample of 25 homes was drawn from a five-strata design. Of these sites, 24 were recruited and allowed an auditor to visit the home and inspect the measures claimed in that home. Due to this initial over-sample, this sample easily met the minimum sampling criteria.

At each site the auditor first determined if the weatherization measure claimed was in fact present. The auditor was then asked to assess the measure installed and attempt to discern the initial conditions prior to the installation. In most cases this represented essentially an un-insulated base case, but in some cases the auditor observed some initial insulation and the savings were then calculated using that adjustment (see Table 6). In addition, the Auditor was asked to confirm the area affected by the weatherization measure. As with the insulation levels these areas were used to calculate the savings estimates for each site.

Using the combination of the savings calculated and shown in Table 6 and the observed areas and insulation base case, a new savings value was calculated for each home in the field sample. The results of this combination of verifications are shown in Table 7; here, the individual allocations by stratum are summarized, including the verified savings, adjusted for the engineering analysis.

The overall verification rate used the ratio estimator explained above. This allowed the statistical weighting implied by the sample design to be expanded to the entire residential program and yielded a single point estimation. This procedure also allowed the development of an estimated confidence interval and a significance test against the claimed savings to determine the statistical significance of the estimate.

Table 7. Residential Weatherization Verification

	Population		Sample			
Sample Stratum	Claimed Savings (Therms)	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
1	54,575	1,496	203	0.37%	225	5
2	143,156	1,481	389	0.27%	375	4
3	155,774	910	1,055	0.68%	726	6
4	115,199	324	1,319	1.14%	1,030	4
5	76,476	93	4,620	6.04%	2,238	5
Totals	**545,180**	**4,304**	**7,586**	**1.39%**	**4,594**	**24**
Verification Statistics				Notes:		
	95% Conf Interval		T-statistic*	*Statistically significant at 95% confidence level		
Ratio	Upper	Lower				
0.792	0.631	0.952	-2.546			

3.1.1. Program Recommendations

In this program there is a serious gap between the standards for calculating *ex ante* savings estimates throughout the region. We would recommend that the prototype analysis used by the RTF be adapted for purposes of developing the savings estimates for this program. Most of the adjustments made in this program were the result of the engineering changes in the savings calculation methodology. There were indications that the inspection of the contractor work was adequate. However, the next largest adjustment in savings came from measures that were improperly credited or where the actual insulation level did not correspond to the savings calculations. This could only be corrected with added inspections and would probably improve the overall program verification

3.2. Heating Equipment

One of the largest programs in the residential sector for Avista was the heating equipment program, resulting in 34.3% of all residential claimed savings. This program offered a rebate to Avista customers who upgraded their furnaces to a condensing-type furnace from a conventional combustion furnace (or boiler). This measure increases the nominal combustion efficiency from .78 (the minimum required by federal standards and Washington State code) to .90 or greater (with added incentives for furnaces with combustion efficiency above .95). The Avista engineering evaluation of the furnace system was based on a single point estimate developed based on a conservative estimate of the total heat-loss rate for typical houses in the Avista service territory. This rate, however, was not justified by any empirical data collected in the service territory or anywhere else.

To verify this program, a simple random sample was drawn of 67 sites; this was meant to be a sufficient sample to get a 90/10 confidence interval. Since every home had the same savings claimed, an assumed standard deviation was constructed to determine the appropriate sample to evaluate this program. An assumed coefficient of variation (standard deviation divided by population mean) was developed from these assumptions of approximately 50% (this represents a large estimated variance in gas heating energy use across the participants in the Avista furnace rebate program).

About 3,200 separate applications were part of this program, each of which include a contractor invoice and documentation of the furnace installed. This invoice allowed a reviewer to determine if the furnace met the efficiency requirements of the Avista program. To complete the engineering verification, a billing analysis was conducted on the sample of homes in which the furnaces were installed. This billing analysis estimated the total space heating used by the homes prior to the installation of the more efficient furnaces. This was used as a substitute for a field review, as we believed that such a review could not assess the heat load adequately within the time constraints of the verification.

The billing analysis was used as a basis for estimating savings based on the documented furnace efficiency from the contractors invoice and the assumed base efficiency. This is probably a conservative estimate since many older furnaces do not meet even current minimum standards. Of the 67 homes, 48 homes had sufficient data with which to assess the heating load prior to the installation of new equipment. For these homes a savings estimate was constructed using the difference in efficiency calculated for each home.

The remaining cases were assumed to be either new construction, or conversions from electric (or some other type of heating) to natural gas. We identified new construction sites either through the use of a new construction rebate form (rather than a replacement rebate form), or because both electric and gas billing records commenced around the installation date recorded on the rebate form. If the electric billing record was present prior to the furnace installation data but no gas bills were recorded (or had no prior heating signature) we assumed the site was a conversion. The conversions could not be evaluated with a billing analysis, so the average of the 48 homes that were evaluated was used to determine the savings. This group included a total of seven homes in the sample. The remaining 12 homes were assigned to new construction. For this group, the savings were decremented by one-third to account for improved insulation. The base furnace efficiency was set at .80 for this group since modern codes require this higher level of efficiency. Table 8 shows the resulting energy savings and verification ratio for this program throughout the service territory.

Table 8. Furnace/Heating System Verification

Population		**Sample**			
Claimed Savings (Therms)**	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
395,076	3,212	8,241	2.09%	7248	67
Verification Statistics					
	95% Conf Interval				
Ratio	Upper	Lower	T-statistic*	Notes: *Statistically significant at 95% confidence level	
0.879	0.788	0.969	-2.62		
**An adjustment of 0.8% was made in the Avista savings claim to account for duplicates in the database.					

3.2.1. Program Recommendations

This program appears to be very effective and has received the support of the HVAC contractors. The result is a large apparent savings. The use of a single "calculated" value to assess the savings seems unavoidable but some adjustment in this rate should be expected to be adjusted with evaluation and/or engineering as the program progress. The documented savings calculation for this program predicted a savings of about 87 Therms for each furnace. The claimed savings was about 123 Therms. This verification was about halfway in-between. We would suggest that collecting a small amount of added data such as house size and the age of the replaced furnace might inform future *ex ante* savings calculations and reduce both first-year verification adjustments and improve overall evaluation realization rates.

3.3. Appliance Rebates

Six separate appliance rebates were offered by Avista over the course of the 2009 program. These are mainly for Energy Star appliances purchased either in the retail sector or from contractors. Rebates were granted based on the receipt or invoices associated with the purchase of the appliances. Overall this program accounts for 36% of all savings applications filed by Avista (about 5,059 separate rebates), but only 4.5% of the natural gas savings claimed in the residential sector.

To sample this, a simple random sample was drawn for all 5,059 appliance rebate applications filed. This was not based on the distribution of savings estimates within that program. A total of 90 appliance rebate forms were randomly selected. The sample size was based on a "binomial" sample. Such a sample is based on establishing the fraction of the rebates that in fact received rebates for appliances on the Avista approved Energy Star list. This sample became the verification sample for the appliance sector. Some accounts had more than one rebate application. These applications were separated out. As a result the final sample was increased to 93 cases.

As can be seen by reviewing Table 4, a simple random sample will draw large numbers of dishwashers and clothes washers, since they represent the bulk of both savings and applications in this program. In this group, however, there are a few "tankless" domestic hot water (DHW) heaters. These appliances offer large savings well beyond any of the other products in the sample. Directly estimating a single "Energy Star verification ratio" for the whole sample (an estimated percentage of rebated appliances that are in fact Energy Star), and multiplying this ratio times the aggregate claim to get verified savings, runs the risk that population verification ratios for high-savings coupons differ from the overall average. Verification rates within sampled coupons did in fact suggest that the assumption of uniform verification percentages across appliance categories was not tenable. We responded to this problem by using a post-stratification estimator which separated sampled accounts with rebates for tankless heaters, from all other accounts.

The verification for the remaining products consisted of reviewing the invoices filed by the homeowner or contractor, and checking them against the Energy Star list for these appliances. Since the savings for each individual appliance was deemed and did not vary with the make model or size of the appliance, we reviewed the applications based on the Energy Star calculator. When the sampled application did not include an appliance that was on the Energy Star list the savings were zeroed out for that application. The verification ratio for this set of appliances was calculated as the ratio of the total claimed savings for the sampled group and the total claimed savings when these cases were removed. The tankless DHW products were evaluated separately in the same way. Since none of these products failed the review, that portion of the savings claimed remained as filed.

As with the other residential programs this procedure resulted in a single point estimate of a verification ratio. Given the sample size and the probability of an appliance failing the Energy Star criterion, a significance test was constructed. The results of this verification are shown in Table 9. The resulting verification ratio for the entire product rebate program is statistically significant.

Table 9. Product Verification

	Population		Sample			
Sample stratum	Claimed Savings (Therms)**	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
0	36,992	4,499	704	1.90%	639	88
1	14,942	234	300	2.01%	300	5
Totals	**51,934**	**4,733**	**1,004**	**1.93%**	**939**	**93**
Verification Statistics				Notes:		
	95% Conf Interval		T-statistic*	*Statistically significant at 95% confidence level		
Ratio	Upper	Lower				
0.899	0.843	0.956	-3.49			
**An adjustment of 1.6% was made in the Avista savings claim to account for duplicates in the database.						

3.3.1. Program Recommendations

This program seems well designed for rebating incentive to customers purchasing efficient equipment as long as there is an agreed standard for such equipment. In general, such a standard exists through the EnergyStar program for almost all of the savings claimed. This made the verification straightforward.

In one case ("Fireplace Dampers") there is no standard and the engineering associated with this "product" seemed very suspect. Since this measure was combined with the other products, and since it was a very small fraction of the entire appliance program, the sample did not include any of these products. We did not adjust or remove these savings from the overall program, but we believe with a larger sample and more time to review the engineering, this program would have been dramatically reduced. We would recommend that it be dropped as a measure or at least that the engineering estimates used be carefully reviewed before the next verification.

3.4. Limited-Income Program

The limited-income (LI) program is a separate program contracted with individual community action programs (CAP). Avista has contracted with four such programs; however, only two had significant activity in 2009. To develop a sample for the limited-income program a stratified random sample was conducted of the individual accounts; these accounts used a combination of measures from essentially all of the weatherization measures used by Avista in the residential sector. The sampling procedures and technical evaluation paralleled the residential weatherization program discussed above.

The CAPs have typically used the savings calculations from Avista. In some cases they generated their own savings estimates and submitted them to the utility as their savings claims. The claims of the CAPs were adjusted using the same analysis used in the weatherization programs based on the simulation results

summarized in Table 6. A few measures were separately evaluated since they did not appear in the Avista program. In these cases, (infiltration/air sealing, insulated doors, and duct insulation) the savings claims reported by the program were used once the measure itself was verified.

Since this is a stratified random sample some recruitment issues unique to the LI program required added sample points to ensure an adequate final sample. The agencies themselves were crucial in recruiting their individual clients. Even with their help the response rate was only about 50%. Unlike the other programs, a second back-up sample was drawn to allow for this high rate of non-response. A total of 16 homes were audited and field verified as part of the final sample.

In this field protocol the auditors were asked to review the measures claimed in the same manner as for residential weatherization. In addition, they were asked to verify if the home was actually gas-heated. This was thought to be important since no separate verification of heating system was included in the claims made by the CAPs. In addition, two measures were reviewed, infiltration control and duct insulation. This was not directly field verified, but the documented blower door results were reviewed and the standard savings calculations used to evaluate changes in blower door tests was used to recalculate the appropriate savings claim for that measure. Duct insulation was verified and, if observed, the savings claims were accepted as verified.

Once this allocation was complete, a full verification ratio was conducted similar to the weatherization program, in which the stratification was evaluated and a verification rate calculated across all strata. In the LI program a total of 38 homes were sampled for purposes of verification; the actual target developed from the sample design was 19 homes (including some over-sample). No homes were reviewed unless they agreed to a field audit. Finally, 16 of the 19 homes were reviewed. The appendix summarizes the audit results and verification rates for the individually audited sites. Table 10 shows the results of this verification and includes the verification ratio once again calculated by accounting for strata and statistical design.

Table 10. Limited-Income Program Verification

	Population		**Sample**			
Sample Stratum	Claimed Savings (Therms)	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
1	18,565	121	756	4.07%	561	4
2	38,794	98	1,253	3.23%	833	4
3	37,892	49	6,352	16.76%	4,097	8
Totals	**95,251**	**268**	**8,361**	**8.78%**	**5,491**	**16**
Verification Statistics				Notes:		
	95% Conf Interval			*Statistically significant at 95% confidence level		
Ratio	Upper	Lower	T-statistic*			
0.676	0.446	0.906	-2.761			

3.4.1. Program Recommendations

The Limited-Income programs are operated by separate CAP agencies who apparently are allowed to calculate their savings estimates. This policy seems to have resulted in large savings estimates which are not easily supported by the engineering analysis done for the weatherization programs. This has resulted in a significant verification adjustment. We recommend that the savings methods used by these agencies be consistent with the Avista procedures or that the *ex ante* savings for the limited-income programs be supplied by Avista as part of its contract with the agencies. It appears that in other respects these programs are well run and that the quality control was effective.

3.5. Ground Source Heat Pump

The ground source heat pump (GSHP) incentive offered by Avista assumed that in developing the ground source heat pump, Avista saved gas heating as a result of removing or otherwise avoiding a gas furnace and replacing it instead with a high-efficiency electric based GSHP. Thus all the heating requirements of the home, which would have been gas, are saved. This is a dubious assumption, and our verification sample included three randomly-selected GSHP cases (out of 20 in the program) in which the auditors were instructed to review the homes primarily for whether gas heating was (or ever could be) a heating source for the home. Thus the verification ratio in effect was the degree to which these homes were likely to ever save gas produced and sold by the Avista utility. From the three sites reviewed, this was not possible in any of these cases. We believe that this is representative of the entire sector, so the verified savings for the program was set to zero and all the claimed savings were removed.

3.5.1. Program Recommendations

It is not clear how this program deliver gas savings for the Avista program. The base case is not gas in any of our sampled cases. If there is to be any savings booked there should be an entry that specifically notes both the existence of gas space heat and/or the existence of a gas service that might be used to provide space heat to these customers. Otherwise this measure, while it may provide electric or other fuel savings, is not a gas efficiency measure.

3.6. UCONS Multi-Family Shell Retrofits

The UCONS program is similar in some respects to the limited-income program, in that a separate contractor was hired to manage the program and to develop program savings claims and implement installation of these measures. The great bulk of the program was focused on developing electric savings from new efficient lighting and hot-water flow restrictors. However, a fraction of the program also was aimed at retrofitting multi-family buildings with various envelope insulation measures. The UCONS program set the savings claims using a set of savings calculations submitted and approved by Avista. These in turn became the basis for the claimed savings.

A two-step verification process was used. The first step was to draw a stratified random sample for the 41 multi-family shell insulation projects claimed under the UCONS program. These were sometimes buildings within the same complex, and sometimes individual buildings operated separately. The overall sample design included 13 such projects and involved 10 separate complexes or buildings. The appendix summarizes the site-by-site verification results for this program. The auditors were asked to review each site and try to discern the measures. They were primarily asked to measure the areas used to assemble the

savings claims and to determine the initial insulation conditions. The saving calculations verified used the same "calculated" savings number (.15 Therms/ft^2) for all insulation measures regardless of initial conditions, building component, or amount of insulation installed.

As a result of this abbreviated method, a multi-family prototype was drawn from the NPCC prototypes (see Table 5) and used for the re-evaluation of the initial savings estimates. Table 11 shows the result of this simulation review. This review often increased the nominal savings estimates assigned to the UCONS measures. In all cases the heating efficiency was set using a combination of anticipated gas distribution and combustion efficiencies of .75.

Table 11. Multi-Family Savings by Measure

Measure	Savings Calculated (Th/ft^2)				Ratio
	Spokane	Lewiston	Weighted	UCONS	
Wall R0-R11	0.171	0.142	0.166	0.15	1.11
Attic R0-R38	0.196	0.148	0.187	0.15	1.25
Attic R19-R38	0.015	0.026	0.017	0.15	0.11
Floor R0-R11	0.200	0.152	0.191	0.15	1.28
Floor R0-R19	0.246	0.190	0.236	0.15	1.57
Floor R0-R30	0.273	0.212	0.262	0.15	1.75
Window U=1.0 to U=.35	1.146	0.904	1.102	0.625	1.76
Window U=.55 to U=.35	0.214	0.159	0.204	0.625	0.33

The overall impact of the UCONS program was recalculated based on the same procedures used in the weatherization programs. There were two sources for the adjustments. First, the areas of the component that received the insulation measure were reviewed and altered by the auditor in the field; and, second, the insulation was assessed and, when possible, the initial insulation value was observed. When components were impossible to verify, the UCONS area claims were used in combination with the revised measure savings values in Table 11. Ten separate UCONS' applications were reviewed, representing 13 separate invoices from the program.

The verification ratio was calculated with a combination of the new savings ratios as shown in Table 12 and based on the verified areas and insulation levels observed by our auditors at these sites. Table 12 shows the allocation of savings by stratum for the UCONS program and shows the calculated verification ratio and significance level for this sample.

Table 12. UCONS Program Verifications

Sample Stratum	Population		Sample			
	Claimed Savings (Therms)	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
1	6,193	21	481	7.77%	370	2
2	16,222	13	7,083	43.66%	8,477	4
3	12,874.8	4	12,874.8	100.00%	9,509	4
Totals	**35,289.8**	**38**	**20,438.8**	**57.92%**	**18,356**	**10**
Verification Statistics				Notes:		
	Confidence Interval			*Not statistically significant at 90% confidence level		
Ratio	Upper	Lower	T-statistic*			
1.000	0.816	1.184	0.00			

3.6.1. Program Recommendations

The UCONS program does not appear to have been reviewed thoroughly during the program set-up and operation. None of the savings claims were justified, although the size of the claim was typically very conservative so the errors actually resulted in increased energy savings estimates. The area documentation was poor and often large adjustments seemed necessary. There were several comments on the quality control of the program by the apartment managers. These comments generally referred to the actual contractors that did the installation but indicated limited accountability. While this verification concluded no savings adjustment was statistically justified, the program itself is very erratic. The program delivered insulation measures in a sector that can use these measures. However, a better designed program operated by the utility through apartment owners or even insulation contractors would serve this sector.

3.7. Energy Star

Avista participated in the regional EnergyStar program for new home construction; this program is managed across the entire region by the Northwest Energy Efficiency Alliance (NEEA). We did not verify those savings directly but rather used the regional evaluation to assign savings to the applications in the Avista program.

This evaluation was completed in July 2010 but did not separately evaluate savings for the climate zones in the Avista service territory. As a result the savings are not calibrated to the same standard that Avista used in its savings claims. The evaluation did not document the climate distinction so we used an upper boundary of their savings estimates, arguing that it was within the confidence interval and was certainly better-suited to the Avista service territory. Even so, the evaluated savings for the Energy Star new construction program documented a savings rate that implied a .528 verification ratio for this program. This ratio was used to calculate savings for the 92 Energy Star applications in the Avista 2009 savings claims.

4. Audit of Commercial and Industrial Sector Programs

The Commercial/Industrial (C/I) program offerings are divided into eleven major categories. Each of these categories has separate program offerings and separate calculation requirements. Table 13 shows both the nominal categories used in this program and the savings filed for each of these categories. As can be seen in Table 13, there are two classes of measures. The first are measures calculated on a custom basis for each application. These include building shells, HVAC equipment, and industrial processes. Prescriptive measures use a deemed savings calculation that is compiled for each particular measure. These measures constitute about 17% of the total Avista savings claim. Measures included here are prescriptive appliances, cooking equipment and other types of specific commercial measures. In all cases, these prescriptive measures' savings are calculated based on an engineering review of the particular measure that could be applied to all such applications.

For the C/I program, given the distribution of savings – especially between the various engineering methods and the overall savings – we elected to sample the program as a whole for purposes of verification. By this device, the verification rate itself is calculated using engineering and deemed savings on the individual sites sampled. The verification rate calculated from this review is designed to apply to the C/I program as a whole.

Table 13. Commercial and Industrial Gas Program Savings Claims

			Savings Claimed	
Program	**Description**	**Applications**	Therms	Percent
Custom				
SSA	Appliances	19	11,970	5.0%
ESG	Energy Smart-Industrial Process	2	5,891	0.5%
SSHVAC	HVAC	160	579,237	41.8%
SSS	Shell	132	173,942	34.5%
SSIP	Industrial Process	4	78,829	1.0%
Prescriptive				
PRW	Energy Star Dishwasher	4	1,955	1.0%
PCW	Prescriptive Comm Clothes Washer	11	3,062	2.9%
PDCV	Prescriptive Demand Control Vent.	3	1,056	0.8%
PFS	Prescriptive Food Service	43	22,726	11.2%
PRW	Prescriptive Refrigerated Warehouse	1	1,863	0.3%
PSTR	Prescriptive Steam Trap Replace	4	9,782	1.0%
	Total	**383**	**890,313**	

The goal of this sample was to verify the savings estimates and measures installed under this program in the 2009 program year. The design was based on a stratified random sample, using savings claims for the database summarized in Table 13. Prior to sampling all the measures were collapsed into the individual accounts. This had the effect of reducing the number of cases but increasing the number of measures reviewed within the sample. The total number of accounts in the sample frame was 288. While this changed the sample design it had no effect on the savings claim used in developing the verification. The sample was drawn using a statistical criterion of 90% significance level, 10% confidence interval, for verification ratios drawn from the individual customers. This criterion was judged to be standard practice for field verification of a program of this type.

To optimize the sample a stratification design was developed using a Dalenius-Hodges stratification and a Neyman allocation among the various strata. This strategy resulted in a sample that represents a large fraction of the total savings claims, and within each stratum, a random sample was conducted across all CI applications. A total of 25 sample points were drawn using the stratification design developed. These are representative of the sample distribution, and would be the basis of both the engineering review and the field review.

A detailed engineering review was conducted on each of the 25 sites. These sites included both prescriptive or the custom measures as they appeared in the site. Given this approach the engineering analysis and the verification calculations were applicable to the commercial sector as a whole but not necessarily to any particular subset of the sector by either geography or measure.

The engineering review included all engineering worksheets, simulations, and related documentation for every claim within the sample. This review included rerunning the simulation calculations when that was supplied. Errors in these calculations were then applied to the entire account to adjust the total savings claim. In cases where there were prescriptive measures, the deemed savings were generally used, but the actual files were reviewed to ensure that the equipment that was installed met the specifications and certifications required by the deemed savings calculator.

Subsequent to this engineering review, a field review of each sample point was attempted. Because of difficulties with recruiting and scheduling, two sites of the 25 were not reviewed in the field. For these sites only the engineering review is used to arrive at final savings verifications. Appendix A summarizes the engineering review and adjustments made on this sample of projects.

Table 14 details the verification findings and rate for each sample stratum and the program as a whole. A significance test was conducted on the ratio of the verified savings from the engineering/field review compared to the claimed savings developed for the Avista savings claim. This process developed a point estimate of the ratio between the verified savings and the claimed savings, which became the verification ratio for the C/I program.

Table 14. Commercial/Industrial Verifications

	Population		Sample			
Sample stratum	Claimed Savings (Therms)	N	Claimed Savings (Therms)	Sample % (Therms)	Verified Savings (Therms)	N
1	75,160	185	2,970	3.95%	2,678.7	5
2	137,059	59	14,194	10.36%	10,862.7	5
3	209,523	29	34,209	16.33%	33,610	5
4	184,089	9	103,381	56.16%	73,055.71	5
5	284,482	6	237,343	83.43%	223,212.3	5
Totals	**890,313**	**288**	**392,097**	**44.04%**	**343,419.41**	**25**
Verification Statistics				Notes:		
	95% Conf Interval			*Statistically significant at 95% confidence level		
Ratio	Upper	Lower	T-stat*			
0.868	0.762	0.974	-2.451			

This point estimate ratio is applicable to the entire program and thus applicable to each individual state directly. Also included in this verification is a significance test; our criterion was that it must achieve significance at a 90% level. As can be seen, this significance level was met by the sample and verification results. In the C/I programs, this verification rate applies across all applications (prescriptive and custom). The UCONS program, which was included in the original C/I claim, was evaluated separately under the residential program.

4.1.1. Program Recommendations

A review of this program provides evidence that this approach is very effective for the C/I sector. There was good evidence that often the custom engineering review resulted in effective measures installed. There were some cases where issues arose that should be addressed. Primarily the use of a code requirement did not always inform the savings calculations. We would recommend that for any replacement equipment covered by the energy code the savings should be calculated from the base code efficiency.

5. Overall Verification Results

Table 15 summarizes the verification ratios for each Avista program using the 2009 savings claims. Because of the nature of these samples, and the independence of these samples, the overall verification is the arithmetic weighted average of the savings claimed and the verification noted in each of these categories. Table 15 summarizes these results as well as the final total verification.

Table 15. All Programs, Summary of Verification Rates

Program	Verification Ratio	T-statistic	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	-2.76	95,251	64,390
UCONS Multi-Family	1.000	0.00	35,290	35,290
Residential Weatherization	0.792	-2.55	545,180	431,544
Residential Products and Appliances	0.899	-3.49	51,934	46,709
Residential Heating Equipment	0.879	-2.62	395,076	347,018
Energy Star New Construction	0.528		18,124	9,569
Ground Source Heat Pumps, Conversions	0.000		15,740	0
All Residential Programs	0.808		1,156,595	934,519
All Commercial/Industrial Programs	0.868	-2.45	890,313	772,659
Total, All Program Claims	0.834		2,046,908	1,707,178

Table 16 and Table 17 summarize the verification results for the states of Washington and Idaho respectively. The sample design was developed around each of Avista's program offerings. To divide the verification into states the savings claims for each of the programs were separated for each state. Subsequently, the program verification ratio was applied to the claimed savings. The overall verification ratio in each state is a weighted averaged over the actual claims, resulting in a small variation in the verification ratio between the two states.

Table 16. Washington Program Verification

Program	Verification Ratio	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	83,178	56,228
UCONS Multi-Family	1	17,548	17,548
Residential Weatherization	0.792	418,529	331,475
Residential Products and Appliances	0.908	24,669	22,399
Residential Heating Equipment	0.879	269,001	236,452
Energy Star New Construction	0.528	13,002	6,865
Ground Source Heat Pumps, Conversions	0	9,444	0
All Residential Programs	0.803	835,371	670,968
All Commercial/Industrial Programs	0.868	608,004	527,747
Total, All Claims	0.830	1,443,375	1,198,715

Table 17. Idaho Program Verification

Program	Verification Ratio	Program Claimed Savings	Program Verified Savings
Limited Income Residential	0.676	12,073	8,161
UCONS Multi-Family	1	17,741	17,741
Residential Weatherization	0.792	126,651	100,308
Residential Products and Appliances	0.908	9,141	8,300
Residential Heating Equipment	0.879	128,075	112,578
Energy Star New Construction	0.528	5,122	2,704
Ground Source Heat Pumps, Conversions	0	6,296	0
All Residential Programs	0.819	305,099	249,792
All Commercial/Industrial Programs	0.868	282,309	245,044
Total, All Claims	0.842	587,408	494,837

Appendix: Site-by-Site Verification Documentation

Residential Sector Verification by Site

Table 18. UCONS Multi-Family Field and Engineering Review

Application	Measures	Claimed savings	Verified savings	Ratio	Comments
29233	FLOOR INSULATION	6362	5864	0.922	Increased engineering savings
29475	ATTIC INSULATION	346	194	0.561	Reduced Area, increased engineering savings
29477	ATTIC INSULATION	3073	3841	1.250	Increased engineering savings
29913	ATTIC INSULATION	840	740	0.881	Reduced Area
30269	WALL INSULATION	648	834	1.287	Increased area, increased engineering savings
30002	FLOOR INSULATION	2315	3634	1.570	Increased engineering savings
31276	ATTIC INSULATION	4840	839	0.173	Decreased area, R30 initial R-value
29997	ATTIC INSULATION	795	1039	1.307	Increased engineering savings
30258	ATTIC INSULATION	135	176	1.304	Increased engineering savings
32125	WALL INSULATION	2647	1195	0.451	Decreased area, increased engineering savings

Table 19. Residential Weatherization Field and Engineering review

ACCOUNT NO.	Measures	Claimed Savings	Verified Savings	Ratio	Comments
503381	ATTIC, WALL INSUL.	431	450	1.045	Increase in insulated component area
804116	WINDOWS	27	21	0.770	Reduced engineering savings
1403781	ATTIC INSULATION	90	81	0.900	Reduced engineering savings
1810248	WINDOWS	126	150	1.190	Increased engineering savings
2001573	ATTIC INSULATION	78	70	0.897	Reduced engineering savings
2009719	WINDOWS	95	74	0.776	Reduced engineering savings
2210009	WINDOWS	163	253	1.554	increased engineering savings, increased Window area
2300185	WINDOWS	57	44	0.774	Reduced engineering savings
50046808	WINDOWS	32	25	0.768	Reduced engineering savings
90024147	WALL INSULATION	269	186	0.690	Reduced engineering savings
130100807	WINDOWS	34	100	2.928	increased engineering savings, increased Window area
170116853	ATTIC, WALL & WINDOWS	746	713	0.955	Reduced & Increased engineering savings, reduced area
250107787	ATTIC, FLOOR, WALL, WINDOWS	183	121	0.661	Reduced engineering savings
250118107	WINDOWS	53	35	0.666	Reduced engineering savings
530098573	FLOOR INSULATION	1349	173	0.128	Reduced engineering savings, reduced area
530102604	ATTIC, WALL, FLOOR & WINDOWS	799	394	0.493	Reduced engineering savings
570114779	WINDOWS	131	23	0.174	Reduced engineering savings
610106985	ATTIC, WALL & WINDOWS	922	567	0.615	No floor insulation, reduced window areas
730005910	WINDOWS	195	31	0.161	Reduced engineering savings, reduced area
730097409	WINDOWS	200	155	0.775	Reduced engineering savings
770029513	FLOOR, WINDOWS	804	462	0.574	Reduced engineering savings, reduced area

Table 20. Limited-Income Field and Engineering Review

ACCOUNT NO.	Measures	Claimed Savings	Verified Savings	Ratio	Comments
1606749	ceiling, floor	865	305	0.353	Small initial ceiling insulation: reduced savings
50070609	ceiling, wall, infilt	556	340	0.612	Reduction due to reduced engineering savings
90038805	ceiling, floor, door, infilt	1154	873	0.756	Floor not accessible, reduced engineering savings
90084309	floor, window, infilt	547	493	0.902	Reduced floor insulation impact, significant insulation base
130068961	ceiling	290	88	0.305	R19 initial insulation base
170081965	ceiling, door, window, infilt	322	98	0.304	4" initial ceiling insulation
250065380	ceiling, floor, door, infilt	671	268	0.399	R11 base case floor insulation, reduced engineering savings
250117883	floor, window, infilt	240	0	0.000	No Gas heat, Heating with wood stove
290077410	ceiling, wall, floor, infilt	292	326	1.115	Larger floor area
330114573	ceiling, wall, floor, window, infilt	1106	807	0.730	Reduced engineering savings
450080245	wall, infilt	276	298	1.081	Reduced engineering savings, increased treated area
450113230	ceiling, floor, infilt, duct	159	223	1.402	Better insulation, increased area
490052185	ceiling, door, floor, infilt, duct	659	551	0.836	Reduced engineering savings
610054496	ceiling, wall, floor, window, infilt	720	460	0.638	Reduced engineering savings
610094039	floor, infilt, duct	146	241	1.647	Increased area
650054852	ceiling, window, infilt	395	120	0.305	R19 initial ceiling insulation, reduced engineering savings

Commercial and Industrial Program Verification by Site

Account #	Measures
490113297	Building Shell Insulation, Window upgrade, Efficient boiler, Heat Recovery
Proposed Savings (Therms)	**Verified Savings (Therms)**
58,351	50,351
Comments	
1. Provided model had errors & wouldn't run. 2. After fixing model, EEMS for High Efficiency Windows, Roof Insulation, and Central System were re-run. Savings were adjusted to be consistent with eQuest model. 3. The Avista HRV calculator was assumed to be correct.	

Account #	Measures
490111094	Building shell insulation
Proposed Savings (Therms)	**Verified Savings (Therms)**
167.7	167.7
Comments	
Ceiling insulation field verified	

Account #	Measures
490105388	CO2 sensor and outside air control
Proposed Savings (Therms)	**Verified Savings (Therms)**
550	550
Comments	
CO2 sensor verified in field	

Account #	Measures
450036381	Water heating efficiency upgrade, DDC control and upgraded control settings
Proposed Savings (Therms)	**Verified Savings (Therms)**
3333	3333
Comments	
Field verified control settings. Control calculation appear adequate	

Account #	Measures
370075982	Prescriptive cooking equipment
Proposed Savings (Therms)	**Verified Savings (Therms)**
1621.8	813.8
Comments	
1. The model number for the installed Fryers was not on the Avista approved fryer list available on the website. Savings were removed for this measure.	

Account #	Measures
370033015	Efficient boiler and OA temp control
Proposed Savings (Therms)	**Verified Savings (Therms)**
60,305	60,305
Comments	
1. The UA calculation did not have enough supporting documentation to verify whether or not it was done correctly. Several of the assumptions seemed suspect; for instance, the Heat Load used to calculate the firing rate of the boilers varied exponentially with temperature rather than linearly. 2. Hand calcs showed that the estimated savings are probably conservative, so no changes were made to the claimed savings.	

Account #	Measures
290117099	New Construction, High efficient boiler, upgraded window and insulation package, efficient DHW
Proposed Savings (Therms)	**Verified Savings (Therms)**
13,476	7335.715
Comments	
1. Assumptions for radiant floor modeling are un-likely & over-estimate the gas savings. The majority of the savings are in the fan energy reduction, rather than a change in the gas use for radiant systems. Savings were remodeled with more appropriate assumptions and the savings claim was adjusted accordingly. 2. Cooling added to residential & deleted from community. 3. Radiant floors require full R-10 underslab insulation.	

Account #	Measures
210011707	Replaced Foam Molding Machine
Proposed Savings (Therms)	**Verified Savings (Therms)**
22,856	37,128
Comments	

Several small calculation errors were found in the review of the calculation:
1. Didn't include g_c (Bernoulli' equation units don't work without an adjustment).
2. Used diameter instead of radius to calculate the cross-sectional area of the opening.
3. Used the wrong density for the steam.
4. On site visit, owners stated that current press produces max 15600 blocks/year

The errors actually caused the calc to under predict the savings. A better method for determining the savings would probably be to install a meter on the steam to the original machine. It would add confidence in the predicted savings considering the size of the incentive payment.

Account #	Measures
130047560	Replaced & upgraded boilers for heat and hot water
Proposed Savings (Therms)	**Verified Savings (Therms)**
31,173	35,015
Comments	

1. Several small errors in the domestic hot water and heating system eQuest model changed the results (increased the savings slightly). Additionally, the estimate for daily DHW use was very low for a residential building.

Account #	Measures
45005940	New controls, upgraded DHW
Proposed Savings (Therms)	**Verified Savings (Therms)**
25,145	329
Comments	
1. Site Visit determined that set-backs for Outside Air & Temperature during unoccupied hours were not programmed into the schedules. Savings from scheduling removed. 2. The savings for the new DHW heater were not adjusted.	

Account #	Measures
10121335	New Construction, Designed a HP loop and a high efficiency DHW
Proposed Savings (Therms)	**Verified Savings (Therms)**
14,880	6690
Comments	
1. Modeled savings for heat pump system not likely for residential project unless there is a mixed use year round cooling load (i.e. retail store). This is confirmed by Ecotope's modeling runs using the provided baseline. Savings were adjusted using eQuest model with more appropriate assumptions.	

Account #	Measures
2529110	Replaced old boiler steam system and replaced with RTU and add controls and ventilation control (CO2)
Proposed Savings (Therms)	**Verified Savings (Therms)**
25,810	21,573
Comments	
1. The geometry in the provided eQUEST models don't match the high school building, which is the only part of the school affected by the heating system upgrade. 2. The hot water calc wasn't included in the documentation, so we re-calculated the savings using the eQUEST defaults for a school building. 3. The original building didn't have programmable t-stats with set-backs, so we added that to the model of the proposed building..	

Account #	Measures
2427024	Replaced old RTU
Proposed Savings (Therms)	**Verified Savings (Therms)**
304	0
Comments	
1. Savings estimates unreasonable, new installed equipment is code minimum.	

Account #	Measures
2416485	Prescriptive Steam trap replacement
Proposed Savings (Therms)	**Verified Savings (Therms)**
2543	2543
Comments	
Field verified functioning steam traps. Pipe temperature change confirm operation	

Account #	Measures
1221764	Boiler Replacement
Proposed Savings (Therms)	**Verified Savings (Therms)**
6703	6703
Comments	
1. Boiler efficiency confirmed with documentation and field review. 2. System confirmed as hot water, no cooling	

Account #	Measures
1216995	Replaced and upgraded steam boiler
Proposed Savings (Therms)	**Verified Savings (Therms)**
49,990	49,990
Comments	
Confirmed boiler efficiency and operating schedule in the field	

Account #	Measures
1216621	Boiler upgrade at replacement
Proposed Savings (Therms)	**Verified Savings (Therms)**
3496	1277.9
Comments	
1. Boilers in proposed model set up as steam boilers (88% combustion efficiency generally isn't possible with steam boilers). 2. Site visit determined that the original and updated heating systems are hot water, w/ fan coils rather than steam as modeled. 3. Re-modeled base-line & proposed using a hot water boiler in both models and reduced savings accordingly.	

Account #	Measures
919170	Boiler replacement, Prescriptive cooking equipment
Proposed Savings (Therms)	**Verified Savings (Therms)**
5155	5155
Comments	
Boiler and cooking equipment verified in field	

Account #	Measures
770014900	New Construction, HP Loop, upgraded window an insulation specs, efficient DHW
Proposed Savings (Therms)	**Verified Savings (Therms)**
35,524	27,551.32
Comments	
1. Changed baseline model to match documentation (DX cooling rather than a water cooled heat pump) & adjusted savings accordingly.	

Account #	Measures
770013072	Upgrade boiler at replacement
Proposed Savings (Therms)	**Verified Savings (Therms)**
5518	5518
Comments	
Confirmed Boiler efficiency in field	

Account #	Measures
730118749	Building shell insulation
Proposed Savings (Therms)	**Verified Savings (Therms)**
1155	1155
Comments	
Auditor confirmed ceiling insulation levels	

Account #	Measures
730113820	Building shell upgrade, fume hood upgrade, efficient boiler replacement
Proposed Savings (Therms)	**Verified Savings (Therms)**
7823	7224
Comments	
1. Changed model to account for fume hood exhaust/outside air load and re-modeled boiler, window and roof EEMs & reduced savings to match modeling results.	

Account #	Measures
690022592	Prescriptive steam traps
Proposed Savings (Therms)	**Verified Savings (Therms)**
2895	2895
Comments	
Steam traps installed and functioning	

Account #	Measures
610018687	Efficient boiler replacement, building controls
Proposed Savings (Therms)	**Verified Savings (Therms)**
9010	9010
Comments	

1. The documentation for this project is nearly impossible to decipher, field verification determined that it's likely that the savings have been under-estimated. In the future, records should be kept which identify as-found and as-left conditions before and after the work is performed. Additionally, on projects which include multiple buildings and multiple incentives, records should be kept identifying which energy efficiency measures were pursued and for which building.
2. Savings not adjusted.

Appendix C

Energy Impacts Evaluation of Select 2008 Avista Residential and Low Income Demand-Side Management Programs

Ecotope, Inc.

Energy Impacts Evaluation of Select 2008 Avista Residential and Low Income Demand-Side Management Programs

ECOTOPE
CONSULTING
RESEARCH
DESIGN

Report

Prepared for:
Avista Corporation

Prepared by:
Ecotope, Inc.

January 2011

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Executive Summary

This report documents the development of an energy impact evaluation conducted on several energy efficiency programs operated by Avista in the residential sector in the 2008 program year. In general these programs focus on energy savings in two main categories: residential space heating and domestic hot water (DHW). The specific programs evaluated were divided into three categories:

1. Regular income gas efficiency measures administered through the Avista's Home Improvement Incentive Program marketed primarily through "Every Little Bit".
2. Regular income Electric efficiency measures aimed at replacement windows primarily marketing through "Every Little Bit" outreach.
3. Low income gas efficiency and electric efficiency measures administered by contract through Community Action Programs (CAPs) throughout the Avista service territory.

Gas Efficiency Measures

Home Improvement Gas efficiency measures marketed through "Every Little Bit" outreach were the major energy efficiency measures evaluated. The program included about 6,850 separate gas efficiency incentives for 5,077 separate customer accounts. For this evaluation, the incentives were divided into five categories: furnace upgrade, insulation retrofit, efficient window retrofit, demand DHW installation, and efficient DHW tank upgrade. After the incentives were grouped into these five categories, they were evaluated with a conditional demand analysis (CDA) approach.

The evaluation methodology proceeded in five steps:

1. **Bills and Account Screening**: This step involved reviewing all the billing records associated with the participating customer accounts, including bills from previous or subsequent occupants if it was determined that a customer had moved during the evaluation period. All the accounts were screened for complete billing records for the 2007-2009 period, as all the measures under evaluation were installed in the 2008 calendar year. The 2007 calendar year was taken as the "pre-installation" year and 2009 was taken as the "post-installation" year. In 5% of the cases accounts were dropped from the evaluation either because the billing record was incomplete or because the billing pattern suggested ineligibility. An additional 17% of the sample was not used to establish the savings estimates, but was used to develop the final program realization.
2. **Weather Normalization**: All bills received were evaluated using a variable base degree-day (VBDD) to normalize for climate variations over the study period. Space heating estimates and base load estimates were developed from this analysis in all accounts, which allowed an assessment of gas fuel use within these accounts.
3. **Conditional Demand Analysis**: The change in normalized gas consumption for each account was combined in a regression specification that attached indicator variables to individual measures and allowed the regression to specify the impact by estimating the coefficients on the indicator variables. Bills from 2007 and 2009 were used and the differences between the consumption in those years became the dependent variable in the regression.
4. **Control Group**: A similar bill screening and weather normalization process was done for a group of non-participating customer accounts to create a control group. These accounts and their change in gas consumption were introduced into the regression.
5. **Realization Rate**: The realization rates for the five evaluated measure types were calculated using the estimated impacts from the CDA regression. The total realization rate was based on the

savings estimates derived without the control group; the net realization rate was derived from the savings estimates made with the control group.

The results of this analysis showed a total realization rate of 79% in the gas efficiency measures under the regular income Home Improvement Incentive Program. When the control group was introduced the net realization rate was reduced to 51%. In this analysis the total realization is probably a more accurate reflection of savings in this program.

Electric Efficiency Measure

Only one electric efficiency measure under the regular income Home Improvement Incentive Program was evaluated. This was the window replacement measure aimed at electrically heated homes. A total of 822 customer accounts received incentives for this measure. An evaluation procedure similar to that used to evaluate the gas saving measures was used to screen and normalize the bills. Because of the relative lack of electric bills with evidence of electric space heat (at least 5000 kilowatt hours/yr in normalized space heat estimated from the VBDD analysis), the impact of the account screening was large: more than 57% of the accounts were dropped from the analysis. With this reduction in savings accounts the overall realization rate calculated for this measure was 26%.

A control group was developed for this group of electrically heated homes, but it did not provide a significant adjustment to the realization rate. It did support the account screening that reduced the number of applications.

Low-Income Program

The evaluation of the Low-Income (LI) Program extended to all the measures and accomplishments filed under the program in 2008, which included electric and gas savings measures and electric-to-gas conversions for space and/or water heating. A total of 454 accounts were filed with about 1,350 separate measures. The same bill screening and analysis process as was done for the gas savings measures evaluation in the regular income Home Improvement Incentive Program was used to screen the bills in the LI program. The analysis of the LI program's savings was divided into three parts: gas savings in gas heated homes, electric savings in electric heated homes, and electric savings that resulted from conversion of space heat and/or water heat from electric-to-gas. This division was done to simplify the analysis in the face of the complexities introduced by the fact that both electric and gas fuels were involved in the savings measures. About 16% of the total accounts filed were dropped from the analysis largely because the space heat signature suggested that these homes were not heated by the fuel that was specified by the savings claim. An additional 24% were not included in the total savings estimations, but were included in the final assessment of the realization rates.

The development of a non-participant control group proved problematic. Since the control group was not drawn specifically from a comparable group, the statistical relation to the program participants was not statistically significant. Overall given the small size of this program we abandoned this analysis and reported only the total savings and realization.

For the LI program three total realization rates were computed: 23% for gas measures; 35% for electric measures; and 69% for electric-to-gas conversions.

Overall Impacts

Table E1 shows a summary of the savings impacts for each measure category based on both the total and net realization rates calculated across the entire Avista service territory.

Table E2 and summarize the savings impacts for the states of Washington and Idaho respectively.

Table E1. Total Evaluated Savings by Measure Category, Avista Service Territory

Measure Category	Gas Claim	Elect. Claim	Realization		Net Realization	Total Savings		Net Savings
	Therms	kWh/yr	Gas	Electric	Gas	Gas	Electric	Gas
Gas	652,120		0.797		0.515	519,951		336,141
Electric		1,493,964		0.268			400,382	
LI Gas	110,663		0.226			24,999		
LI Electric		948,427		0.353			334,678	
LI Conversions		906,965		0.693			628,414	
Total Savings	762,783	3,349,356				544,950	1,363,475	

Table E2. Washington Evaluated Savings by Measure Category

Measure Category	Gas Claim	Elect. Claim	Realization		Net Realization	Total Savings		Net Savings
	Therms	kWh/yr	Gas	Electric	Gas	Gas	Electric	Gas
Gas	487,771		0.797		0.515	388,911		251,426
Electric		1,001,634		0.268			268,438	
LI Gas	98,647		0.226			22,285		
LI Electric		652,750		0.353			230,341	
LI Conversions		906,965		0.693			628,414	
Total Savings	586,418	2,561,349				411,196	1,127,193	

Table E3. Idaho Evaluated Savings by Measure Category

Measure Category	Gas Claim	Elect. Claim	Realization		Net Realization	Total Savings		Net Savings
	Therms	kWh/yr	Gas	Electric	Gas	Gas	Electric	Gas
Gas	164,349		0.797		0.515	131,039		84,715
Electric		492,330		0.268			131,944	
LI Gas	12,016		0.226			2,714		
LI Electric		295,677		0.353			104,338	
Total Savings	176,365	788,007				133,753	236,282	

The overall lesson from this evaluation is the need for better oversight and increased quality control in delivering Avista's residential energy efficiency programs, especially in the insulation and window replacement measures where the realization rates are unacceptably low. These results suggest that the programs should be redesigned to ensure a minimum cost-effectiveness in these measures through better on-site quality control or better oversight of the contractors delivering these services.

The equipment measures, such as efficient furnace upgrades and conversions, perform much better. This suggests that contractors delivering these measures have an independent procedure for insuring a quality installation.

1. Introduction

Ecotope has performed an impact evaluation on selected measures in the Avista gas and electric conservation portfolio. There are three types of programs evaluated in this report:

1. A program of gas savings measures that support more efficient windows, furnaces, insulation and domestic hot water heaters in the residential sector gas customers, delivered throughout the Avista service territory in Washington and Idaho.
2. A program to support more efficient windows aimed at electric heating customers.
3. A program aimed at Low-Income (LI) customers with both electric and gas savings largely from space heating measures and electric-to-gas conversions.

The principal goal of this evaluation is to provide a third party estimate of the savings achieved by the installation of the energy (gas therms and electric kilowatt hours) savings measures in each of the above programs, with as much specificity as possible, and then to compare these estimated, or actual, savings to the Avista savings claims in order to develop a realization rate.

This evaluation was performed using billing analysis techniques coupled with a review of the tracking database for each of the individual filings. While some of the insights into the program design were developed during an earlier verification phase (Ecotope 2010), for the most part, this impact evaluation used the actual billing performance of the individual houses and the documented measures and savings claims for each participating customer to establish program realization rates.

1.1. Programs Evaluated

Gas Savings Measures: The main targets of this evaluation were Avista's residential gas savings measures. These individual or combined and related measures were grouped into five major categories for evaluation:

1. Insulation and Weatherization
2. Furnace Upgrades and Conversions
3. Replacement and New Windows
4. Tankless (demand) Water Heaters
5. Efficient DHW tanks

Electric Savings Measures: In addition to the gas measures, a single family window replacement measure was evaluated for homes that were said to be electrically heated as part of their incentive application. This measure was evaluated completely separately from the gas heated homes using the electric bills provided for those customers.

Low-Income Program: Finally, the Low-Income (LI) program was evaluated for both gas and electric savings. This program has numerous measures so the evaluation focused on changes in gas bills and/or electric bills that resulted from participation in Avista's LI program. The gas savings and the electric savings were evaluated separately. In addition, about half of the electric savings claimed by this program were the result of conversions from electric heating or hot water. These conversions were evaluated separately from the other energy savings measures.

1.2. Evaluation Goals

The primary goals of the evaluation of the selected Avista demand-side energy savings programs are:

1. To develop the realization rates associated with savings claims made by Avista for these individual measures and the overall programs. This is meant to be inclusive of the observed changes in energy consumption that were identified through an examination of the individual customer's bills associated with the measures supported by the Avista efficiency programs.
2. To review the files and applications to determine customers who had either been inappropriately awarded incentives or who were ineligible because their fuel-type or heating system type was not consistent with the savings claimed in their application.
3. To review billing data and determine the fractions of measures, particularly furnace and water heater measures, that involved conversion from electric or other fuels to gas and ensure that proper savings were calculated for these even though before and after billing records are not available.

2. Methodology

The evaluation methodology used here began with a complete set of billing records for all homes that received incentives under the select Avista programs evaluated (*participants*). In addition, a control group (*non-participants*) was designed to provide estimates of underlying consumption changes in the Avista service territory. The control group is meant to be a surrogate for net-savings under the theory that aggregate shifts in consumption in the Avista service territory should be taken into account in developing the final realization rate of participating customers. There were several distinct steps in this process.

2.1. Bill Screening and Customer Attrition

First, all of the bills collected, from both participants and non-participants, were screened for a complete billing record for the 2007 and 2009 calendar years. Second, a regression analysis was conducted and homes with insufficient billing data or erratic bill patterns were dropped from the statistical analysis. In about 20% of the applicant billing records the customer and account that applied for the incentive moved or changed occupancies resulting in a different account. For this group the utility retrieved bills for the site from the previous occupant and these were used in the analysis. This process was imperfect and some fraction of the applications were lost.

2.2. Removed Sites

In addition to screening the billing records for completeness, further customer attrition was applied in each program evaluated. In some cases, especially the electric heating cases, there was no evidence of space heating in the target fuel. That is, the home did not use the type of space heating that it was said to use. Those cases were dropped from the analysis and the savings claims associated with those homes were dropped from the final realization rate.

In a small number of cases the bills were missing entirely. For the gas measures evaluation some cases had no gas bills, but did have electric bills.

Some bills were anomalous. The principal cause was the lack of bills from the pre-2008 period. This seemed to be an indication of new construction. These bills were dropped from the analysis since that population is not directly applicable to the Avista programs or this evaluation.

2.3. Weather Normalization

All bills submitted were evaluated using a variable based degree-days (VBDD) methodology (Fels, 1986). This has the advantage of determining energy consumption with respect to the changes in temperature and the time of year. The result of this analysis was a direct estimate of space heating requirements normalized to a common weather condition. Additionally, our analysis corrects for seasonal trends in non heating loads (e.g. a DHW load). All accounts, both electric and gas, used this method. Thus, heating estimates were constructed in both 2007 (the pre-installation year) and 2009 (the post-installation year) insofar as complete billing records were available. In some cases the bills were either missing or had serious anomalous readings that made this normalization impossible. For the most part these applications were removed from the savings analysis.

A total of twelve weather sites were used to characterize the Avista service territory. Table 1 shows the weather sites from the NWS Cooperative Network used in this evaluation and the distribution of participants and non-participants assigned to those sites.

Table 1. Percentages of Participant and Non-Participant Accounts Assigned to Each Weather Site

Weather Station	State	Participants	Non-Participants
Bayview	ID	0.5%	0.0%
Chewelah	WA	2.5%	1.8%
Coeur d'Alene	ID	8.4%	12.5%
Ephrata	WA	0.4%	0.2%
Kellogg	ID	2.1%	2.4%
Lewiston	ID	12.2%	11.1%
Moro	ID	0.2%	0.0%
Moscow	ID	6.2%	6.9%
Priest River	ID	1.4%	2.3%
Spokane	WA	65.6%	62.5%
Troutdale	WA	0.0%	0.0%
Winchester	ID	0.5%	0.0%

2.4. Normalized Heating Requirements

Upon completion of the weather normalization regressions a home's normal energy use was recalculated using the weather average at each weather site for the five year period ending in 2009. This process gave a standard weather year for both pre-installation and post-installation years and comparable weather across all programs. Subsequent comparisons of accounts using this average weather were directly comparable independent of annual climate transients.

A similar process was done for the electric window measure using the electric bills. In cases where an electric savings was claimed, but the bill records showed no electric heat or a substantial gas heating signature, the application was dropped from further consideration and removed from the realization rate.

For the LI program a similar process was used to normalize heating requirements, but gas and electric were evaluated separately based on the observed bills.

In the case of the LI program a substantial number of measures were electric-to-gas conversions. These were evaluated using the weather normalized bill totals from the electric bill. This had the effect of documenting the electric savings. While the corresponding gas bills were also weather normalized the increase in gas was not included in the program evaluation. Thus, the averages from the remaining low-income gas measures were used to calculate the measure savings for those homes.

2.5. Realization Rates

Realization rates were calculated for each measure or group of measures evaluated where the data sets were sufficiently large for a disaggregation. Generally, the evaluation procedure for developing these rates was based on savings estimates developed in a conditional demand analysis (CDA) in which a

simple linear regression was specified with the aim of assigning savings calculated to the measures used in each particular home. Appendix A details this methodology. The dependent variable in the regression is the change in normalized savings estimated from the VBDD analysis. The resulting coefficients can be interpreted as the savings associated with each measure specified. For this procedure to be effective a sufficiently large number of cases are required. All the gas savings measures were estimated using this technique. Only one measure was estimated for the electric savings claims (window replacement) so the CDA format was modified to include the effects of nonparticipants.

In the LI program the conversion measures were estimated this way since even though there were a small number of participants the size of the savings was sufficient to allow a statistically significant coefficient to be generated. There were insufficient cases in the remaining measures in the LI program to perform a CDA analysis, so only total electric and gas savings were estimated for that group.

Gas measures were grouped into broader categories for the CDA analysis. Presence or absence of each of these measure categories was then indicated using the dummy variable specification. The regression coefficient was used to estimate a savings numbers for each measure category independent of all the other measures. The ratio of these estimated savings to the claimed savings in Avista's files is taken to be the total realization rate for these measures.

As with any regression this approach has its limitations and pitfalls (See Appendix A for a more complete discussion). The certainty with which the savings can be estimated is a function in part of the absolute size of the savings and in part on the number of available cases to estimate those savings, and on how measures are distributed across the participants. In most cases in the Avista program adequate amounts of both the size of the savings and the number of cases were present. In one case, conventional DHW tanks, this was not the case; because of the small number of valid cases and the very small estimated savings this estimation procedure could not discern a significant coefficient, and could not discern any significant savings from these measures.

2.6. Net Realization Rates

The VBDD process was repeated using the non-participant control group. The savings analysis used a comparison between 2007 and 2009 weather-normalized consumption for each site. These accounts were then included in the CDA regression. The control group has no measures (by definition) therefore, changes in consumption are included in the constant term in the CDA regression. The assertion is that the control group represents the non-participant customers in the Avista service territory and that they have adjusted their gas consumption as a result of macroeconomic factors such as reduced economic activity, unemployment, or as a result of changes in the gas utility rates that were paid for their heating and hot water. This systemic change occurred independent of any measures that might have been installed by the participating customers. A second CDA was specified using the control group. This resulted in across the board reductions in estimated savings and thus across the board reductions expressed as a net realization rate.

The same VBDD process was repeated for the electric measures and for the LI measures. In both of these programs the control group offset was not statistically significant and did not actually impact the overall savings estimated from the gross realization rate.

3. Impact Evaluation, Gas Savings Measures

The first step in applying the evaluation methodology to the gas savings program was to carefully screen the actual savings measures (the actual applications from which the savings claims were derived). A total of 5,077 accounts received incentives under Avista's "Every Little Bit" Home Improvement Incentive Program. Within these applications there were approximately 6,800 separate measures represented, spanning about 10 separate measure types. For this evaluation, these measures were grouped into five categories, and about 9% of all the applications were combined into the 5,077 accounts in the evaluation.

For each customer account the applications were collapsed so that all of the measures types that any particular customer installed were included. For example, if a customer insulated their house and put in a new gas furnace, the indicators for that customer in the regression would flag those two measure categories and the other measure flags would be set to zero. In these cases the coefficient of the regression represents the savings estimate and the statistics associated with that coefficient – the standard error, confidence interval and significance level – are the results of that regression.

3.1. Conditional Demand Analysis Measures

The measure groupings that were ultimately used for the conditional demand analysis and for the final impact evaluation were:

1. **Insulation and Weatherization**. This measure category includes all weatherization measures insulating particular components of a home. This includes insulation retrofit into floors, walls and ceilings. The program savings are based on the savings calculator developed by Avista and those are translated into the savings claim for each individual measure. For this analysis, all the insulation measures and all the savings from those measures were combined into a single measure.
2. **Furnace Upgrades**. These upgrades are applied to furnace and boiler replacements in existing homes. The furnace upgrade was from an AFUE 78 gas furnace (meeting the minimum code for performance to a condensing gas furnace with an AFUE above 90. In some cases it appears that these upgrades were applied on top of fuel conversions in existing homes. In such cases the site was not used in CDA, because there was no prior gas usage to compare with post-installation usage, although such conversion sites were included in calculations of program effects.
3. **Replacement Windows**. Windows are treated separately from other weatherization measures. The window measure was based on a new window that achieved a U=0.30, which represented a 14% improvement over current code requirements for residential windows.
4. **Efficient Domestic Hot Water (DHW) tanks**. This measure is designed to upgrade a conventional tank from current code (EF=58%) to a measure with a rating of EF=62%. This amounts to small improvements in nominal efficiency of approximately 6%.
5. **Tankless Water Heaters**. This measure is somewhat specialized and uses a tankless gas water heater technology; essentially a small modulating gas boiler, as the basis for delivering instantaneous hot water to the home. In general, these devices are in excess of EF=80% hot water efficiency. This measure replaces the existing gas hot water tank with a rating of about EF=58% with this higher efficiency option.

The evaluation used these five categories to proceed with estimating impacts from the measures in the gas savings program. Table 2 summarizes the initial savings claims associated with each of the above

measure categories, including the total number of applications that used these particular measures. It should be pointed out that the overlaps between measures results in a somewhat larger number of applications (5,618) than the actual number of accounts (5,077) used in the evaluation (as shown in the "Total N" in Table 2); some accounts had two or more measures and thus appeared in two or more categories. Approximately 91% of the accounts that filed applications had only used one measure category; the remaining 9% used multiple measures.

Table 2. Claimed Savings by Measure Type

	Customer Savings		Total
Measure	**Therms/Cust.**	**N**	**Therms**
Furnace	123.9	2,377	294,620
Insulation	182.5	857	156,438
Windows (gas)	97.6	1,953	190,683
DHW Demand	56.6	124	7,020
DHW Tanks	9.9	307	3,052
Total			**651,814**

N = # of customer accounts

3.2. Bill Screening, Attrition

The first step in applying the evaluation methodology to the gas savings program was to carefully screen the actual savings measures (the actual applications from which the savings claims were derived).

The second step in applying the evaluation methodology to the gas savings program was to carefully screen the 5,077 bill histories collected from the gas savings applicants for a complete billing record for the 2007 and 2009 calendar years to arrive at a working estimation sample (see Table 3). The impact evaluation targeted energy usage in the 2007-2009 period. Table 3 shows the actual attrition rates that resulted from the bill screening process.

Table 3. Customer Attrition Totals, Gas Measures

Screening Stage	Bills Removed	N	Account Status
0	n/a	**5,077**	Total customer accounts delivered
1	-43	5,034	Total accounts with gas bills (missing bills removed)
2	-188	**4,846**	Total accounts with bills before 2008 (bills for new construction removed)
3	-523	4,323	Total accounts with bills before 2008 (bills for conversions removed)
4	-406	**3,917**	Total accounts for successful regression (estimation sample)

N = # of customer accounts

As can be seen in Table 3, forty-three accounts were lost in the early stages of this analysis as these accounts had no gas bill and no discernible gas usage. We assumed from this result that these accounts were not eligible for the Avista gas program and subsequently they were removed from the savings claim analysis and the overall program customer accomplishments results.

In the second screening stage, 188 accounts were removed as there were no bills of any sort before 2008. This suggested that these accounts were new construction of some sort. Since this evaluation is an evaluation of the *retrofit* and conversion program these accounts were removed from the analysis and the realization rate.

The third screening stage identified 523 accounts where gas was added as part of a conversion to gas heat and subsequently savings measures were also added to the house. This group was not included in the normalized heating analysis or the CDA analysis, but the savings derived from the remaining cases were used and they were added into the realization rate calculation. It was assumed that the savings derived from the measures in these applications would be predicted by the savings observed in the remaining applications.

The fourth screening stage identified 406 accounts that were removed from the evaluation because deficiencies in the billing record that made the VBDD impractical. Usually this was the result of skipped or combined bills or the result of insufficient bills for the billing analysis to return a reasonable answer. These accounts were treated like the preceding screen and added back into the realization rate calculation using the savings estimated on the remaining accounts.

The first two screening stages in Table 3 resulted in approximately 231 accounts being dropped (about 4.6% of the total accounts) from the gas saving impact analysis. The second two screening stages in Table 3 resulted in 929 accounts being removed (about 18.3% of the total accounts). The accounts remaining after the third and fourth screenings were used to estimate the savings and were included in the CDA to establish the individual savings estimates for each measure type. The final savings impacts were calculated with 3,917 accounts. Once this phase was complete the final savings were calculated using the accounts available after the second screen to calculate the final gross and net savings for the program (N = 4,846 in Table 3 and Table 4).

The distribution of the accounts by measure, after the review of the bills and savings claims, is shown in Table 4. The shaded areas show the total at that stage of the screening. The center shaded column shows the number of homes that were used to develop the realized program savings. The final column shows the number of accounts that had sufficient data to estimate the saving from the measure categories used in the gas program.

Table 4. Customer Attrition by Measure Type, Gas Measures

Measure	N Claimed	Screening Stage 1 + 2 (Missing Bills & New Construction Removed)	N Accounts Realized	Screening Stage 3 (Conversions Removed)	Screening Stage 4 (Bill Records)	N Estimation Sample
Furnace	2377	-191	2186	-498	-229	1459
Insulation	857	-6	851	-23	-86	742
Windows (gas)	1953	-21	1932	-36	-121	1775
DHW Demand	124	-17	107	-11	-18	78
DHW Tanks*	307	-13	294	-19	-41	234
Total (accounts)	**5,077**	**-231**	**4,846**	**-523**	**-406**	**3,917**

N = total # of accounts

3.3. Total Savings Analysis

The entire estimation database from Table 4 was used to estimate the total savings available from each measure type. The original specification of this regression was based on the theory that many of the accounts from the Avista program applications would include more than one measure. In the end, only approximately 91% of the accounts that filed applications had only used one measure category.

The procedure for developing this indicator variable (CDA) regression analysis was based on the procedure for weather normalization and normalized heating requirements introduced in Section 2 and detailed in Appendix A. The process was conducted in three steps:

1. The first step was to develop a variable-based degree day analysis (VBDD) analysis for the year before and the year after the claimed installation of a measure. The VBDD analysis is designed to weather normalize the heating estimate and the overall energy use, or normalized energy consumption (NAC), for each home.
2. The before-and after response coefficients from VBDD regressions for each site were then applied to "average" weather from the weather station used in the VBDD regressions. "Average" in this case means the average annual degree-days calculated over the five years ending in 2009.
3. The changes in normalized heating estimates and in NAC from 2007 to 2009 were then compiled into a data set that included indicator variables for the measures used. The CDA regression then generated a coefficient for each indicator which is the estimate of the average impact on gas consumption of each measure.

The results of this procedure are summarized in Table 5.

A second analysis was conducted on the subset of accounts that had only one measure category in their applications. This group was a large fraction of the overall estimation sample (3566 accounts out of 3917 accounts in the full sample). This resulted in a separate savings estimates for each measure category. The purpose of this exercise was to compare with the results of the CDA regression and to provide an estimate of the variation in savings estimates. Since the number of accounts with more than one measure type of the total accounts collected is only 9% of the total population the single measure review is very informative.

To arrive at savings estimates for these single measure cases a simple differences approach was used:

1. The normalized consumption for the 2007 period was subtracted from the normalized consumption in the 2009 period.
2. This resulted in a savings estimate calculated directly for each account.
3. The distribution of these estimates allowed a mean savings estimate as well as the confidence interval to be computed for each measure category.

The results of the CDA analysis and the single measure analysis are summarized in Table 5. In the case of DHW tanks neither the estimate from the CDA or the single measure analysis is statistically significant. When compared to the unit saving estimates in Table 2 these values are somewhat different and in most cases that difference is statistically significant. In particular the DHW tank measures are more than double the *ex ante* estimate.

Table 5. Total (Gross) Unit Savings Estimates, Gas Program

	Total Savings Estimate			
	Full CDA Method		Single Measure Method	
Measure	Therms/Cust	N	Therms/Cust	N
Furnace	-145.5†	1459	-150.5†	1272
Insulation	-113.1†	743	-137.4†	536
Windows (gas)	-49.9†	1773	-58.4†	1531
DHW Demand	-60.8†	78	-113.3†	51
DHW Tanks	-19.5*	234	-22.2*	176
Total		3,917		3,566

N = # of accounts
*Estimate not statistically significant at 90% level
†Significantly different from 0 at 95% level

3.4. Net Savings Analysis

The evaluation of program savings impacts can be influenced by aggregate macro-economic conditions that induce an aggregate change in consumption across all Avista gas customers. While the relation

between the savings of individual participants to some aggregate sample of gas customers is somewhat debatable, an effort was made to account for any shifts in consumption that might have occurred in the period 2007 to 2009.

3.4.1. Control Group

In order to determine the impact of macroeconomic effects on overall consumption in the Avista service territory, a control group was drawn from the residential sector gas customers in the period between 2007 through 2009. No incentives or measures of any type were present in this group. The homes were drawn at random with the initial size of the control group being approximately 350 homes. When the same weather normalization and VBDD procedures were applied to this group of non-participants as those used on the participant groups (see Section 3.3) a total of about forty therms of incremental energy savings was observed; seemingly as a result of the combination of the relatively poor economy and changes in gas billing rates in the 2007 period.

This appeared to be a substantial fraction of the claimed savings. To confirm this trend an additional 3,600 bills were then drawn and the exercise was repeated. After using the same bill-screening criteria on the non-participant control group as was used on the participant group (see Section 3.2), the final sample was reduced to 3,186 accounts. This larger group was used to establish the impact of the aggregate consumption shifts on the observed saving and to assess the net savings impacts.

3.4.2. Net Savings Results

To generate a net savings analysis using the control group the CDA regression was repeated with the addition of the control group (all the indicator variables were set to zero). The regression itself was re-specified to include a constant term. The interpretation here is that to the extent the non-participant group (or the participant group) had changes in consumption beyond those attributed to the measures installed under the Avista program.

For the single measure estimates a regression was specified with a single variable for each measure type. This became a two parameter regression when the control group was included in the specification. The constant term of the regression determined the impact of the control group and the net savings of these single measure cases. Table 6 summarizes the results of this analysis.

Table 6. Net Unit Savings Estimates, Gas Program

	Net Savings Estimate			
	Full CDA Method		Single Measure Method	
Measure	Therms/Cust.	N	Therms/Cust.	N
Furnace	-107.9†	1459	-110.4	1272
Insulation	-82.5†	743	-97.4†	536
Windows (gas)	-12.5†	1773	-18.4†	1531
DHW Demand	-33.6*	78	-73.5†	51
DHW Tanks	12.3*	234	17.8*	176
Total		**3,917**		**3,566**

*Estimate not statistically significant at 90% level
† Significantly different from 0 at 95% level

These results are appreciably different from the total savings estimates (see Table 5). The reduction in savings estimates for the individual measures is slightly over 40 therms/customer/year. This is a robust result and, in every regression that used the control group, the constant term that represents the impact of the control group was statistically significant. The savings estimates for the DHW efficient tank measure is not statistically significant, but when it is combined with the control group, it actually changes sign and is assigned a negative savings impact.

The control group is thought to be an index of changes in consumption inside the overall energy requirements, especially heating energy, in the Avista Service territory. Since the analysis first normalized for temperature changes at every site, the apparent change in consumption was thought to be an actual effect of changes in behavior on the part of Avista customers in the 2007-2009 period. If this analysis is used, then the behavior of the control group does act as a major influence in the assessment of gas savings.

3.5. Gas Savings Realization Rates

Table 7 shows the relationship between the gas savings evaluation developed in this evaluation and the gas savings claimed by Avista. This table shows the relationship between the estimated customer level savings developed in the savings analysis and the savings claims used by Avista to calculate the *ex ante* savings for an individual measure.

The most significant reduction from savings claimed to savings actually achieved occurred in the window replacement measure. This measure was influenced by the lack of cooling savings and an absolute reduction in the estimated gross savings. The analysis was unable to develop a significant cooling savings estimate (see Section 4.4). When combined with the underlying trends in gas consumption, as expressed in the net savings, the impact of the window measures is nearly eliminated. It appears that a combination

of program effects and overestimation of the initial saving impacts result in a significant reduction of the impact of this measure.

For the comparison between claimed and evaluated savings shown in Table 7 only the estimation sample was used (see Table 6 for the net savings estimation sample and Table 5 for the total savings estimation sample), except in the case of the water heater measures. In the case of the water heater measures the efficient conventional tank measure was not a significant result in either the CDA or the single measure analysis, and in the case of the demand hot water heaters the CDA net savings analysis was unsuccessful, so the single measure savings were used to calculate the total and net savings.

Table 7. Gas Program Realization Rates (Estimating Sample Only)

	Claimed Savings	Evaluated Savings			
		Total		Net	
Measure	Therms/Cust.	Therms/Cust.	Realization Rate	Therms/Cust.	Realization Rate
Furnace	-123.9	-145.5	1.17	-107.9	0.87
Insulation	-182.5	-113.1	0.62	-82.5	0.45
Windows (gas)	-97.6	-49.9	0.51	-12.5	0.13
DHW Demand†	-56.6	-113.3	2.00	-73.5	1.30
DHW Tanks*	-9.9	0.0	0	0.0	0

* Not statistically significant @ .10

† Demand DHW evaluated using single measure analysis to determine savings

In both the net and total realization rates presented in Table 7 the analytical sample of 4,846 accounts (see "Accounts Realized" in Table 4) developed during the customer attrition analysis) was used to calculate the overall realization rate. When the realization rate is recast using the "Accounts Realized" totals from Table 4 an additional adjustment to the program realization results. Table 8 shows the realization rates that result.

There is one exception here and that is that the net tankless (demand) DHW savings were taken from the single measure analysis. This measure had fewer cases but the single measure saving analysis was more robust. To use this analysis the single measure population (with the cases dropped for statistical reasons added back) was used to calculate the overall impact of the measure. The total realization rate shown in Table 8 represents the application of the results for each measure type applied to the total number of accounts. In effect this is a realization rate for the entire residential gas program.

Table 8. Final Realization Rates (Realized Sites, Realized Savings)

Measure	Realization Rates	
	Total	Net
Furnace	1.080	0.801
Insulation (Wx)	0.615	0.449
Windows (gas)	0.506	0.127
DHW Demand**	1.259	0.817
DHW Tanks*	0.000	0.000
Total	0.793	0.512

*Savings not statistically significant
**Single measure analysis used to calculated final realization

It is important to realize that the net realization rates are the product of both the program measures and their actual performance in the participating residences and an underlying shift in residential gas use during the analysis period. Given that the factors influencing this shift are likely to shift further as the economy improves or as the relatively volatile gas prices force rate adjustments we have become convinced that the total realization rate is more representative of the performance of the Avista gas program.

4. Impact Evaluation of Electric Savings Measures

An electric savings impact evaluation was targeted for one measure: replacement windows installed in electrically heated homes. This measure is similar to the window replacement measure in the gas program in that it has the same reporting requirements and the same specifications.

The analysis was developed around a single measure which was operated in parallel with the gas savings program. The overall savings claim for the window measures under this program was 1,493,964 kilowatt hours. This was generated by 822 separate accounts with one or more individual applications for replacement windows. This computes to 1,817 kilowatt hours per account. This final savings number coupled with the number of accounts claiming savings under this program form the basis for the computation of electric realization rates.

There were some problems in evaluating the electric savings from the replacement windows measure that were not significant in the parallel gas program:

1. Electrically heated homes are often heated in part by supplemental heat (usually wood). This feature makes weather normalization more difficult. It also reduces the amount of electric heat used in the home, which lowers the measurable electric heating load and creates a problem for estimating savings relative to electric heat alone.
2. There are only 822 unique applications for this measure (as opposed to the 5,077 applications for the gas program), thus, with any significant attrition rate, the size of the sample available to estimate energy savings is relatively small.
3. There were significant reporting issues within the Avista program that made the exact nature of some applications unclear. For example, some applications appeared to have substantial gas loads in the home or their billing pattern suggested new construction.

4.1. Customer Attrition

Table 9 shows the bill screening review of the account records for the savings claims of the 822 accounts with applications for windows in electrically heated homes. 199 of those accounts had gas heat as evidenced by the gas bills that were provided from the utility, and they were dropped from further analysis. In the next screen those applications where an electric bill was not present at all or only in part of the period of analysis (2007-2009) were dropped. Additionally, if there was no electric bill prior to 2008, then we interpreted that to mean that the home was new construction and thus was not eligible for this Avista program. Sixty-seven accounts were dropped from the original 822 applications for missing bills or ineligibility and removed from further analysis. Thus, the total number of cases to begin the evaluation was 556 accounts (see N=556 in Table 9), or 67% of the original number of applications.

In the next screening stage forty-seven of the 556 accounts ready for evaluation failed a billing analysis. These accounts usually had some problem in the structure of their bills (such as with missing bills or other anomalies in the billing record). While these cases were not included in the individual savings analysis they were used in assessing the overall program accomplishments 509 accounts.

These sites were evaluated using the weather normalization procedures discussed in the gas savings analysis in Sections 3.3 and 2.3. As with the gas applications, a heating estimate was made for both the 2007 and before period and for the 2009 period. The difference between these heating estimates was taken as the impact of the window replacement measure.

Using the results of this billing analysis the homes with electric space heat estimates that were less than 5000 kilowatt hours were screened out. This had the effect of reducing the total number of cases but it also had the effect of focusing on those accounts with significant electric heat. The result of this screen was a reduction of 202 cases. The results of both of the last two screens are discussed below. It was assumed that if the larger number could develop a significant savings it would be preferable.

Table 9. Customer Attrition Totals,
Replacement Windows Measure, Electric Savings

Screening Stage	Bills Removed	N	Account Status
0	n/a	822	Total customer accounts delivered with electric claims for window measures
1	-199	623	Total accounts with no gas heating signature (bills with gas heating signatures removed)
2	-67	**556**	Total accounts with bills before 2008 (missing bills and bills for new construction removed)
3	-47	509	Total accounts with successful regression (bills with Failed Billing Analysis removed)
4	-202	307	Total accounts with electric heat signature greater than 5,000 kWh/yr

N = # of customer accounts

4.2. Control Group

Like the gas savings program evaluation a control group was constructed from the original sample of non-participating accounts drawn by Avista and screened to develop electrically heated homes that could serve as a control group for the electric savings analysis. Accounts were removed that had gas bills (many of which were used for the gas saving analysis) to create an "all electric" sample set of homes with only electric bills for the 2007-2009 period. The accounts were further screened following the same screening process as was conducted on the participant applications (see discussion of Table 9 above). A total of 82 non-participating all electric homes were identified in this process. This group was directly parallel to the results of the third screen in Table 9 on the participant group. Using the weather normalization procedures already discussed the change in consumption was developed and this group became the non-participant group in the electric analysis.

4.3. Electric Savings Estimation

Table 10 shows the results of a differences analysis for the accounts with window savings claims. The analysis uses the same procedure as used for the single measure billing analysis in the gas program (see

Section 3.4). For this analysis the accounts that passed all the screens except an electric heat signature were used. For this table all the cases that passed the screen at the third stage (N=509 in Table 9) were used. This screen did not require that the accounts exhibit an indication of electric heat only that they did not have a gas bill.

As can be seen in Table 10, the control group exhibited 690 kilowatt hours of savings between the 2007 and 2009 period. This was then included in a CDA analysis with the control group. A total of 66 kilowatt hours of savings were identified as the net savings for this analysis.

While the individual components of this analysis were significant at the 90% level, when these were combined with the relatively small sample set of participants there were no significant savings identified. This can be attributed to the ambiguity of the heating systems in both the participants and the non participants. It is reasonable to assume that most of these homes use some sort of supplemental heat such as wood, pellets, or propane. Even if these sources represent a fraction of the total heating requirements the impact on the savings analysis can be very significant. Thus, for this group as a whole the electric savings associated with any electric heating measure is uncertain and not distinguishable from the consumption shifts of the non participant group

Table 10. Electric Savings Estimates without Heating Screen

	Savings Estimates		
Source	**kWh/yr**	**N**	**Comment**
Participant Successful Regression Group (no heat screen)	-756.9	509	significant @ .10 level
Control Group (no heat screen)	-690.6	82	significant @ .10 level
Net (no heat screen)	-66.8	588	Not significant @ .10 level

To solve this problem the 2007 normalized electric estimate was screened to limit the analysis to homes with at least 5,000 kilowatt hours of space heat. When this was done, the number of cases was reduced from 509 to 307. The control group was also screened for 5,000 kilowatt hours per year of space heat in order to insure comparability. This resulted in a further reduction in the size of the control group from 82 to 28 electrically heated homes. The total and net savings analysis described above was then repeated using the smaller population with a demonstrated heating load.

The result of this analysis is shown in Table 11. In this case, the total savings from the applications with the window measure was increased to 1,129 kilowatt hours (a 60% increase in savings estimate) while the control group heating consumption change was reduced to 124 kilowatt hours a year. The reduction to the control group's savings estimates resulted in an estimate that was not statistically significant and, when combined with the participants in the CDA analysis remained not significant. For purposes of this analysis the simple differences in the heating load for participant group in Table 11 was then taken as the total net impact on the heating load from the window replacement measures.

Table 11. Electric Savings with Heating Screen

Source	Savings Estimates		
	kWh/yr	N	Comment
Participant Group (with electric heating screen)	-1129.1	307	Significant at 95%. level
Control Group (with electric heating screen)	-124.8	28	Not significant @ 90% level

4.4. Cooling Energy Impact Analysis

In addition to the heating savings, a cooling savings estimate was calculated. Weather-normalizing of monthly cooling-related energy use is difficult for climates such as Spokane's. The cooling season is relatively short, and energy use is often not truly thermostat-controlled, as CDD calculations implicitly assume. To make the task more tractable, only the gas replacement window measures (sites with gas heat) were used to establish per-site cooling savings. This approach allowed the potential interaction between electric heating and air conditioning in the swing seasons to be avoided. Monthly cooling loads in the Avista climates easily overlap with the heating season in months such as May and September. By limiting the analysis to homes with gas heat the change in consumption over the entire potential cooling season could be calculated.

Even restricting the analysis sample to gas-heated sites, CDD weather-normalization proved problematic, with poorly defined coefficients, many response coefficients of the wrong sign, and savings estimates highly sensitive to small changes in screening criteria. We instead opted to compare raw changes in cooling season electric usage for suitably screened sites, with a control group subjected to the identical screening criteria.

Both the gas window measure sites and the control group were screened in two steps:

1. Verifiable gas heating signatures in both 2007 and 2009
2. Complete electric bill series for 2007 and 2009. Several sites were dropped because even though a valid heating estimate was made using gas bills the electric bills were incomplete.

A total of 994 out of 1,953 participant cases met these screens and were included in the analysis. It was our intent to assign the results of this analysis to all valid cases in both electric and gas window replacement applications.

The results of the cooling savings analysis are shown in Table 12. The window measure had a small calculated cooling benefit. The gross cooling savings was 145 kilowatt hours and was statistically significant. The analysis was repeated with the screened nonparticipant group. When this group was included in a CDA regression the net savings impact was reduced to 30.4 kilowatt hours and the result was not statistically significant. Given that the changes in summer consumption were not weather-normalized, including a control group is essential in making sense of the year-to-year consumption change.

Since the participant summer kilowatt hours change net of control group changes was small and not significant, the cooling savings were dropped and not included in the final realized savings from either electric heated or gas heated accounts.

Table 12. Window Measure Cooling Impacts

Cooling Applicants	Savings Estimate	N	Confidence Interval (90/10)	
			low	high
	kWh/yr		kWh/yr	kWh/yr
Window Replacements (Gas)	145.9	994	100.2	191.6
Nonparticipant Energy Impact	115.6	2826	71.5	159.7
Net Cooling Savings*	30.4	994	-48.8	109.6

*not significant at 90% level

4.5. Electric Realization Rates (Window Measures)

It is important to note here that the impact of the window measures on electric heating savings is compromised considerably by the mechanism by which this measure is delivered and the incentives paid. The Avista program does not actively check on the heating system that is used and claimed by the prospective applicants. In other words, there is no mechanism to verify that the homes applying for electric heating incentives are actually electrically heated. The fact that our heating estimate usage in the absence of screening directly for electric space heat (Table 11) did not result in any statistically significant savings, especially when the control group was taken into account, suggests that an approach that does not require any screening or inspection to insure that the applicants are electrically heated, has not been and is not likely to be successful. Once electric heat had been established, even at a reduced rate, these savings become much more significant, with over 62% net realization rate for each individual case. This suggests that if electric heat were the primary or exclusive heating source, then the original savings calculations for window replacements in electrically heated homes were reasonably justified. Since the program does not actually screen for any of the criteria the amount of electric savings is reduced even in places where electric heat is clearly dominant.

The realization rates are reduced as a result of three factors:

1. The reduced space heating savings for the cases that were identified with electric heat.
2. The reduced number of total applications/total number of accounts, for which a savings calculation could be made either because of obvious gas heat identified in the bills or because the heating analysis in the face of alternative space heat or other factor.
3. The lack of identified cooling impact was a small but consistent impact on the final savings estimate.

Table 13 shows the realization rates associated with the electric window replacement program. The original measure of about 1.5 million in kilowatt hours was predicted using an average of 1,817 kilowatt hours per home for the 822 accounts. This is based on the direct claims, which were in turn based on the number of square feet rebated by the window measure. In the evaluated case a total of 307 buildings were evaluated, with an average savings rate of 1,129 kilowatt hours.

The total savings was 346,000 kilowatt hours for a total realization rate of 23%. In stage three of the original bill screening process, forty-seven homes were removed from the analysis because of statistical failures in the billing analysis (see Table 9), not because they were necessarily poor candidates. While the lack of a billing analysis in this group makes it impossible to be certain that electric heat was actually being used in the house, the removed homes have been added back in to the analysis. By adding these extra forty-seven homes back in, the total savings increases, leaving a total realization rate for the window replacement measure at 27%, which can be seen in Table 13 below.

Table 13. Window Measure Realization Rates, Electric

	kWh/cust.	N	Total savings (kWh)	Realization
Claim	1,817	822	1,493,964	
Evaluated	1,129	307	346,603	0.232
Evaluated, Adjusted	1,129	354	399,666	0.268

5. Impact Evaluation of the Low-Income Program

The last phase of the impact analysis was to evaluate the LI program for both gas and electric savings. This program is operated by Community Action Programs (CAPs) under contract from the utility. A total of 454 separate accounts were included in the LI savings claim. Each of these 454 accounts represented a single residential account in which gas and/or electric savings measures were installed. A total of 1,379 individual measures were claimed in the LI program for all the accounts.

5.1. Customer Attrition

The CAP agencies use a variety of gas and electric measures to promote energy savings in the LI program. These measures often include several different weatherization measures as part of the program's overall approach. In addition, health and safety measures, which do not necessarily save energy, but improve the quality of the home for its occupants, are included in the LI program. There were a total of 454 total applications with savings claims. There are three sources for these claims:

1. Electric Measures including refrigerators and weatherization for electrically heated homes.
2. Gas measures including improved DHW tank efficiency and weatherization applied to gas heated homes.
3. Electric-to-gas conversions of furnaces or electric DHW tanks. These measures largely overlapped with each other and sometimes overlapped with weatherization measures for both electric measures and gas measures (including electric-to-gas conversions).

Two-hundred seventy-three applications were identified as gas heated homes dominated by gas measures; including 88 applications that had electric-to-gas DHW conversions. One-hundred eighty-one accounts were identified as electrically heated homes with electric savings measures, but 33 of these applications also included homes that were converted to gas heat as part of the 2008 LI program. A total of 90 separate accounts converted their furnace and/or their DHW from gas-to-electric. All but two of the furnace conversions included a conversion to gas DHW. These categories were analyzed separately to establish the impacts of the three components of the LI program.

Table 14 summarizes the development of the evaluation sample for the LI program. There is some overlap in how the accounts were counted: where conversions were made that also included additional gas measures (such as weatherization) the account appears in both the conversion category and in gas savings category. As with the previous sections of this report, customer attrition is due in part to missing or partly missing bills from the 2007-2009 period and from the missing or combined bills that preclude a VBDD (see Section 2.3). After removing inapplicable bills, 383 accounts remained (both electric and gas).

The next factor in the attrition process was screening by heating type. There was some confusion in the accounts as a result of gas savings measures filed for buildings with no evidence of gas heat, or similarly misfiled electric measures. After these were removed, 372 accounts remained. The final estimation sample was established after removing homes that failed to produce useable weather normalized heating estimates.

The estimation sample represents all the LI applications that could be used in the regression analysis. However, the "Bills Available" account set of 383 accounts was used to develop the final realization rate for the LI program. The difference between the estimation sample and the realized population was the result of three factors:

1. Missing bills in the 2007 or 2009 period that were the result of occupancy changes not corrected in the LI program.
2. Partial missing bills that compromised the regression analysis but had otherwise received the measures and probably achieved equivalent savings to the homes included in the estimation sample.
3. Electric-to-gas conversions that did not have gas service prior to the conversion. This affected only those accounts that had additional gas savings measures applied to the converted heating system.

Table 14. Low-Income Attrition

	Accounts			
	Gas	**Electric**	**Conversions**	**Total**
Saving Claims	255	156	90	454
Bills Available	222	117	80	383
Proper Heat Type	221	108	79	372
Estimation Sample	156	81	63	274

5.2. Total Savings Analysis

The ability to estimate significant coefficients in the CDA regressions for the LI program following the methodology outlined in Section 2 was severely limited for particular efficiency measures. For the most part the small sample (and small savings impacts) precludes the possibility of estimating individual measure coefficients. This is not true of the conversions, however. Both the electric savings impacts and the gas use impacts of these conversions are large and estimating their impact with a CDA analysis proved effective. As a result a hybrid approach to the savings estimation was developed.

The conversion measures were estimated with the CDA approach used in the gas programs evaluation (Section 3) and the remaining impacts, both gas and electric, were estimated using an aggregation of the VBDD results that combined all the other measures. To do this the estimated impacts of the conversions were removed arithmetically from the electric saving estimates to develop the estimated impacts from the other measures. The gas savings estimates were computed with the remaining gas sample excluding the conversion cases.

Conversions, Electric-to-Gas

The major savings claim for the electric measures was the fuel conversions for both heating and DHW. Together these two measures represented 49% of the LI program electric program savings claims. While these savings are substantial they also result in an increase in gas usage that corresponds to a reduction in electric usage. Table 15 shows the result of the CDA estimates of the consumption patterns brought on by the conversions of the heating and/or the DHW systems. The realization rate shown reflects the savings in the sites analyzed only and not the impacts of attrition within the LI program.

Table 15. LI Conversion

Conversion	Claim		Conditional Demand Estimates				Site Realization (Elect. 0nly)
	N	kWh/cust	N	kWh/cust	Standard Error	Gas Impact th/cust	
DHW	88	-5548	80	-4318.2	650.4	68.4	0.778
Heating System	33	-12687	32	-8840.9	1119.4	519.3	0.697

All but two of the heating system conversions included a DHW conversion to gas. The remaining DHW conversions were conducted on homes that already had gas space heat and thus gas service. In the case of DHW conversions it is apparent that this measure was generally applied to a home with gas heating; 40% of these homes received additional conservation measures. This group was removed from the estimation of the gas measure savings since the impact of the DHW conversion swamped the consumption change in these homes. These cases were used in calculating the overall realization rate as though they had similar impacts to the remaining estimation sample.

Measure Savings, Gas and Electric

The same screening criteria as was used on the gas and electric measures in the "Every Little Bit" program (Sections 3 and 4) was used to evaluate the remaining measures in the LI program. Screening the accounts was complicated by some confusion as to the heating fuel used in the home. We identified homes with electric measures coupled with substantial gas usage, as well as homes with both electric and gas heat savings measures. All of these accounts were removed from the analysis and from the final assessment of the savings claims.

Table 16 shows the savings impacts from the LI program measures. This analysis was conducted on the homes that did not receive any conversions. The estimation sample from Table 14 was altered to remove all homes that had DHW conversions that also had weatherization measures. These measures were added back to the final N used in calculating the program accomplishments. Since N was calculated by comparing two weather normalized years – the 2007 pre-period and the 2009 post-period – all these cases use the same weather normalization procedures and average weather years that were used in the gas heated homes; namely, 2007 as the base case for the pre-case and 2009 for the post-case.

Table 16. Low-Income Program Savings Impacts

Electric				
	kWh/cust.	**N**	**Total Savings (kWh)**	**Realization**
Claim			948,427	
Evaluated	2,861	108	308,934	0.326
Evaluated, Adjusted	2,861	117	334,679	0.353
Gas				
	th/cust.	**N**	**Total Savings (th)**	**Realization**
Claim			110,655	
Evaluated	113	156	17,566	0.159
Evaluated, Adjusted	113	222	24,997	0.226

The savings shown in Table 16 are net of the conversion effects. Thus, the impact of the gas usage that resulted from a conversion was not included in describing the overall accomplishments of this program. In the estimation sample where some conversion overlapped the gas weatherization measures the gas use increase was about 97% of the savings estimated from the consumption estimated by the VBDD regression analysis. The gas savings and realization from this table represent the total evaluated gas savings from the LI program. The electric impact and realization do not include conversions.

5.3. Control Group

Only the gross savings were calculated for the low-income group, because we did not have a readily available control group. Given the size of this program, we suspect that a practical control group could not actually be constructed without doing a careful physical match between the various customer groups and similar groups that were not treated under the program.

5.4. Overall Realization Rates

Because the electric impact is a combination of conversions impacts and electric measures applied across the remaining program, a separate realization rate was calculated to combine these two program elements. The gas realization rate developed for Table 16 was used without modification. For the conversions the electric heat signature was estimated from the 2007 bills (before the conversion) and the savings were estimated from that heating signature and the change in electric consumption between the two years. The final realization rate combined these two components of the electric savings to get a final realization rate for the LI program. Table 17 summarizes this result.

Table 17. Electric LI Realization Rates

	Claimed	Evaluated	Realization
	kWh/cust.	kWh/cust.	
Measures	948427	334679	0.353
Conversions	906965	628365	0.693
Total	1855392	963043	0.519

In calculating the final realization rate the savings estimated were applied to all the cases where a conversion could be identified in the bills even if the size of the electric heating signature was small in the pre-period. Cases were only dropped altogether if there was evidence of gas heating in the pre-period. These accounts were added back into gas savings analysis and included in the final realization calculation.

The non-participant group developed for the electric and gas measures was not appropriate to the low-income clients of this program. As a result these final gross realization rates were elected as the evaluated savings for this program. The overall realization rate, however, suggests a combination of issues with the savings claims as calculated by the contractors, and suggests that there were reporting issues that overestimated the impacts of various components of the LI program.

6. Program Impacts, All Programs

The measures evaluated in this impact evaluation of Avista's "Every Little Bit" Home Improvement Incentive Program and Low-Income Program were divided into three categories:

1. Residential gas savings (all measures);
2. Electric savings (window replacement measures only);
3. Residential gas and electric savings in the Low-Income program (all measures).

These measures were evaluated using similar methods, but the final impact analysis and realization rates for each were based on the unique conditions of each program.

6.1. Gas Realization

The primary issue with the gas impact evaluation was the presence of significant consumption shifts in the large control group. The control group represented the actual consumption trend among Avista residential gas customers from 2007 through 2009. This period included a major recession and a significant increase in gas rates brought on by the volatility in the market for natural gas. Not surprisingly, these macro-economic effects resulted in an underlying a reduction in gas consumption in Avista's service territory.

While the results with and without the control group are reported as the net realization in Table 18 through Table 20, it should be pointed out that macroeconomic effects actually are the results of changes in behavior brought on by economic or other factors, and are, by definition, transient. In the event that the macroeconomic factors change, the apparent changes in consumption and net savings would drift back to original consumption patterns once more. This would not be true of the participants, since they have changed the underlying efficiency of their homes as a result of the measures installed under the Avista program.

In contrast to the control group, the participant group's observed improvements in efficiency were the result of actual efficiency improvements to the physical structure of their homes or improvements in the heating system of their home, which were supported, in part, by the Avista incentive programs. These improvements stem from permanent physical changes to the homes, rather than from behavioral changes by the inhabitants (as in the control group). Therefore, the savings observed in the individual measures should not be decremented by the control group. Nevertheless, the impact of the gas savings measures in the Avista savings program is reported both with and without the control group.

A second issue in developing the overall realization rate for the gas programs was the performance of the two classes of DHW measures. The DHW tank upgrade did not develop a significant savings estimate in any of the methods used. With the addition of the control group the sign of the savings actually changed (although it was not statistically significant). For the demand DHW measures the impact of the measure itself was potentially quite large, thus a significant estimate was developable through the analysis. Even though these estimates varied substantially, the savings analysis of the single measure analysis were the most likely to reflect the true savings from all of the gas savings measures under evaluation.

Table 18 summarizes the results of the gas savings impact analysis over the entire Avista service territory using the final realization rates from Table 8. This table incorporates the impacts of site attrition as well as the site impact realization rates. Table 19 shows the evaluated savings from gas measures applied to the Washington portion of the Avista Service territory. Table 20 shows the evaluated savings from gas measures applied to the Idaho portion of the Avista service territory.

Table 18. Total Gas Savings by Measure Type, Avista Service Territory

Measure Type	Savings Claim	Realization	Net Realization	Total Savings	Net Savings
	Therms			Therms	Therms
Furnace	294,744	1.080	0.801	318,294	235,994
Insulation (Wx)	156,621	0.615	0.449	96,361	70,301
Windows (gas)	190,683	0.506	0.127	96,460	24,136
DHW Demand	7,020	1.259	0.817	8,837	5,733
DHW Tanks*	3,052	0.000	0.000	0	0
Total	652,120	0.797	0.515	519,951	336,141

Table 19. Total Gas Savings by Measure Type, Washington

Measure Type	Savings Claim	Realization	Net Realization	Total Savings	Net Savings
	Therms			Therms	Therms
Furnace	208,434	1.080	0.801	225,088	166,888
Insulation (Wx)	122,497	0.615	0.449	75,366	54,984
Windows (gas)	150,160	0.506	0.127	75,961	19,007
DHW Demand	4,200	1.259	0.817	5,287	3,430
DHW Tanks*	2,480	0.000	0.000	0	0
Total	487,771	0.797	0.515	388,911	251,426

Table 20. Total Gas Savings by Measure Type, Idaho

Measure Type	Savings Claim	Realization	Net Realization	Total Savings	Net Savings
	Therms			Therms	Therms
Furnace	86,310	1.080	0.801	93,206	69,106
Insulation (Wx)	34,124	0.615	0.449	20,995	15,317
Windows (gas)	40,523	0.506	0.127	20,499	5,129
DHW Demand	2,820	1.259	0.817	3,550	2,303
DHW Tanks*	572	0.000	0.000	0	0
Total	164,349	0.797	0.515	131,039	84,715

6.2. Electric Realization

Table 21 summarizes the results of the savings impact analysis done on the electric efficiency measures aimed at replacement windows under the "Every Little Bit" Home Improvement Incentive program.

This table divides the total evaluated savings between Washington and Idaho proportionally to the overall realization rate and the separate savings claims for each state. Unlike in the gas measures' analysis, the

electric measures' net savings analysis did not develop a statistically significant adjustment, so the net realization rates were not calculated. Cooling savings claims for this measure were not statistically significant, so the final realization applies to the entire claim even though a portion of that claim assumes some impact on the air conditioning energy in the home.

Table 21. Electric Savings, by State and Full Territory

Measure Type	Territory	Savings Claim	Realization	Total Savings
		kWh		Therms
Replacement Windows	All Avista	1,493,964	0.268	400,382
Replacement Windows	Washington	1,001,634	0.268	268,438
Replacement Windows	Idaho	492,330	0.268	131,944

6.3. Low-Income Realization

The entire Low-Income (LI) program was evaluated for both electric and gas savings. The savings claims and realization rates were divided into three categories: gas savings in gas heated homes, electric savings in electric heated homes, and electric savings that resulted from conversion of space heat and/or water heat from electric-to-gas.

The control group's statistical relation to the program participants was not statistically significant. The dominant savings impact for the Avista LI program was heating and DHW fuel conversions from electric-to-gas. This measure was only applied in Washington. The savings claims for this conversion measure do not take the gas use that results from the conversion into account. The tables presenting the overall accomplishment of the LI program also do not include those impacts in the final savings estimates.

The realization rates were applied to all electric and gas savings claims. For some measures the analysis neglected small savings claims in the alternative fuels. The Health and Safety measures, for example, were assigned savings. This was a small savings and these measures were not included in our analysis. They were, however, included in the total claimed savings and they were adjusted by the realization rate. In a few cases the savings claim did not correspond to the fuel type. These savings were included in the savings claim but they were removed from the analysis. In these tables, the realization rate includes the impact of dropping those cases.

Table 22 shows the total impact of the LI programs on the entire Avista service territory. Table 23 and Table 24 show the distribution of savings claims and total evaluated savings estimated from this analysis for Washington and Idaho respectively.

Table 22. Total Energy Savings, Low-Income Program

Measure Type	Claimed Savings		Realization	Total Savings	
	Electric	Gas		Electric	Gas
	kWh/yr	Therms/yr		kWh/yr	Therms/yr
Furnace Conversions*	418,681		0.676	282,916	
DHW Conversions*	488,284		0.708	345,498	
Electric Measures	948,427		0.353	334,678	
Gas measures		110,663	0.226		24,999
Total	1,855,392	110,663		963,093	24,999

*excludes 22090 therms of gas use to replace electric equipment

Table 23. Total Energy Savings, Low-Income Program, Washington

Measure Type	Claimed Savings		Realization	Total Savings	
	Electric	Gas		Electric	Gas
	kWh/yr	Therms/yr		kWh/yr	Therms/yr
Furnace Conversions*	418,681		0.676	282,916	
DHW Conversions*	488,284		0.708	345,498	
Electric Measures	652,750		0.353	230,341	
Gas measures		98,647	0.226		22,285
Total	1,559,715	98,647		858,755	22,285

*excludes 22,090 therms of gas use to replace electric equipment

Table 24. Total Energy Savings, Low-Income Program, Idaho

Measure Type	Claimed Savings		Realization	Total Savings	
	Electric	Gas		Electric	Gas
	kWh/yr	Therms/yr		kWh/yr	Therms/yr
Furnace Conversions*	0		0.676	0	
DHW Conversions*	0		0.708	0	
Electric Measures	295,677		0.353	104,338	
Gas measures		12,016	0.226		2,714
Total	295,677	12,016		104,338	2,714

7. Conclusions and Recommendations

This evaluation only examined the impacts of gas and select electric measures in two of Avista's residential incentive programs ("Every Little Bit" Home Improvement Incentive Program and the Low-Income Program). The evaluated savings raise issues about the overall performance of these energy efficiency programs that should be considered in their future evolution. The following recommendations are based on the impact evaluation documented in this report, as well as on lessons learned from an earlier savings audit of the same programs (Ecotope, 2010). The observations that appear in this section of the report are organized by measure category and are meant to apply to all the programs evaluated.

In general, the primary lesson from the current impact evaluation is the need for better oversight and quality control in delivering Avista's residential energy efficiency programs, especially in the insulation and window replacement measures where the realization rates are unacceptably low. These results suggest that the program should be redesigned to ensure a minimum cost-effectiveness in these measures through better on-site quality control or better oversight of the contractors delivering these services.

The equipment measures, such as efficient furnace upgrades and conversions, perform much better than the insulation and window measures. This suggests that contractors delivering equipment measures have an independent procedure for insuring a quality installation. Additionally, the relatively good performance of the equipment measures suggests that they do not need as much improvement as the weatherization measures. Therefore, the following recommendations focus on those measures and programs with low realization rates (even where those measures are well established in other utility programs).

Replacement Windows

These measures were designed to provide Avista customers with an incentive to replace their existing windows with modern windows that meet or exceed the Washington State Energy Code standards. The program is designed to allow a homeowner to select their own windows and submit an invoice based on window size. The utility processes this request and sends an incentive check. While the program is designed to provide incentives to homeowners, it is used by many types of people: contractors who are involved in remodels and rehabilitation of existing homes; weatherization crews trying to address windows and insulation in an existing home to improve its efficiency; and do-it-yourself homeowners who purchase windows at a hardware store or home improvement center and install them. These mechanisms provide an effective delivery mechanism for the actual windows but there is no apparent quality control beyond that provided by the homeowner who files for the incentive.

The total savings impacts (on a per site basis) are about 50% of the anticipated savings in gas heated homes. In electric "heated" homes, the savings impact is eroded by the uncertainty of the heating system fuel. It appears that a high percentage of the electric heated homes with window replacement claims did not use a significant amount of electric heat. In some cases this could have been the result of some confusion in the application (e.g. where the customer checked a wrong box). But in most cases the use of some sort of supplemental fuel (not gas) would be the only explanation. This confusion over the actual heating energy used reduces the realization rate for this measure to about 25%. No measure can survive a cost-effectiveness test with such a realization rate.

If the replacement window measures are to remain as part of a cost-effective program, then a considerable change in program design would be necessary. Here are three recommended strategies:

1. Limit participation in the program to contractor installed window measures. Contractors should apply for the right to participate in the program. They should be reasonably experienced at home

remodel and rehabilitation or at home weatherization. It should be made clear to them that Avista is providing the incentives to improve the energy efficiency of the home. If new windows (not actual replacements of existing windows) are to be allowed they need to be incented separately; the application should clearly separate replacement windows from new windows installed in new openings.

2. Window replacement applications should be limited to window areas that imply a significant fraction of the glazing in a home. One hundred square feet (or more) might be considered a minimum area for an application under this program.
3. A limited utility-sponsored or utility-administered quality control program should be instituted. Contractors should know that one out of 10 or one out of 15 of their applications will be inspected by the utility. In the 2008 program this would amount to about 125 inspections of window jobs over the whole year, which would improve both the quality of the installations and the correct reporting of space heat type. However, in 2008 in excess of 50% of the applications would not be eligible under one of the above proposed criteria (accounting for about 20% of the claimed savings).

The above suggested changes may not be sufficient to develop cost-effective window measures in the Avista service territory, but they would greatly improve the possibility of a positive evaluation. The impacts of such applications should be large and the installation would be reasonably likely to meet Avista specifications.

Insulation and Weatherization

The insulation and weatherization measures evaluated mostly came from gas heated homes in the "Every Little Bit" Home Improvement Incentive Program, and a much smaller group was evaluated from the Low-Income (LI) Program. In both these programs the performance of individual sites (not including site attrition for one reason or another) created a realization rate of about 60%. This rate does not take into account the homes with very low space heat loads (especially in the LI program). This performance suggests that some redesign is needed to improve performance. Here are three recommended changes:

1. Limit the use of DIY in the insulation applications. In our verification work for the 2009 program the number of insulation applications submitted were minimal. It would be beneficial, however, if established weatherization contractors, or general contractors with experience in these measures, were required to make the incentive application. This would allow Avista to vet contractors and ensure some more predictable performance in these installations.
2. The weatherization measures should be subject to some quality assurance inspections. These could be only 5% or 10% of the applications. These inspections would provide both an incentive to the contractor and feedback to the utility on the progress and success of the program.
3. The Low-Income measures are somewhat different. In those cases the CAP agencies are like Avista contractors. This contracting mechanism with the providers should provide an avenue to improve quality control by discussing the need for more reliable savings from the program.

DHW Upgrades and Conversions

The DHW tank upgrade program does not appear to offer any reliable savings to the utility. It seems unlikely that any mechanism would result in a reliable savings from this measure unless the target efficiency for the incentive was raised considerably above current practice.

As a practical matter such a measure is already in the Avista program. The demand water heaters seem to show a great deal of promise in this evaluation. Total savings appears to be very comparable with the savings claims and in some cases somewhat better than claimed savings. With the demand water heater a careful review of products as they come into the market is probably needed especially given the number of new products and efficiency claims. Given the size and reliability of these savings a modest attention to equipment specifications would probably ensure an expanding role for this product in the Avista savings program.

Equipment Upgrades and Conversions

By far the most effective measures in this evaluation were the furnace upgrades and conversions. These measures require the use of licensed contractors and are well within the standard practice of the HVAC contractors that install these technologies. If anything is to be learned, it is that established contractors can be expect to deliver installations that meet specifications and have some quality control..

It should also be pointed out that equipment measures do not address underlying efficiencies in customer homes. It is not likely that HVAC contractors in the current program design would help identify or address other measures in a home. If the opportunity to do so was present or encouraged, then other measures that address insulation or duct sealing might be identified.

Other Observations

The residential programs evaluated here show some disappointing results. It should be pointed out however that these programs are almost all self-administered. The utility accepts the customer's assessment of both the nature of the claimed installation and the assessment of space heat in the home. Much of the difficulties with the realization rates can be traced to this approach. When compared to Avista's commercial/industrial (C/I) program virtually no comparable level of oversight by the utility is present in the residential programs. This is in part the result of a lack of technical resources inside the utility to actually address a quality control step in the residential sector. In the C/I program, by contrast, the program has substantial engineering oversight ranging from inspection to engineering to specification review. The C/I could not be transferred directly to the residential sector, but could inform the design of future residential programs. The use of more program oversight from the utility is feasible but would require additional technical resources.

The utility might require one or two specialists that are not currently available to implement the quality control and coordination suggested. Given the potential to substantially raise these realization rates, the savings from the gas program alone would likely approach 250,000 therms, level of savings now claimed, but not achieved. Adding capacity to address this savings would be very important to improving the overall performance of the programs in the residential sector.

Appendix A

CDA Methodology; Regression Specifications

Our basic analytic approach is to compute weather-normalized total annual consumption (NAC) for program participant sites (and a nonparticipant control group) before and after the installation of measures, and explain the change in NAC as a function of installed measures. In addition a control group of nonparticipants was developed and the methodology was designed to take account of the changes in consumption in that group. The net of the NAC difference observed in the nonparticipant control group, using a form of conditional demand analysis (CDA), was included in the net regressions to adjust the estimates of the savings from the measures and take account of the underlying shifts in consumption among Avista customers. The consumption takes the form of gas or electricity, depending on the measures in question; the effects for each energy source are estimated separately. Our presumption is that the program measures were installed some time in calendar year 2008, but we do not know exactly when. We compute "before" NAC using billed consumption from calendar year 2007, and "after" NAC consumption using calendar year 2009. Individual sites are mapped to a nearby source of weather data[1]. NAC is computed using standard variable-based-degree-day (VBDD) regression methodology[2]. We apply the identical NAC methodology to a control group of nonparticipants randomly selected from Avista's customer database.

Gas Savings Measures

We group individual measures (as defined by measure codes) into broader categories for purposes of creating explanatory variables. For residential gas conservation measures, the following groupings are used:

Code	Utility Description	Grouping for Gas CDA
RE4	G HE FURNACE	furnace
RE5	G HE BOILER	furnace
RE6	G HE WH 40G	DHW Tank
RE7	G HE WH 50G	DHW Tank
RE9	G INS - CEIL/ATTIC	insulation
RED	G INS - FLOOR	insulation
REF	G INS - WALL	insulation
RR0	G HE WH TANKLESS	tankless DHW
RRC	G REPLC WINDOWS	window
RRE	G REPLC WINDOWS	window

[1] Either a station maintained directly by the US Weather Bureau or a cooperating weather station. Twelve separate weather stations are used to cover Avista's service territory.

[2] See Fels (1986) or Geraghty et al. (2009) for a brief explanation of the methodology.

For our participant sites we create a set of indicator variables for each of these measure groupings, set to 1 if the site installed (received a rebate for) one or more measures in that particular measure grouping, and set to 0 if no measures in that grouping are present for that site. Possible multiplicity of measures does not affect the value of the indicator. For example, if a site has both floor and wall insulation measures, the value of the "insulation" indicator is set to 1, not 2. For the nonparticipant control group, the value of all these measure indicator variables is of course 0. These indicator variables are then used as the explanatory variables in a linear CDA regression with the dependent variable being the before-to after change (delta) in NAC. For the above residential gas measure participants, the resulting regression equation is as follows:

Where the subscript j refers to site j, and ε_j is an independently distributed error term for that site. This regression equation is fitted to the data (the participants and control group jointly) by choosing the six β (coefficient) values which minimize the sum of squared errors.

Because all the explanatory right-hand side variables are indicator variables with a value of 0 or 1, the β coefficients have an interpretation as conditional means, that is, the expected change in NAC due to the presence of a particular measure class at a site. The constant term β_0 is the expected change in NAC observed in the absence of any measures, that is, the expected NAC change for the control group. The expected change in NAC at a site with, e.g. a furnace measure and some insulation measures but nothing else, would be $\beta_0+\beta_1+\beta_2$.

This specification assumes that there are no savings interaction effects between different classes of measures installed at the same site. This is an *a priori* defensible assumption for the interaction of certain classes of measures—for example, there is no obvious mechanism for hot water heater replacement measures to interact significantly with envelope measures—but for others, notably furnace and insulation measures, the possibility of significant interactions should at least be explored (basic heat loss arithmetic implies that the joint savings from installing both classes of measures should be less than the sum of individual savings if only one class were installed at a site). In fact as an experiment we created a furnace-insulation interaction indicator (set to 1 if both furnace measures and insulation measures were claimed at the site, 0 otherwise) and added it to the above regression specification. Although the resulting coefficient was of the expected sign (positive, implying a reduction in savings), it was not statistically significant, and did not appreciably shift the estimated values of other coefficients, so in the interests of parsimony we excluded it from the final specification

Electric Savings Measures

For residential electric savings measures, the situation is in some respects much simpler, and in others more complex. The only measures which claim electric savings are replacement window measures: The "gwindow" measures already noted in the context of gas savings regressions (replacement windows installed in gas-heated houses), and the analogous "ewindow" measures (replacement windows installed in electrically heated houses). The "gwindow" measures claim electric savings because they are presumed to reduce energy consumption for summer cooling, which takes the form of electricity, even in gas-heated houses. "ewindow" measures claim savings for reductions in both winter electric heating consumption and summer electric cooling consumption. Thus, although there are far fewer electric savings measure categories to contend with than was the case with gas measures, there is the problem of estimating both summer (cooling) and winter (heating) effects. Our strategy for estimating these various savings

components is to estimate them in separate regression specifications. To estimate the effect on electric heat consumption of "ewindow" measures we use the very simple regression specification:

Where β_0 is the expected change in NAC observed in electrically heated houses in the absence of any measures, and $\beta_0+\beta_1$ is the expected change in NAC in electrically heated houses (ignoring any reduction in summer cooling load) which have installed one or more window replacement measures. The before-and after NAC estimates used to create the left-hand side ΔNAC terms in this regression are calculated with VBDD regressions including only heating-degree day terms, not cooling-degree-day terms. Because the VBDD methodology employed here excludes from the regressions any 0-heating-degree day (HDD) consumption months (which are also the months where most cooling would occur), the VBDD regression coefficients are largely insulated from biases which would result from summer cooling loads.

To estimate reduction in summer cooling loads, we estimate the very similar regression specification:

Where ΔNAC terms in this regression are calculated with VBDD regressions including only cooling-degree day terms, and we restrict the participants to "gwindow" (gas-heated) sites. Our reasoning is that the easiest way to isolate estimates of summer cooling loads from winter heating consumption is to perform the estimation on bill streams which do not embody any winter heating load (as is the case with electric bills in gas-heated houses). Our experience with joint estimates of HDD and CDD effects in a single VBDD regression specification using monthly data(such as one might fit to electric bills from a house with both winter electric heat and summer cooling) is that the regressions often appear ill-specified, and fit the data poorly. Cooling energy use in most parts of the inland northwest, including the Avista service territory, is intermittent and might occur to a notable degree for only a couple of months a year; it is not very fruitful to fit a two-parameter model to , in effect, two monthly data points. The chances of getting meaningful CDD response coefficients are greater if any cooling consumption in shoulder-season transition months is not contaminated by heating in the same month.

Although we thus use only gas-heated sites to estimate reductions in summer cooling load due to window retrofits, we assume that identical or very similar reductions occur at electrically heated sites, although we do not have good tools or techniques to measure these reductions directly using monthly billing data.

Low Income Measures

A similar analytic approach is used on the low-income residential programs. Compared to the regular residential conservation program, there are more measures, and a comparable number of measure groupings. Gas measure groupings for CDA are as follows:

program code	Utility description	grouping for CDA
L19	G HE WH 40G	gas conventional water heater (gcwh)
L20	G HE WH 50G	gas conventional water heater (gcwh)
L21	G INS - CEIL/ATTIC	gas heated envelope excluding doors and windows (genvelope)
L22	G INS - DUCT	gas heated envelope excluding doors and windows (genvelope)
L23	G INS - FLOOR	gas heated envelope excluding doors and windows (genvelope)
L24	G INS - WALL	gas heated envelope excluding doors and windows (genvelope)
L29	G AIR INFILTRATION	gas heated envelope excluding doors and windows (genvelope)
L10	G ENERGY STAR WINDOWS	gas heated envelope--doors and windows (gdoorwind)
L12	G ENERGY STAR DOORS	gas heated envelope--doors and windows (gdoorwind)
L18	G HE FURNACE	gas furnace (gfurn)
L13	E TO G FURNACE CONVERSION	conversion to gas furnace (egfurncnv)
L14	E TO G H2O CONVERSION	conversion to gas water heater (egh2ocnv)

Note that two of the measures (each its own "measure group" for CDA purposes) are actually electric-to-gas fuel conversion measures, which are not gas conservation measures; in fact they would be expected to increase measured gas consumption at a site (For program evaluation purposes they are considered electric conservation measures.). However, they need to be included in gas CDA regressions since some sites with these conversion measures also have gas conservation measures which apply to the gas heating in the post-period. For example, a previously gas-heated site might get a rebate for electric-to-gas hot water conversion and at the same time install rebated envelope measures. Without taking into account the new gas consumption from the hot water conversion, one might conclude that the envelope measures actually resulted in a significant increase in gas consumption. The resulting low-income gas measures CDA regression specification is:

Note that, unlike the regular residential program CDA specifications, there is no regression constant $\beta_{0.}$ This lack is due to the fact that we have no non-participant low-income residential control group available and comparable to that available for regular residential conservation programs. We are thus unable to estimate with accuracy any systematic tendency for low-income residential customers to change NAC over the period in question, independent of program participation. We are, in effect, making the convenient assumption that there is no such tendency, or, put differently, the low-income programs get the credit for it should it happen to exist.

For low-income electric conservation measures, we use the following groupings:

Program Code	Utility Description	Grouping for CDA
L01	E HE WH	electric conventional water heater (ecwh)
L02	E INS - CEIL/ATTIC	electrically heated envelope excluding doors and windows (eenvelope)
L03	E INS - DUCT	electrically heated envelope excluding doors and windows (eenvelope)
L04	E INS - FLOOR	electrically heated envelope excluding doors and windows (eenvelope)
L05	E INS - WALL	electrically heated envelope excluding doors and windows (eenvelope)
L28	E AIR INFILTRATION	electrically heated envelope excluding doors and windows (eenvelope)
L08	E ENERGY STAR REFRIGERATOR	refrigerator (erefrig)
Program Code	**Utility Description**	**Grouping for CDA**
L09	E ENERGY STAR WINDOWS	electrically heated envelope --doors and windows (edoorwind)
L11	E ENERGY STAR DOORS	electrically heated envelope --doors and windows (edoorwind)
L13	E TO G FURNACE CONVERSION	conversion to gas furnace (egfurncnv)
L14	E TO G H2O CONVERSION	conversion to gas water heater (egh2ocnv)

These specifications lead to the following CDA regression specification for low-income electric conservation measures:

There is no constant term here because there is no suitable control group was available. Also note that the fuel conversion measures appear in this regression, as in the gas CDA regression, but the interpretation is different. In this case the conversion measures are bona fide electric conservation measures, with potentially rather large negative coefficients (reflecting, for example, the significant reduction in electric consumption due to conversion of the heating system).

References

Fels, M. 1986. PRISM: An Introduction, *Energy and Buildings*, Volume 9 (1986)

Ecotope, 2010, *Savings Audit of Avista's 2009 Natural Gas Demand-Side Management Programs*, prepared for Avista Corporation, Spokane WA.

Appendix D

Policy, Planning & Analysis Team Report PPA 11-I-001

Avista Utilities

Policy, Planning & Analysis Team Report
PPA 11-I-001

Follow-up on the January 2011 Ecotope Impact Evaluation of Selected Residential and Low-Income Portfolio Acquisition

February 4, 2011

Mark Baker
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Introduction

Pursuant to the requirements established in Avista's 2010 Natural Gas Decoupling Order, Avista is required to perform an annual independent estimate of the therm acquisition from the natural gas DSM portfolio. The results of that independent audit are then incorporated into the Company's decoupling surcharge filing (Schedule 159) in September of each year.

Ecotope was selected to perform the independent audit of the 2009 natural gas DSM portfolio (using 2008 program year data). In addition to a general review of the portfolio, Avista also specifically requested several additional impact evaluations within the residential and low-income customer portfolios using statistical billing analysis applied to 2008 program participation. Due to delays during the EM&V Collaborative, Ecotope was unable to complete these impact evaluations in time to be incorporated into the Schedule 159 filing. Those impact evaluations are now complete and have been delivered to Avista.

This memorandum is a summary of recommended topics for further discussion and study that the Policy, Planning and Analysis (PPA) team have assembled from the Ecotope study as well as recent internal discussion and analysis resulting from the review of that study. Recommendations have been categorized to make the review and application of the recommendations more manageable.

General Implementation Recommendations

These are recommendations that the PPA team felt were applicable to multiple customer portfolios.

- Establish minimum dollar levels and/or minimum square footage requirements for incentives.
    - The Ecotope study noted that rebates for amounts as small as $3 (1 therm) may be processed for payment. In cases such as these, there is not enough square footage weatherized to deliver measureable energy savings with any impact evaluation methodology.
    - Another consideration is the administrative cost associated with processing a rebate that exceeds the small incentive.
- Perform periodic data quality screenings to reduce errors resulting from incorrect information being captured on rebate forms, data entry errors or other easily identifiable issues for individual projects.
    - The PPA team (and predecessor organizations) has annually screened energy efficiency projects to identify those that seem to have identifiable inconsistencies or errors. Recent screening of residential and low-income projects support the conclusions of the Ecotope study in that a number of projects with apparent inconsistencies are the result of data collection or data entry errors. Although a deeper review may clear up some of those issues, it would be desirable to establish a process which is designed to capture and present data that has been screened and validated.

- Develop a means of improving the estimates of energy savings for customers participating in multiple programs with interactive effects. This is particularly important for low-income customers who frequently have such interactive measures (e.g. shell and HVAC equipment) or improvements within a short time span.

Program Implementation Recommendations – the Low-Income Customer Portfolio

Ecotope's review of the low-income portfolio led to a realization rate of 35.3% for electric measures, 22.6% for natural gas measures, 67.6% for furnace conversions and 70.8% for DHW conversions. Discussion of the programs and the quantitative findings of the study pointed out several recommendations. Most of these recommendations relate to the screening of program participants, how data is captured for the work that is performed and the consistency for which estimates are made for the utility energy savings.

- Require that the Community Action Program agencies (CAPs) acting under contract to Avista complete estimates of energy savings that are based upon Avista's prescriptive residential estimates that are more readily supported with engineering assumptions and calculations.
    - The current process allows for CAP agencies to select their own method of estimating energy savings. Sometimes these are based upon Avista's calculations but oftentimes they are based upon the standards of other agencies that may not be suitable for Avista's needs.
    - Establishing a single means of estimating savings from a particular efficiency measure would improve the ability for Avista to track savings estimates that would more accurately represent the likely result from independent evaluations.
    - Standardized energy savings would support better data quality controls and review.
    - In the case of measures installed in low-income households which also have a comparable prescriptive residential program, the assumption of the energy savings should be based upon the residential prescriptive estimate barring a compelling reason to differentiate between low-income and non-low-income residences.
- Establish an improved means of comprehensively verifying the fuel source and improving quality control of program delivery of homes treated by CAP agencies under the low-income program.
    - Currently it is required that homes demonstrate a minimum R level (a means of approximating the use of electric space heat) for participation within the electric to natural gas conversion program. The required R level of 4,000 may be insufficient to meet the cost-effectiveness needs of the portfolio. Additional analysis may be required to determine the R level necessary for cost-effectiveness based upon reduction in Avista retail energy usage.
    - Other programs within the low-income portfolio are not necessarily subject to the same R level screening as the conversion program. Analysis should be performed by the CAP agencies and confirmed by implementation staff prior to payment to determine the

minimum electric or natural gas space heat load required for shell improvements to be cost-effective based upon reduction in utility fuels only.

- Review and document the income requirements for low-income customers by CAP agency. Currently Avista does not capture the income status of participating customers. Implementation staff should consider creating an additional field within CSS to track income.
- CAP agencies should be instructed to collect additional information (e.g. square footage etc) that would contribute to the ability to demonstrate reliable energy savings within future impact evaluations. The PPA team can work with the implementation team to identify the data that would be useful for future analyses.
- Confirm the verification of the installation of efficiency measures installed through the low-income portfolio on an adequate sample of the program participants.

<u>Program Implementation Recommendations – Residential Customer Portfolio</u>

Several issues relating to the make-up of the portfolio, screening of participants and data gathering were applicable to the residential portfolio. Additionally more specific program recommendations from Ecotope and the PPA team have also arisen as a result of the evaluation.

- Many recommendations that were specific to the residential windows program (both electric and natural gas) have been omitted in anticipation of the expected termination of those programs. Based upon Ecotope's realization rates of 26.8% for electric windows and 12.7% for natural gas windows from the recent impact analysis coupled with previous cost-effectiveness analysis of actual program results and projections of 2011 cost-effectiveness performed as part of the business planning process, it does not seem plausible that the program will be cost-effective. This lack of cost-effectiveness is even clearer when likely net-to-gross ratio scenarios are taken into consideration. There are no known program revisions that are significant enough to reverse this expectation.
    - The PPA team strongly recommends the termination of the electric and natural gas window programs for the residential segment. Barring compelling evidence to the contrary, this is necessary to remain compliant with the Company's commitments within the Idaho Public Utilities Staff MOU.
    - Based upon discussions with the program implementation group over the past few months, it is understood that there is agreement on these findings and that the windows program will be scheduled for termination.
- Comprehensively review the electric and natural gas portfolios for prescriptive programs with little current or prospective throughput. Individually consider the termination of each of these low-throughput prescriptive programs so that resources can be devoted to programs with more reliable savings, (such as furnaces/boilers), and the development of new programs better suited to provide significant contributions to the portfolio.

- Avista retains within the portfolio a number of prescriptive programs with very little throughput. Sometimes these programs have been retained for a number of years with no prospects for significant increases in throughput. These programs have the potential to create a distraction for the implementation team and other elements of the organization, making it significantly more expensive, difficult and time consuming to perform program evaluations.
- Avista's policy in regards to the creation of prescriptive programs has been that they be considered for measures with significant volumes of measures that are used in a relatively uniform manner. In order for a program to be considered for prescriptive treatment, the compromises in energy savings and incentive estimates that are inherent within a prescriptive program should be more than fully offset by the increased marketability and streamlined utility administrative cost. This is not the case for prescriptive programs with low throughput.
- Avista has, in the past, adopted a strategy of launching programs with minimal marketing research since the adverse impact of a program's failure upon portfolio cost-effectiveness was low. This was the result of Avista's DSM cost structure at the time, specifically the proportion of non-incentive costs relative to overall utility costs was very low (as low as 12% in many cases, with most of that cost being relatively fixed). If customers didn't respond to a prescriptive program it could be terminated with little or no incremental utility cost having been expended. Avista's 2011 DSM Business Plan anticipates that 36% of total utility cost will be within non-incentive categories. Though much of those costs are fixed for a particular prescriptive program launch, it is clear that there is, in general, an increasing level of exposure to risk involved in launching or maintaining prescriptive programs with little throughput. It could be speculated that one of the reasons for the significant growth in non-incentive utility costs may be the proliferation of the number of prescriptive programs maintained within the Avista portfolio.
- There may be exceptions for natural gas programs which have the future potential for significant net TRC benefits. The 2011 DSM Business Plan has identified the need to initiate and actively market such measures in order to optimize the cost-effectiveness of the natural gas portfolio.

- Establish a means of verifying the installation of insulation measures
  - Currently the program provides rebates for insulation measures based solely upon the customer submission of receipts. There is no process in place for the verification of installation. This recommendation extends to contractor as well as 'do-it-yourself' installations, though it is recognized that the 'do-it-yourself' installations may be the most problematic.
  - Establish a means of performing verification on an adequate sample of homes receiving insulation rebates with the intent to increase that sample as necessary, and to modify the program as necessary, to meet the objectives of the program.
    - Specifically sample the 'do-it-yourself' homes to determine if the insulation has been installed and the quality of the installation.

        - Advise contractors that Avista will be inspecting a sample of installations to drive increased quality control.
        - Further advise contractors their continued participation as a recommended vendor is contingent upon the satisfactory attainment through this verification process.
    - Gather additional information on the level of pre-existing insulation and verify heating source and efficiency as part of the field work.
    - Consider including field or EM&V work necessary for other programs within the scope of these verifications to the extent feasible.
- Review the data collected as part of the rebate process. Additional or improved data relating to square footage of the home, construction date, prior insulation level, pre-existing (replaced) equipment specifications should be gathered to the extent possible.
- Review all shell and space heat measures with the consideration of incorporating a minimum demonstrated utility (electric or natural gas as appropriate) heat load into program eligibility requirements. The minimum level should be evaluated based upon what is required to be cost-effective based upon utility fuel benefits alone.
- Commit to either (a) terminating the fireplace damper program due to low throughput or (b) work with trade allies to market the program to establish a reasonable level of throughput.
    - It should be recognized that this is a measure with significant potential cost-effectiveness that may support a viable natural gas DSM portfolio. As noted in the business plan and other departmental communications, the natural gas DSM portfolio is projected to be of marginal cost-effectiveness and is failing to achieve verified Washington decoupling acquisition targets. Consequently the PPA team has previously recommended that measures with significant cost-effective potential be aggressively pursued.

<u>Program Engineering Recommendations</u>

Most of the issues related to the implementation engineering estimates of energy savings were captured in the prior Ecotope verification of 2009 natural gas acquisition rather than within the more recent impact evaluations of selected non-residential programs. However, a few additional topics for discussion were identified that merit further discussion within Avista.

- Revise the base case assumption for ground-source heat pumps to assume that the alternative installation is an electric space heating alternative rather than a natural gas space heating alternative.
    - Based upon the Ecotope field work and analysis, none of the ground source heat pumps had a viable natural gas alternative. Ecotope believes this is true of the entire population as well.

    - Several of the ground source heat pump installations claimed natural gas savings (seemingly the equivalent to the full space heat load) in addition to the uniform electric energy savings claim. Thus it appears that these projects were being credited with both the avoidance of a natural gas furnace load as well as an electric efficiency upgrade.
- Revise the assumptions for the savings related to Energy Star homes to reflect Avista's service territory rather than the overall region.
    - The current assumptions for Energy Star homes are based upon NEEA's results from the overall region rather than the climate zones within Avista's service territory. Ecotope recalculated these savings to reflect Avista's service territory and provided this amount in the 2010 report. These revisions should be used to quantify the savings estimates for Energy Star homes.
- Establish a base case for all non-residential measures that is derived from the current code minimum or, in the absence of an applicable code, the current industry standard for that application.
    - Some analysis with this customer portfolio has been based upon base cases that exceed (require a higher efficiency than) the applicable energy code.

Evaluation, Measurement and Verification Activities

For small savings measures, such as high-efficiency natural gas water heaters, savings can be difficult to substantiate through the use of a statistical billing analysis.Therefore, additional study is necessary in order to provide useful recommendations regarding the future status of the measure.

- Perform an impact evaluation on residential high-efficiency natural gas water heaters.
    - The billing analysis performed was hampered by an inability to distinguish the small projected impact of the water heater efficiency within a significant amount of variance in the overall natural gas usage.
    - A level of therm savings that would be sufficient to make the high-efficiency water heater measure cost-effective may be too small to be statistically significant in a billing analysis approach.
    - The Northwest Research Group is currently considering a regional electric end-use load research effort that may provide opportunities for a review of residential natural gas as well. This work is being performed as an augmentation of the Residential Building Stock Assessment. It is possible that the methodology will progress in such a manner that it is possible to isolate natural gas water heater usage characteristics that are useful for a more detailed review of this measure.

Conclusion

The PPA team will work with the implementation team to carry the discussion of the topics identified above to a useful conclusion. The timeline and follow-up on this future review will be incorporated into the Company's Integrated Management Reporting System (IMRS).

Appendix E

Demand Side Management Programs Observations and Recommendations

Moss Adams LLC

AVISTA CORPORATION

DEMAND SIDE MANAGEMENT PROGRAMS
OBSERVATIONS AND RECOMMENDATIONS

DECEMBER 31, 2010

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Acumen. Agility. Answers.

Ms. Lori Hermanson
Avista Corporation
Spokane, Washington

The following findings and comments resulted from performance of procedures as outlined in our professional services agreement with Avista Corporation (Avista) dated December 28, 2010, related to Avista's Demand Side Management programs (Programs) and the scope of work that was included in Avista's Request for Proposal R-37058. We have performed certain consulting procedures focusing on Avista's Programs. We make no representations as to the sufficiency of our procedures, but note that our report is designed to comment on improvements Avista can make with the Programs. Our procedures were not designed to detect fraud or represent an audit made in accordance with generally accepted auditing standards. Accordingly, we have not expressed an opinion or any other form of assurance as a result of this engagement. Our comments are intended to help you add efficiencies and improved controls to your existing system. This report pertains to only those items and procedures described below. It is not intended to be a complete, thorough review and testing of the entire internal control system.

PROJECT APPROACH AND SAMPLE SIZE

We selected a sample size of 105 rebates from nonresidential, residential and low income rebates processed during 2010. The listing of rebates was provided by Avista. This sample selection was chosen based upon the American Institute of Certified Public Accountants Audit Sampling Guide based upon an expected error rate of 1.75% and providing a 90% confidence rate and a 5% tolerable deviation rate. This error rate of 1.75% allowed for two errors to obtain a confidence level of 90%. During our testing, we found one error in the rebate amount and therefore the 90% confidence was achieved related to the dollar amount of the rebates. The original sample selected only resulted in 4 nonresidential rebates, which did not seem representative of the population. Although there are not a lot of rebates on the nonresidential side compared to the total rebates (residential, nonresidential, and low income), the dollar amount for the nonresidential rebates are much greater than the others. Because of this, we judgmentally determined that a sample of 15 nonresidential was more representative of the population. Therefore we replaced 11 of our random sample with the next 11 nonresidential rebates. Ultimately, we tested 15 nonresidential rebates, 4 low income rebates, and 86 residential rebates, which were selected using a random number generator and provided us with our total population of 105 items.

EXECUTIVE SUMMARY

Overall, we found the Demand Side Management programs to be working as intended. However, the current process is very manual and labor intensive, which increases the potential for error. As Avista processes over 35,000 rebates during a year, we do not believe the current system to be an efficient process. We recommend a more integrated system that includes fields, which are updated from the current customer contact system (CCS), would result in a much more efficient and effective process. We also found that because the process is so manual, there is not enough time devoted to the review and monitoring of outstanding projects to determine why they may still be outstanding. Therefore, projects may sit for a period of time when they should actually be closed out or deleted as they are no longer a viable project.

We also noted that there are weaknesses in the review and approval process over the closure of nonresidential projects, particularly with those closed near to year end. There are a number of projects that were coded as complete during December and then moved back to the study phase in January. As a result, there is a risk of duplicate reporting for the two separate fiscal years involved.

We also identified several areas for improvement, which are detailed in our report below. In addition, although there was only one rebate in which the dollar amount was incorrect, we found several small clerical/processing errors that would not necessarily change the rebate amount, but do not follow policy. Those are also identified in our report below.

We would like to thank your staff for their openness, cooperation, and assistance during our fieldwork. We enjoyed working with them and found them to be very helpful and we appreciate their time.

Moss Adams LLP

Spokane, Washington
February 25, 2011

:abm

Internal Controls

We met with several program implementation staff and walked through the process related to residential, nonresidential, and low income rebates. We documented these processes and have provided the following recommendations based upon those discussions and our walk-throughs of the processes:

- Due to time constraints, as the current manual process is very time consuming, staff do not consistently monitor reports to ensure projects are moving ahead or updated. As a result, old projects are often maintained in the system that either need to be moved to completed status or deleted. An automated system would allow additional time for appropriate review and monitoring functions to be performed and is considered a best practice. In the interim time prior to automation, we make the following recommendations:

  - ❑ Management should perform a monthly review of reports (best practice) so that errors can be detected and corrected in a timely manner.

  - ❑ If errors are detected that would amend a prior year's report, management should determine the impact to the prior year report. Prior year reports that would be significantly impacted by errors should be amended to reflect those changes. If not significant, the current year report should be adjusted so that the cumulative reports are correct.

  - ❑ Management should set a threshold with stakeholders to determine what would be considered material (a percentage of error and/or a dollar amount of error). When assessing what is significant or material, both qualitative and quantitative information should be used and an amount or error that would create a substantial likelihood that a reasonable user's view of the results would have been altered due to the change would be considered material. Therefore, not only the number of rebates should be considered, but also the cost effectiveness should be considered and those results that would alter a reasonable user's view should be considered material.

  - ❑ Exceptions are currently investigated using a manual process, which is time consuming and prone to error. Best practices would dictate using an automated process. We recommend the use of data extraction software, such as a program called Audit Command Language (ACL) which can be used to look for exceptions.

  - ❑ Currently the vouchers that are submitted for payment to accounts payable are not pre-numbered, which could lead to rebates on a voucher being paid twice. We recommend the use of pre-numbered vouchers to prevent duplicate payment. This is an internal control best practice.

Internal Controls, Cont.

- Currently, there are no checks or balances to ensure that a project is not double counted as completed in two separate years. For example, a project can be marked as completed in December 2010 and then moved back to the study phase in January 2011 until the project is actually completed and then moved back to completed status again once the project is done. This would lead to the deemed savings of the project being reported in both 2010 and 2011. Due to this concern, we were asked to select a sample of nonresidential projects marked "completed" during December 2010 to see if the projects were actually completed and paid. The results of our testing disclosed a risk of potential for duplicate reporting. See "Cut-off Testing" section of our report for these results.

- As only a copy of a receipt is needed for residential customers, there is a risk that a customer could make multiple copies of a receipt and give it to friends to also submit a rebate. At this time, Avista does not complete home inspections on certain rebates, including appliances. As each residential rebate is not significant, the risk is minimized; however, it does exist and is somewhat limited to purchases in which the receipt does not have the customer name or address. The only way to prevent this risk would be to require an original receipt or home inspection; however, customers would likely not want to provide original receipts in case they have problems with their purchases and need to return them and home inspections would probably cost more than the actual rebate.

- Windows and insulation are only effective if installed properly. Currently, customers can install windows and/or insulation themselves (and therefore it may not be properly installed and not result in any deemed savings) and still obtain a rebate.

    - ❑ We recommend Avista consider either an inspection of window and insulation installations that are completed by the customer, or consider providing rebates only for professional installations.

- The nonresidential customers are tracked through the nonresidential database, which is a Customer Relationship Management (CRM) system typically used to manage a company's interactions with customers, clients, and sales prospects. Since a CRM system is not intended to be used as it is here, there are no controls to prevent a customer from being set up more than once as an account and therefore there is potential for a customer to be paid twice for the same rebate. Project implementation staff typically will do a search for a customer to try to ensure the customer is not entered more than once; however, the risk is still present. An integrated demand side management system that is integrated with customer accounts would prevent this from happening in the future.

Internal Controls, Cont.

- When nonresidential rebates are submitted, the engineering department reviews the information and creates a report detailing the savings and project. Once that report is complete, another engineer within the department reviews the report. As the engineers are in the same department and likely peers, Avista may want to consider having engineers from the policy, planning, and analysis group to perform the review to provide an independent and fresh look.

- Once rebates are entered for payment for residential rebates, a voucher is processed. This voucher is then reviewed by the program manager or program manager lead and then another reviewer. A program implementation staff does a thorough review and will make any changes manually on the voucher itself. The review by the program implementation staff is not apparent as the voucher is not signed or initialed by this person. The second review may be redundant and unnecessary, other than for authorization authority. In addition, accounts payable is making payments from the voucher, with the manual changes rather than being integrated with the CCS system. This again makes the process more time consuming and manual than it should be.

- The nonresidential system does not currently have proper segregation of duties implemented for access to the system. This allows users to make changes to the system and does not allow for the proper checks and balances to be in place.

    - ❑ Best internal control practices require segregation of duties. Management should review who has access to the system and implement proper access controls, assuming the system will allow access controls, to ensure checks and balances are adequate.

Nonresidential Testing

We selected a random sample of 15 nonresidential rebates and tested the following attributes:

- Signed contract was in place if site specific, or signed incentive agreement if prescriptive.

- Customer rebate was for the same address or name as on the report.

- If site specific, an engineering report was completed.

- If site specific, the customer contacted Avista before the work took place.

- If site specific, there was evidence that an inspection took place.

Nonresidential Testing, Cont.

- The measurement life agreed to the engineering study (if site specific) or the business plan (if prescriptive).
- If the customer noted maintenance savings, the engineering report also included those savings.
- The engineering tracking system showed approval of the engineering report (for those projects processed after the tracking system was put into place in 2010).
- The rebate was calculated appropriately and agreed to the duel fuel incentive calculator (DFIC) if site specific or the business plan or process document if prescriptive.
- Invoices supported the cost.
- The proper rate schedule was used.
- The amount of the rebate check was correct.
- The voucher was approved.
- If prescriptive, the incentive cost agreed to the business plan.

Based upon our testing, we found the following:

- With regards to inspections that are to take place for site specific projects, there were two instances in which there was no evidence that an inspection took place. There was evidence in the file that there was a visit; however, it was not clear if an inspection occurred.
- There were three instances in which the customer did not contact Avista before the site specific work took place. It is our understanding this was because the customers originally believed they were prescriptive and Avista determined they should have been site specific. This change took place after the work was completed. It is our understanding that Avista will try to make accommodations for their customers if it appears an error like this is reasonable.
- We noted one instance in which the measurement life was different than the engineering study (as it was site specific).

Residential Testing

We selected a random sample of 86 residential rebates and tested the following attributes:

- The application was signed.
- If a weatherization incentive, the application noted the primary heat source was not wood, oil, or propane.
- The customer name and address agreed to the name and address on the invoice (when there was an invoice rather than a receipt).
- The date of installation was within 90 days (rounded to within a month) of when the application was received.
- The total cost in the system agreed to or was less than the invoice or receipt.
- The measure, model, size and/or efficiency rating of the equipment noted agreed to the invoice or receipt.
- If the equipment was a pump or furnace and was variable, the variable calculation was input properly.
- The amount of the rebate was calculated properly.
- If the customer is gas only, the estimated kilowatt hour savings was blank and if electric only, the estimated therm savings was blank.
- Information on the voucher agreed to the system.
- The voucher was approved for payment.
- The copy of the check agreed to the amount of the calculated rebate.
- The rebate amount was 50% or less of the total cost or incremental cost of improvements.

Based upon our testing, we found one residential rebate was calculated incorrectly. In addition, we found several rebates that contained missing information or incorrect information provided, although the total rebate was correct. These are noted as follows:

- Of the residential rebate forms tested, we noted 19 of those were for weatherization incentives, which require the customer to indicate their primary heating source to ensure it is not wood, oil, or propane. We noted that 3 of the 19 tested did not note their primary heating source on the application.

Residential Testing, Cont.

- Of the 86 residential rebate forms tested, we noted 4 rebate applications that were not signed by the applicant although the rest of the application was completed.

- One application did not include the actual receipt or invoice for the unit purchased. There was however, a shipping bill of lading that was included, which indicated the item listed on the application and that it was a catalog purchase. The bill of lading ship to address was the same as the application. There was no indication of the cost of the unit purchased (a dishwasher); however, there was no indication the unit was a used unit rather than new and therefore there is minimal risk the cost was not at least twice as much as the rebate.

- We found one rebate in which $14.64 was overpaid on a $400 rebate. This was related to a furnace installation, which was variable and therefore required a calculation to determine how much of the rebate went to each component. As the rebate is capped at 50% of the cost, when each component was separated out, the variable speed portion amounted to $170.72 of the total cost of $4,268.00. If the 50% cap is applied to each component (rather than the total cost) then the $100 rebate paid for the variable portion was $14.64 too much ($170.72 * 50% = $85.36 rather than $100). We do want to note however, that the total rebate was significantly less than 50% of the total cost of the furnace. The policy itself is not clear if the 50% is related to each component or the total cost.

- We found one instance in which a rebate customer was gas only; however, the kilowatt hour savings of 14 kilowatt hours was not deleted; therefore, outside reporting would be overstated by the 14 kilowatt hours.

Low Income Testing

We selected a random sample of four low income rebates and tested the following attributes:

- The address on the account agreed to the invoice.

- If pre-approval was required, pre-approval was indicated on the form.

- The total cost was equal to or less than the amount on the invoice.

- The amount of the rebate was calculated properly.

- The rebate information on the voucher agreed to the system.

- The voucher was approved for payment.

Low Income Testing, Cont.

- The amount of the rebate check was correct.

Based upon our testing, we did not identify any errors with the low income rebates.

Cut-off Testing

We selected a random sample of 27 out of 241 nonresidential rebates (under our sampling guidance this was considered a small population and a very important attribute and high assurance) that were shown as "completed" in the system during December 2010 to test if the projects were in fact complete.

This was done as Avista has seen a higher number of rebates during the last month of the year and was concerned there was incentive to change the status to "complete" for reporting purposes and then back again to "study" in the system in January until the project was in fact complete. As multiple people have access to the system, including those out in the field who help customers with rebates, there is a risk that a change can be made without anyone knowing of the change. For the sample selected, we tested to see if the check was processed by January 15, 2011, as all paperwork would have to be completed for the check to be processed. Based upon our testing, we found that 5 of the 27 tested (or 18.5%) had been marked as "complete" during December 2010 and then moved back to the "study" phase during January 2011. Based upon this testing, it seems there is a large percentage of nonresidential projects that are being claimed on reports as completed in the last month of the year, and then reported again as complete in the following year when the project is actually completed.

- ❑ We recommend Avista either edit the program so that only the program implementation staff can change a project to "completed" or if this is not possible, either deny access to others (which would put a large burden on the program implementation staff) or perform an internal audit or review of all nonresidential rebates marked "complete" during the last month or two of the year. Best practices would be to ensure that access to the program is limited to those that need it and to ensure proper segregation of duties.