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PacifiCorp

Final Utah Low Income Weatherization Program Evaluation for Program Years 2013 - 2015

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Table of Acronyms

Acronyms	Meaning
ARRA	American Recovery and Reinvestment Act
CFL	Compact Fluorescent Light Bulb
HCD	Utah Department of Workforce Services, Housing and Community Development Division
kWh	Kilowatt-hour
LIHEAP	Low Income Home Energy Assistance Program
PCT	Participant Cost Test
PTRC	PacifiCorp Total Resource Cost Test
RIM	Ratepayer Impact Measure Test
SIR	Savings-to-Investment Ratio
TRC	Total Resource Cost
TRM	Technical Reference Manual
UCT	Utility Cost Test
USDHHS	United States Department of Health & Human Services
USDOE, DOE	United States Department of Energy
WAP	Weatherization Assistance Program

1. Executive Summary

Opinion Dynamics presents its evaluation findings for the Rocky Mountain Power Low Income Weatherization Program (referred to as the "Program" throughout this report) in operation in the state of Utah during the 2013 through 2015 program years. We performed both an impact and process evaluation and results from these are presented in the report.

Rocky Mountain Power provides funding on energy efficiency measures installed in the homes of eligible residential customers through a partnership with the Utah Department of Workforce Services, Housing and Community Development Division (HCD). HCD receives state and federal government grants that are then used by several non-profit weatherization agencies to provide energy efficiency services targeted towards weatherization of existing single family, multi-family, and manufactured homes in all territory served by Rocky Mountain Power in the state of Utah. "Low Income" qualifications are determined by HCD. Government grants are leveraged with Rocky Mountain Power funding so that the energy efficiency measures installed in the homes of eligible households are installed at no cost to them. Because agencies rely on government grants in addition to funds from Rocky Mountain Power, the full cost of weatherizing customers' homes is not incurred by Rocky Mountain Power.

Opinion Dynamics conducted this evaluation of the Program on behalf of Rocky Mountain Power with the following objectives in mind: (1) document and measure effects of the Program (energy and non-energy); and (2) identify areas of potential improvement. To quantify energy savings, we conducted a deemed savings review of current ex-ante savings assumptions. This included reviewing existing program assumptions, and researching other algorithms and savings assumptions based on Technical Reference Manuals (TRMs), studies, and other secondary sources as applicable.[1] We also conducted a process evaluation based on a program materials review, an in-depth interview with HCD agency staff, and customer responses to a telephone survey. The telephone survey asked about customer satisfaction with the Program and implementing agencies, program barriers and bottlenecks, best practices, and any opportunities for improvement. Last, this report includes the cost-effectiveness analysis conducted by a third-party consultant, Navigant Consulting.

1.1.1 Impact Results

For the impact evaluation, we verified Program participation through participant telephone surveys. We completed surveys with 70 of the 725 Rocky Mountain Power customers who participated in 2014 through 2015.[2] All surveyed participants verified they participated in the Program and received measures.

We conducted a deemed savings review to estimate the ex-post energy savings from the Program. The results show the average annual net energy savings per participant for the 2013-2015 program years is 922 kWh. In Table 1, we present the ex-post net savings for each program year and in total. Overall, the Program achieved 108% of its ex-ante gross savings for the evaluation period.

[1] See Appendix A for a complete list of all assumptions and sources for TRMs and other documents.

[2] Our survey sample included all participants from the 2014 and 2015 program years. Participants from 2013 were not included to avoid recall bias, given the amount of time that has passed since these participants received weatherization services through the Program.

Table 1. Ex-Ante Gross and Ex-Post Net Energy Savings (kWh)

Program Year	Participation	Ex-Ante Gross Energy Savings (kWh)	Ex-Post Net Energy Savings (kWh)	Realization Rate
2013	543	475,374	525,342	111%
2014	419	383,040	415,149	108%
2015	306	225,327	229,012	102%
Total	**1,268**	**1,083,741**	**1,169,503**	**108%**

Note: For this low income program, the net-to-gross ratio is assumed to equal 1 and therefore gross savings are equal to net savings.

We did not have insight into all ex-ante savings assumptions and therefore cannot identify the exact reasons behind the ex-ante and ex-post differences. We describe the impact evaluation in more detail in the sections below and we document all ex-post algorithms and assumptions in Appendix A.

1.1.2 Process Results

The process evaluation examined Program operations from multiple perspectives. Rocky Mountain Power and HCD have worked together for several years to deliver the Program. Over this time, HCD and its subcontracting agencies have developed expertise in implementing the Program using multiple funding mechanisms. Combining the funds from Rocky Mountain Power with those from government organizations allows the Program to reach more utility customers and demonstrates a best practice in low income energy efficiency program delivery.[3] It is a common practice for utilities to work with community action agencies to bring their energy efficiency programs to low income households since these organizations generally have well-established relationships with them already.

HCD maintains a waitlist of customers who are eligible and approved to receive weatherization services. A customer cannot be placed on the waitlist until an energy audit has been completed and the home has been approved to receive services. HCD uses a point-system to determine where customers are positioned on its list, with households including young, disabled, and elderly residents receiving more points than other households. Agency staff reported that customers observe wait times of 12-24 months before receiving services, which is consistent with survey findings where one-third of customers indicated a wait time of more than a year after submitting their application to receive services. The HCD representative we interviewed noted that there is no performance standard for timeliness. The agencies are not given a time goal but rather are given production goals at the beginning of the fiscal year.

The Program is meeting customer needs well. Participant experience with the Program is positive with nine of ten surveyed participants reporting they were “extremely satisfied” with services received. Customers provided a few recommendations for Program improvement such as reducing wait times to receive services, improving advertising and accessibility to services, and ensuring follow up services are delivered when projects are not

[3] Kushler, Martin, York, Dan and Witte, Patti, “Meeting Essential Needs: The Results of a National Search for Exemplary Utility-Funded Low-Income Energy Efficiency Programs”, ACEEE Report Number U053, September 2005.

completed. All surveyed participants reported that they would recommend the program to others, which is consistent with previous program evaluation results.[4]

While energy education is not a formal part of the Program and is offered through outreach and education to promoting the efficient use of electricity[5], agency staff speak to Program participants about ways to save energy in the home. Coupling informal energy efficiency education with home audits and measure installation is one way implementation staff can take advantage of their visits to help induce behavioral changes that may further reduce their energy costs. It is also considered a best practice of energy efficiency programs designed to serve low income customers.[6] Three of every four survey respondents recalled learning about ways to save energy from the agency staff and a majority (71%) found the information to be "extremely helpful".

We also explored non-energy impacts experience by Program customers. In the telephone survey, we asked participants if the air quality, appearance, and comfort improved, stayed the same, or worsened after they received services. Based on responses given during the telephone survey, 81% of participants reported an improvement in home comfort. Air quality and appearance of the home were better for 61% and 47% of participants as well. This provides further evidence of the positive impact of the Program beyond energy saving benefits.

There remains little awareness of the source of funding for the Program. Only 3% identified Rocky Mountain Power as a funding source and close to three-fourths of participants reported that they did not know the source of Program funding. In 2015, Rocky Mountain Power tried to increase awareness about its sponsorship of the Program by sending thank you letters and magnets to customers. We segmented responses from program participants in 2014 compared to 2015 to determine if there was a difference in recognition of Rocky Mountain Power as a source of funding but did not find evidence of increased awareness. It is possible that there is a time delay in customers recognizing Rocky Mountain Power's role in the Program and that during the next evaluation, surveyed participants may report higher levels of awareness.

1.1.3 Cost Effectiveness Results

The Company's third-party consultant, Navigant, conducted cost-effectiveness analysis of the Program using various approaches: the PacifiCorp Total Resource Cost (PTRC) test, Total Resource Cost (TRC) test, Utility Cost Test (UCT), Ratepayer Impact Measure (RIM) test, and the Participant Cost Test (PCT). Opinion Dynamics and PacifiCorp provided the inputs to Navigant for their calculations. The PCT was considered "not applicable" as a measure of cost-effectiveness for this program since customers do not pay for the measures and the PCT examines cost-effectiveness from the perspective of the participating customer. The annual and evaluation period benefit/cost ratios are presented in Table 2 and show that the program is considered cost-effective based on the UTC, TRC, and PTRC, tests. Note that Program cost-effectiveness is determined by the UCT test.

[4] Smith & Lehmann Consulting and H. Gil Peach & Associates, *Utah Low-Income Weatherization Program Evaluation Report for Program Years 2010-2012*, Prepared for Rocky Mountain Power Company. October 29, 2014, page 30.

[5] Rocky Mountain Power 2015 Utah Energy Efficiency and Peak Reduction Annual Report: January 1, 2015 – December 31, 2015. Issued May 26, 2016.

[6] Same as footnote 3.

Table 2. Benefit/Cost Ratios - Low Income Weatherization

Program Year	PTRC	TRC	UCT	RIM	PCT
2013	3.97	3.61	3.61	0.74	n/a
2014	2.59	2.35	2.35	0.67	n/a
2015	2.23	2.02	2.02	0.42	n/a
2013-2015	3.03	2.76	2.76	0.65	n/a

1.1.4 Recommendations

Based on the evaluation results, we recommend the following:

- **Update unit energy savings (UES) values for individual measures for this program based on the values provided in Appendix A.**
- The ex-post impact evaluation relied on many high-level engineering assumptions to estimate impacts because participant- or program-specific data were not collected. For example, information on results of refrigerator testing; capacity of equipment serviced by furnace fan, programmable thermostat, and insulation measures; and type of heating and cooling equipment in participant homes were not available so we relied on state-wide averages and other sources to make estimates for these and other parameters. We understand that this is a relatively small program with a desire to minimize burden on agencies in collecting these data, but collecting and providing this type of information for the measures that contribute the most to the overall program savings can greatly improve the accuracy of UES estimates. **We recommend collecting and providing these data to the evaluator moving forward to improve the accuracy of UES savings estimates.**
- Rocky Mountain Power is adhering to best practices by delivering the Program HCD. HCD has spent many years serving as a Program implementer on behalf of Rocky Mountain Power by subcontracting with multiple non-profit agencies in Utah to provide weatherization services to qualified homes. It is customary practice for utilities to work with one or more community action agencies to bring their energy efficiency programs to low income households since these organizations generally have well-established relationships with them already. Additionally, HCD is knowledgeable about combining funding from utilities with government funding to expand the reach of programs. The implementing agency demonstrates its understanding of Program processes, requirements and funding mechanisms. Leveraging these types of agencies is a best practice in low income weatherization programs. **Rocky Mountain Power should continue to use the same Program implementer moving forward.**
- Participants continue to be highly satisfied with the Program. Nine of every ten participants reported "complete satisfaction" with the Program and virtually all participants agreed that weatherization staff were courteous and respectful towards their homes. In most cases, Program implementers provide customized customer energy conservation recommendations that allow customers to go beyond measure savings with behavior savings as well. Three out of every four surveyed participants recall this education and of those, 75% took recommended actions. The most common actions taken include turning off lights when not in use and installing energy efficient light bulbs. On a scale from 0 to 10 where 0 means "not at all helpful" and 10 means "extremely helpful", all surveyed participants rated the helpfulness of the energy education at a 5 or higher, with an average rating equal to 8.2. The one-on-one interactions that occur through the Program provide a fortuitous opportunity to provide customers with useful behavioral related tips to become more energy efficient. **Though not a formal**

part of the Program, this informal education may lead customers to save energy beyond the savings from the installed weatherization measures and should continue.

- While satisfaction with the program is high, just under half the surveyed participants provided feedback about ways the Program could better serve households. One area of improvement mentioned by some surveyed participants included incomplete weatherization services. One participant recommended that the program make sure that staff complete the follow up visit to perform a final check of the home services provided, as he did not receive one. Another noted that the Program would benefit if weatherization staff made sure all equipment installation was completed. **Given this feedback, we recommend a re-examination of the existing quality assurance procedures associated with the Program. Rocky Mountain Power could provide customers with a 1-800 contact number to call if they find issues with the weatherization services received or if they have concerns about the quality of work completed.**

- While Rocky Mountain Power relies on several agencies that subcontract through HCD to provide weatherization services, the backlog of customers on its waitlist tends to be long. Servicing these customers is a challenge because of shortages of staff who provide weatherization services. Wait times for services reported by HCD were 12-24 months, which is supported by feedback provided during the participant telephone survey. At the time of the agency interview, HCD had 470 approved and eligible customers on its waitlist, of which 70% were Rocky Mountain Power customers. Some customers wait for several years to receive services because households with children, disabled, or elderly residents are prioritized. As a result, other households get pushed down on the waiting list as new customers who are prioritized send in applications for services. The HCD representative we interviewed noted that there is no performance standard for timeliness. The agencies are not given a time goal but rather are given production goals at the beginning of the fiscal year. **Based on the agency's feedback and the reported wait times for certain customers to receive services, Rocky Mountain Power should consider developing goals related to shortening wait times for customers to receive services. For example, Rocky Mountain Power could establish a goal to service a certain percentage of its customers within a year.**

- Rocky Mountain Power has tried to increase awareness about its funding of the program, given that the company provides at least 50% of the costs of measures installed (that reduce electricity usage) in participants' homes. However, based on feedback from surveyed customers, 3% identified Rocky Mountain Power as a funding source and close to three-fourth of participants reported that they did not know the source of the funding. In 2015, Rocky Mountain Power started to send letters and magnets to participants to thank customers for participating and to increase awareness of the utilities' role in the program. However, no difference in recognition of Rocky Mountain Power as a source funding was detected between 2014 and 2015 program participants. The effect of these outreach efforts may be seen in the next evaluation period. **If it is a priority for Rocky Mountain Power to make sure they are recognized for their sponsorship of the Program, Rocky Mountain Power might also consider branding the agency staff who conduct the audits and installation services by wearing shirts that note the Program's affiliation with Rocky Mountain Power.**

2. Introduction

Rocky Mountain Power's Low Income Weatherization Program (the "Program") provides energy efficiency measures to eligible residential customers through a partnership with the Utah Department of Workforce Services, Housing and Community Development Division (HCD). HCD subcontracts with the following non-profit agencies to install energy efficiency measures in the homes of income eligible households throughout the Company's service area:

- Bear River Association of Governments
- Salt Lake Community Action Program
- Housing Authority of Utah County
- Six County Association of Governments
- Five County Association of Governments
- Uintah Basin Association of Governments
- Southeastern Utah Association of Local Governments

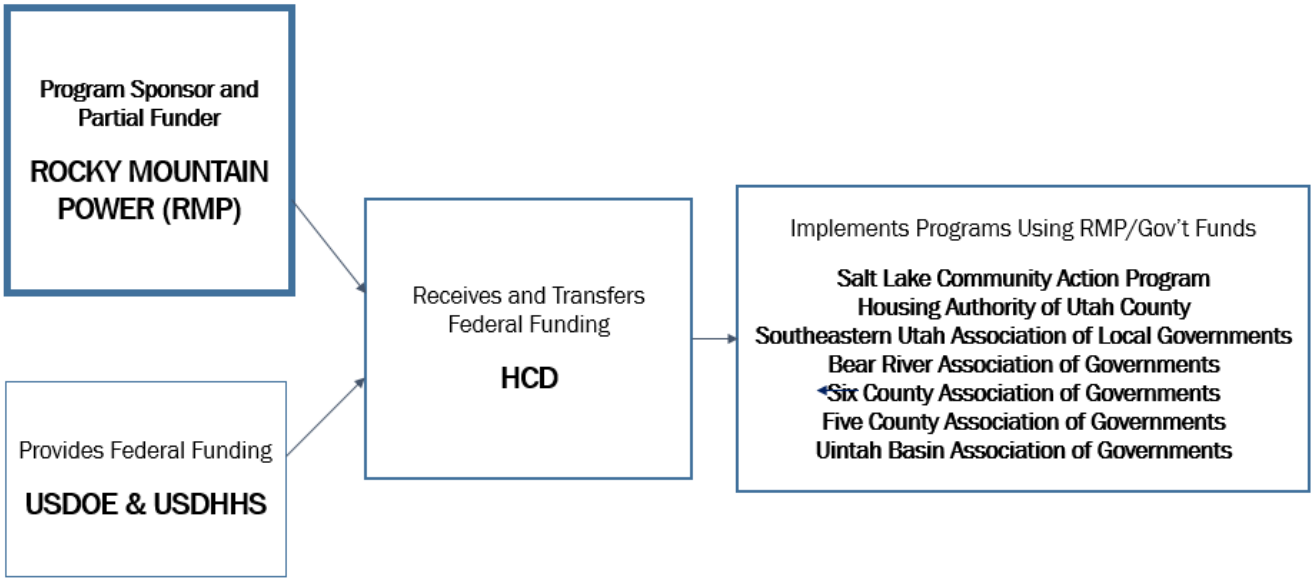
The agencies serve different counties covered by Rocky Mountain Power's service territory using funds from the utility as well as governmental funding sources.[7]

The program operates by reimbursing agencies for 50% of the installed cost of measures for Rocky Mountain Power customers. Agencies are also reimbursed for administrative costs based on 10% of Rocky Mountain Power's rebate on installed measures. To cover any remaining program costs, the implementing agencies leverage federal government funding from the United States Department of Energy (USDOE) and the United States Department of Health and Human Services (USDHHS). HCD administers the federal government funds to the implementing agencies and monitors completed weatherization projects.

Leveraging utility, state and federal funding sources allows the agencies to provide comprehensive weatherization services to more low income households than they may have otherwise. Other exemplary utility-funded low income energy efficiency programs also bring together multiple funding sources and implement programs through social service agencies. We show the sources of funding and roles of oversight and implementation of Rocky Mountain Power's Program in Figure 1.

[7] Program names and counties served by the non-profit agencies can be found at the following website: https://jobs.utah.gov/housing/wap/where.html

Figure 1. Funding and Oversight for Rocky Mountain Power's Low Income Weatherization Program



2.1.1 Program Implementation

Program implementation involves the following steps, which are detailed in the 2015 Utah Energy Efficiency and Peak Reduction Annual Report[8]:

- income verification based on HCD guidelines to ensure that participants qualify for program participation,
- energy audit using a U.S. Department of Energy approved tool to determine eligible measures (audit results must indicate a savings to investment ratio (SIR) of 1.0 or greater)
- installation of eligible measures,
- post-inspections of all projects, and
- billing notification from HCD to Rocky Mountain Power Company within 60 days of job completion, which must be accompanied by a home owner agreement, invoice form with installed measures, and associated cost for each completed home.

The Program is available to income eligible residential customers in existing single family, multi-family, and manufactured homes served by Rocky Mountain Power Company in the state of Utah. Duplexes and fourplexes are eligible if low-income tenants occupy at least one-half of the unit. Other multifamily units are also eligible if low-income tenants occupy at least 66% of the units. Income eligibility is determined according HCD.

[8] http://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Demand_Side_Management/2016/UT_Energy_Efficiency_and_Peak_Reduction_Report.pdf

Energy conservation measures broadly fall into two categories: “major” and “supplemental.” Major measures include floor, wall and ceiling insulation and window replacement, applicable in dwellings with permanently installed operable electric space heating systems that heat at least 51% of the home. Electric heat required supplemental measures include, but are not limited to, weather stripping, attic ventilation, ground cover, timed thermostats, and thermal doors. Supplemental measures that do not require an electric heating system include low flow showerheads, faucet aerators and pipe insulation that require an electric water heater, and LEDs, CFLs, furnace fans, and refrigerators.

2.1.2 Evaluation Objectives

Below we list the objectives of our evaluation of the Rocky Mountain Power Program and we include in parentheses the evaluation type in which the objective is covered:

- Document and measure effects of the Program (impact and process)
- Verify measure installation and savings (impact)
- Review Program operations (process)
- Document all other funding used by agencies to provide no-charge services to participants (process)
- Provide data to support Program cost effectiveness assessments (impact)
- Identify areas of potential improvement (impact and process)
- Document compliance with regulatory requirements (process)
- Survey participants and Program staff (process)

In the remainder of the report, we include a description of the data collection and methodologies used to conduct the study, a presentation of the impact evaluation, the findings from the process evaluation, and cost effectiveness results.

3. Data Sources

In this section, we present the data sources used in this evaluation.

3.1 Program tracking data

We requested and received Program tracking data for program years 2013 through 2015 to support both impact and process evaluation. These data are tracked at the measure level, therefore program participants who received more than one measure or treatment are listed multiple times. Our examination of the data revealed that Rocky Mountain Power changed their Program tracking system after 2013, therefore the same set of variables provided in the 2014-2015 program tracking data were not provided in the 2013 data. Regardless, we received the necessary data fields to conduct both the impact and process evaluation components of the study.

We received the following key variables in the 2013 Program tracking data:

- Customer name, address, and phone number
- Project name (embedded within this is the implementing agency that provided services)
- Project ID
- Utility premise ID
- Bill account number
- Cost recovery date
- Agency invoice date
- Measure installed
- Measure level kWh/year savings for most measures
- Direct install costs
- Measure costs

The Program tracking data included kWh/year savings at the measure level for furnace fans, refrigerator replacements, fluorescent lighting, and a bundled measure called “Utah Weatherization” that includes customers who had building shell measures installed and have electric heat.

The Program tracking data system used for 2014 and 2015 participants differed from the system used in 2013. We received more variables per record, which was at the measure level. We received the following key variables in the 2014-2015 Program tracking data:

- Customer name, address, and phone number
- Project name (embedded within this is the implementing agency that provided services)
- Project ID

- Primary utility number (customer identifier)
- Bill account number
- Cost recovery date
- Project creation date
- Project last update date
- Measure category, type, sub-type, and name
- Measure level kWh/year savings for some measures
- Direct install costs
- Measure costs

The 2014-2015 Program tracking data also included kWh/year savings at the measure level for furnace fans, refrigerator replacements, fluorescent lighting and duct insulation and sealing and a bundled measure called "Utah Weatherization" that includes customers who had building shell measures installed and have electric heat.

We used the Program tracking data to identify program participants and the measures they had installed to develop the participant telephone survey sample. During the survey, we asked respondents to verify their participation.

3.2 Agency Interviews and Participant Survey Data

Primary data collection activities included an in-depth interview with staff at HCD and a participant telephone survey. The agency interview helped inform our review of Program operations, compliance with regulatory requirements, as well as major accomplishments and challenges related to Program implementation. We used information gathered through the participant telephone survey to verify the installation of measures, estimate lighting in-service rates, and inform process related Program findings.

3.3 Other Data Sources

We requested all sources for ex-ante assumptions and reviewed all received files. These included the Company's Utah Technical Reference Library (TRL) file and several previous evaluations. In addition, we submitted several measure-specific questions via email to the Rocky Mountain Power Program Manager and received some clarifying answers.

The documents provided by the program were not entirely sufficient to document all ex-ante calculations as described above in our recommendation, and we therefore relied on several additional sources to perform our ex-post analysis and update ex-ante savings values. For example, we did not have specific wattages of CFLs, capacities of heating and cooling equipment, pre- and post- R values of insulation or square footage of installed insulation or baseline refrigerator test results. For the additional resources, we attempted to use Utah-specific values to the extent possible. We list these resources below at a high-level, and provide additional details on each source in Appendix A.

- ASHRAE Fundamentals 2017

- ENERGY STAR
- Lawrence Berkeley National Labs
- National Renewable Energy Labs
- Residential Energy Consumption Survey (RECS), 2015 data
- Technical Reference Manuals
  - Illinois TRM
  - Indiana TRM
  - Iowa TRM
  - Mid-Atlantic TRM
- Utah participant survey conducted by Opinion Dynamics

4. Impact Evaluation

A total of 1,268 customers participated in the Program during the 2013-2015 Program years. In the participant telephone survey, which included participants from the 2014-2015 program years, we asked respondents whether they recall someone coming to their home to provide weatherization services and perform energy efficiency upgrades. All survey respondents (n=70) confirmed their participation and receipt of services. A list of the various measures installed from the most common, compact fluorescent light bulbs (CFLs), to the least common, duct insulation and sealing, is presented in Table 3 below. Other common measures include refrigerator testing and replacements as well as furnace fans.

Table 3. Utah Participation Counts and Measures for Program Years 2013 through 2015

Measures	2013	2014	2015	Total	Percent
Participation – Total number of Homes Served	543	419	306	1,268	100%
Compact Fluorescent Bulbs*	8,300	406	290	8,996	NA
Refrigerator Testing	345	268	140	753	59%
Furnace Fans	114	103	61	278	22%
Refrigerator Replacements	199	132	58	389	31%
Thermostats	0	3	9	12	1%
Duct Sealing	0	6	1	7	1%
Ceiling Insulation	2	0	2	4	0%
Energy Education	2	2	1	5	0%
Duct Insulation and Sealing	0	0	2	2	0%
Total Count of Installed Measures	**8,962**	**920**	**564**	**10,446**	**NA**

* The count of CFLs in 2013 represents the number of bulbs installed, while 2014 and 2015 show the number of homes receiving CFLs. This is a distinction in how PacifiCorp changed reporting on Program activities.

4.1 Methodology

We performed an engineering review of ex-ante documentation and developed revised assumptions for the ex-post analysis. We requested, but did not receive information on results of refrigerator testing; capacity of equipment serviced by furnace fan, programmable thermostat, and insulation measures; square footages of insulation installed per home; R-values of pre- and post-insulation; and type of heating and cooling equipment in participant homes. In the absence of these data, we developed average savings assumptions at the measure level (e.g., CFLs, refrigerator, furnace fan, thermostat) based on other TRMs and similar programs in other jurisdictions. We customized the savings assumptions and inputs to Utah as much as possible. We used these average savings per measure to estimate program-level savings by multiplying the per-measure savings by the total installed measures of each type from the program tracking database.

We leveraged data from the Utah participant survey to develop installation rates for the lighting measure (CFLs) and applied this installation rate (76.3%) to the deemed ex-post lighting savings. For all non-lighting measures, we assumed an installation rate of 100%.

Appendix A documents all ex-post equations, assumptions, and sources in detail.

4.2 Results

In Table 4, we present the annual ex-ante and ex-post net energy savings for the Program. The overall net savings realization rate is 108% for the 2013-2015 program year and the average annual net energy savings per participant is 922 kWh.

Table 4. Ex-Ante Gross and Ex-Post Net Energy Savings (kWh)

Program Year	Participation	Ex-Ante Gross Energy Savings (kWh)	Ex-Post Net Energy Savings (kWh)	Realization Rate
2013	543	475,374	525,342	111%
2014	419	383,040	415,149	108%
2015	306	225,327	229,012	102%
Total	**1,268**	**1,083,741**	**1,169,503**	**108%**

Note: For this low income program the net-to-gross ratio is assumed to equal 1 and therefore gross savings are equal to net savings.

In Table 5, we present ex-post savings by measure type and the percent contribution to the overall program ex-post savings.

Table 5. Ex-Post Net Savings by Measure

Measure	Quantity			Quantity Unit of Measure	Ex-Post Net Savings			Percent of Total Ex-Post Savings
	2013	2014	2015		2013	2014	2015	
CFL	8,300	7,385	4,570	Bulb	208,376	185,405	114,732	47%
Refrigerator Replacement	199	132	58	Refrigerator	239,903	159,131	69,921	36%
Furnace Fan	114	103	63	Fan	76,999	69,569	42,552	17%
Programmable Thermostats	0	3	9	Participants	0	457	1,372	0.28%
Duct Sealing	0	6	1	Participants	0	587	98	0.11%
Attic/Ceiling Insulation	2	0	2	Participants	64	0	64	0.01%
Duct Insulation and Sealing	0	0	2	Participants	0	0	272	0.04%
Total					**525,342**	**415,149**	**229,012**	**100%**

5. Process Evaluation

We present both the implementation agency and participant perspectives on the Program in this section.

5.1 Agency perspective

We interviewed the director from HCD in December 2016. HCD subcontracts with multiple non-profit agencies that support HCD low income weatherization projects on behalf of Rocky Mountain Power. We spoke with the director to gain a deeper understanding of the Program's operations, how funds from multiple sources are used to service its customers, and any key areas of improvement that could be made to the Program. We present HCD's perspective on topics we addressed during the interview in Table 6 below.

Table 6. Agency Feedback

Topic	Feedback
Balance of Funding	- HCD leverages Rocky Mountain Power funds to supplement funding from government sources to increase the number of homes weatherized per year. The Utah weatherization agencies expend federal funds to install the measures. After services are provided, HCD receives reimbursement funds from Rocky Mountain Power, which are then reinvested in the Program and used to weatherize additional homes.
Waitlist Process	- The customer waitlist is maintained at the agency level for the service area the agency covers. A customer cannot be placed on the waitlist until their home is found to be eligible through an energy audit and proof of low-income status. - A customer's position on the waitlist is determined by a priority point system; households with the most points appear at the top of the waitlist. By federal statute, agencies provide preferential status (through an increase in points allocated) to households with elderly, disabled, young children (preschool age and younger), high energy users, and customers with a high energy burden. - Customers at the top of the waitlist are called first, and once services are received, the agency removes them from the list. - HCD indicated they observe a wait time of 12-14 months until an eligible and approved applicant receives services, which is consistent with survey findings in which over one-third of customers indicated a wait time of more than a year after submitting their application to receiving services. HCD noted there is no performance standard for timeliness; the agencies are not given a time goal but rather are given production goals at the beginning of the fiscal year. Production goals differ by home age and home size. As the HCD Director indicated: o *"When I…see an agency lagging behind the curve, I pick up the phone and talk to them, but there is no specific production timeline. It can vary by type of home we work on - everything from homes built the last 15 years to [a home] that was built in 1970s"* - HCD noted the production time varies by agencies. In the more rural agencies the average time from audit to final inspection runs about 45 days and in urban areas, it runs around 90+ days. - Production time tends to be longer for larger agencies in urban areas because municipalities in these locales tend to be more bureaucratic (i.e., requiring more permits for work). Larger agencies, by the nature of their design and

Topic	Feedback
	their business process, tend to queue their customers a little bit more, whereas smaller agencies can move more quickly because they face less oversight from municipalities.
Current Waitlist	- At the time of the interview, HCD had 470 approved and eligible applicants on their waitlist across the subcontracted agencies. Approximately 70% of which are Rocky Mountain Power customers.
Challenges and Barriers	- HCD's biggest challenge during the evaluation period was adjusting to changes in federal regulations affecting the implementation of low income weatherization programs. In 2014, the DOE quality work plan was implemented resulting in subsequent training and certification for many personnel. The changes included updating and reissuing field guides to align with standard work force specifications, a national certification exam for auditors and quality control inspectors, and an inspection of completed projects. As HCD stated: o *"I think the system moves pretty smooth all the way through. In the last two years, they have been slower getting the final inspections done because of the new standards. The quality control inspection process became an area of emphasis nationally and like many states we went out and trained these individuals and inspectors started cracking the whip to these new standards forcing a lot more callback so the crews were having to go back and fix things."* - HCD is aware of future DOE energy requirements and is getting ahead by beginning the certification process of DOE energy auditors. HCD noted their energy auditors are in the last round of testing and training, and are meeting the timeline to complete necessary certifications on time to avoid backlog of projects. - HCD noted they do not have a high deferral rate: o *"We have some but they are negligible at best. [In most cases] when we run into the issues causing a deferral, it really becomes a referral. We are the organization that facilitates connecting them with these other agencies that can help them out."*
Marketing and Outreach	- Throughout the weatherization process, HCD works with the households to identify real savings opportunities in their households. Energy education is customized to the household, and auditors identify customer education opportunities in multiple areas. When applicable, implementation staff provide pamphlets and publications from various organizations, such as Rocky Mountain Power newsletters related to energy savings, pamphlets from the EPA on mold and lead, and brochures on indoor air quality through ASHRAE. Auditors also provide guidance on how to navigate to the utility website to access additional energy education. - In addition to hands on energy education, HCD broadcasted four local news television segments. One segment covered lightbulbs and showed how incandescent bulbs use more energy and give off more heat than LEDs. Additional segments included education on thermal energy, insulation, and HVAC. - HCD plans to utilize technology more with YouTube and other technological marketing aspects in the future.

5.2 Participant perspective

The evaluation team attempted to reach a quota of 70 customers who participated in the Program in 2014 and 2015, prioritizing those participants who received refrigerators, furnaces, and high counts of CFLs. Of the 725 customers who participated in 2014-2015, we had valid phone numbers for 715. A total of 70 participants completed telephone interviews, yielding a response rate of 28%, a cooperation rate of 33%[9], and a relative precision of 9% (see Table 7).

Table 7. Utah Customer Telephone Survey

Population Frame	Unique Telephone Numbers	Final Survey Responses	Survey Response Rate	Survey Cooperation Rate	Precision
725	715	70	25%	62%	9%

The call center attempted to reach participants multiple times. Table 8 lists the survey disposition categories.

Table 8. Participant Survey Disposition

Survey Disposition	Sample
Complete	70
Answering machine	114
Disconnected phone	112
Not available callback	31
Initial refusal	28
Respondent scheduled a callback	13
Customer said wrong number	12
Mid-interview termination	5
Hard Refusal Do Not Call	5
Callback to complete	4
No answer	4
Privacy line/Number blocked	4
Language problems	4
Computer tone	3
Not available	2
Busy	1
Business/Residential phone	1

[9] Response rate is calculated using American Association for Public Opinion Research (AAPOR) Response Rate 3.

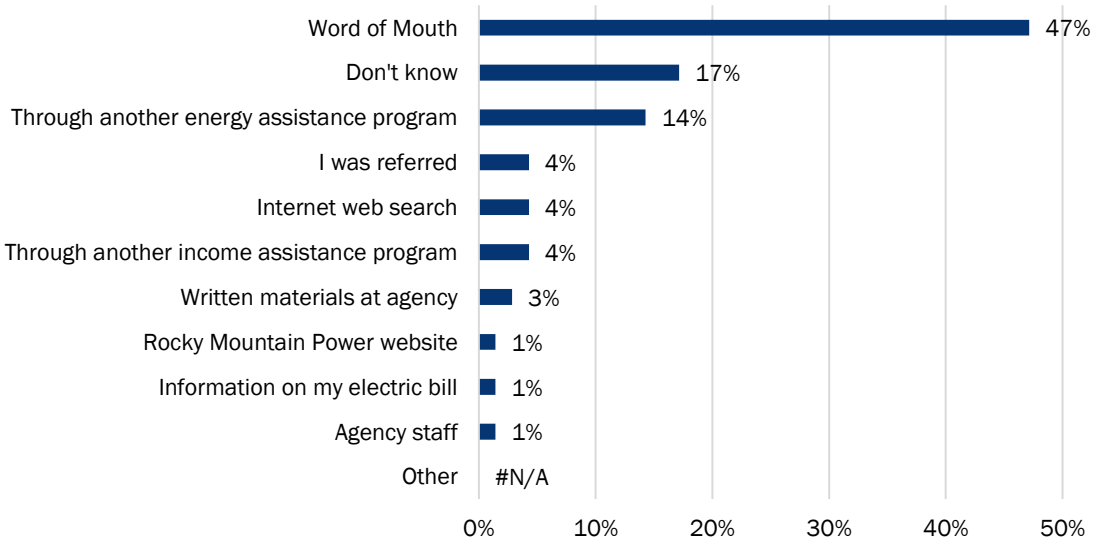
Survey Disposition	Sample
Non-specific callback/secretary	1
Cell Phone Refused b/c of cell phone	1
Cannot confirm participation in program	1

We used this survey to collect data about participant household characteristics and Program experience. Based on demographic data, approximately 89% of surveyed participants (n=62) reported residing in single family homes, and 10% reported living in mobile/manufactured homes (n=7). A total of 93% (n=35) own their homes with the remaining 7% renting their residences.

5.2.1 Program Awareness

Participants were asked how they heard about the Program. Figure 2 shows that close to half heard about the Program by word of mouth from family, friends, and neighbors (47%). This source of awareness continues as the predominant source for most customers since a similar proportion of participants noted friends, family, and neighbors were the main way they heard about the Program during the previous evaluation period.[10] About one-quarter of participants learned about the Program from through another energy assistance program.

Figure 2. How Participants Learned of the Program (n=70)

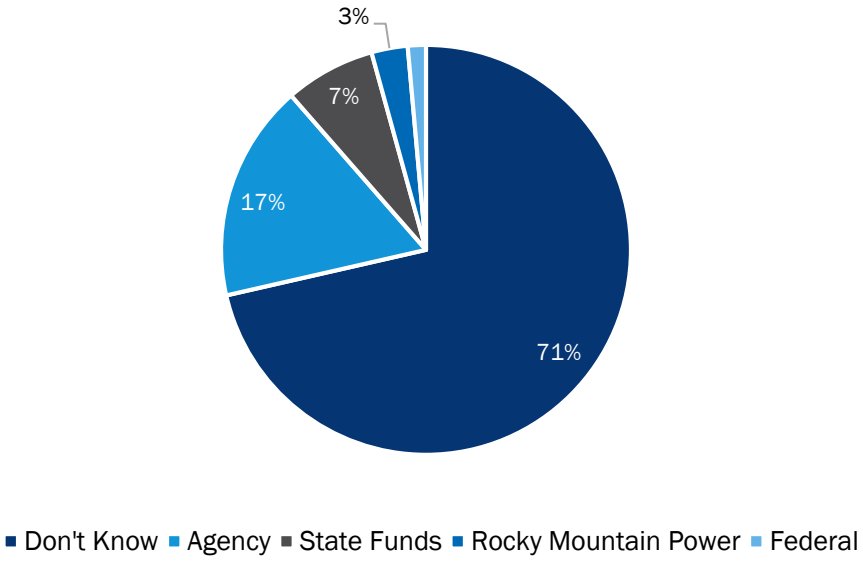


Historically, Rocky Mountain customers have had difficulty identifying Rocky Mountain Power as a funding source of the Program. Only 3% identified Rocky Mountain Power as a funding source for the services received. As Figure 3 shows, close to three-quarters of customers could not identify a funding source and those who could often associated the Program with the implementing agency and not Rocky Mountain Power. In 2015, Rocky Mountain Power started to send letters and magnets to participants to thank customers for participating

[10] Smith & Lehmann Consulting and H. Gil Peach & Associates, *Utah Low-Income Weatherization Program Evaluation Report for Program Years 2010-2012*, Prepared for Rocky Mountain Power Company. October 29, 2014, page 27.

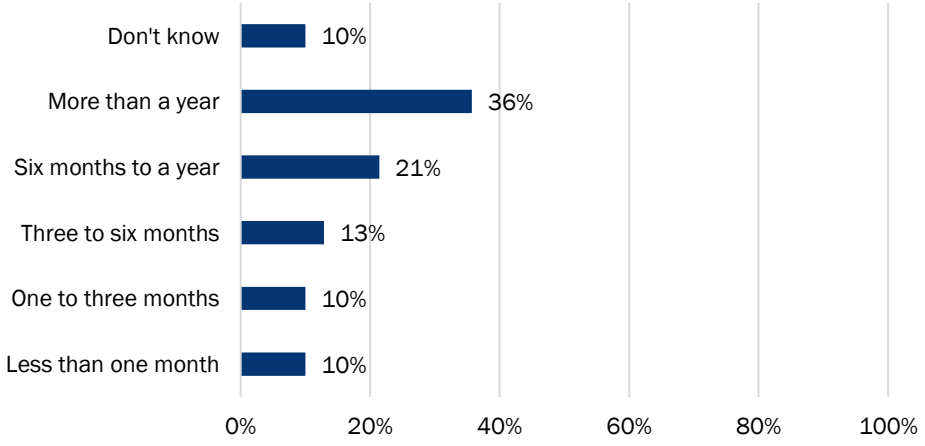
and to increase awareness of the utilities' role in the program. However, no change in recognizing the utility as a funding source could be seen in the survey responses from participants from 2014 versus 2015.

Figure 3. Participant Awareness of Program Funding Sources (n=70)



Over a third of surveyed participants (36%) reported waiting more than one year after submitting an application for weatherization services (see Figure 4). This finding supports the information shared by HCD since they have a significant customer wait list.

Figure 4. Time between Application Process to Receiving Weatherization Services (n=70)

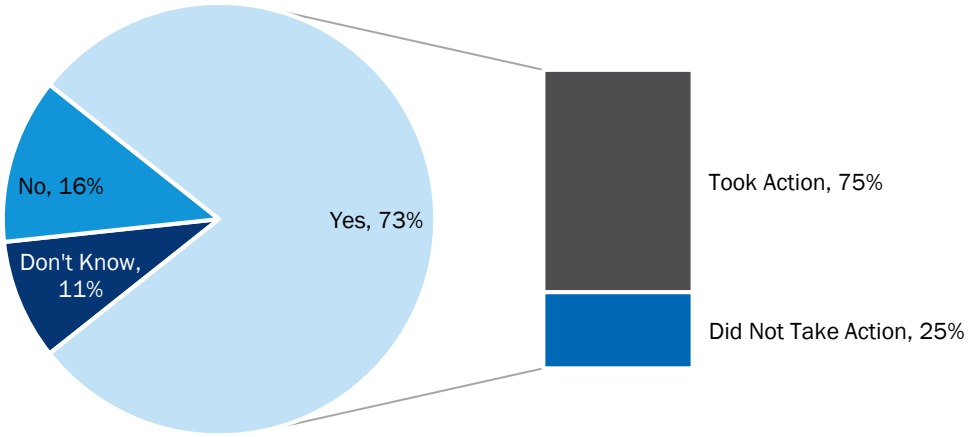


5.2.2 Energy Education

As stated in the agency interview with HCD, the Program offers customized customer energy education. Figure 5 shows nearly three in four survey respondents learned about ways to save energy from agency staff. Of those, 75%, (n=38 of 51) reported taking some recommended energy saving actions. Of the participants who

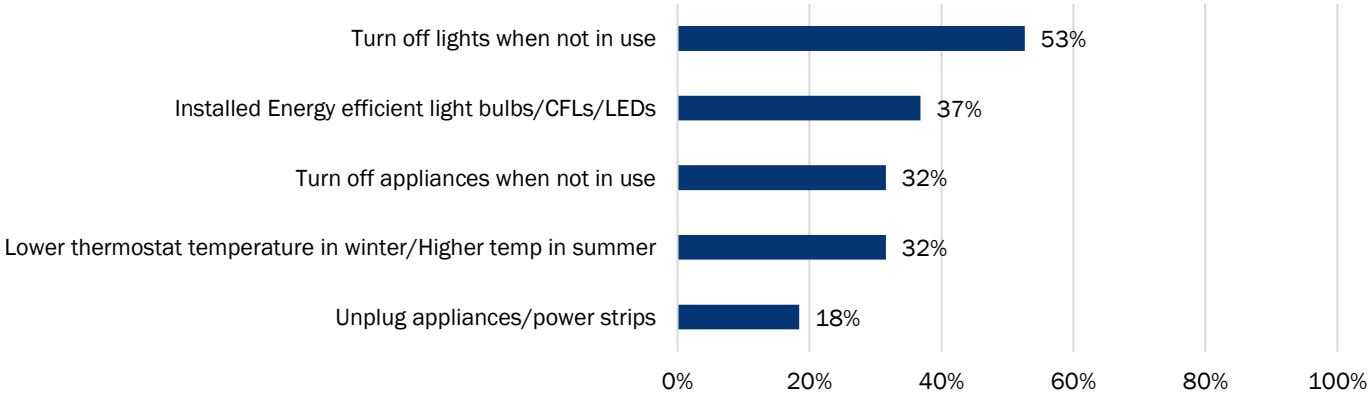
had not acted on recommendations received, a majority (7 of 13) stated that they intended to in the future. The opportunity to present energy saving recommendations during audits or measure installations has had a positive impact on customers and likely has led to behavioral changes that enhance the energy savings coming from the Program.

Figure 5. Weatherization Staff Provided information on Ways to Save Energy in the Home (n=70)



There were 38 participants who reported taking energy saving actions following the information received when they received weatherization services. Figure 6 lists the top five energy actions taken by participants. The two most common actions relate to lighting.

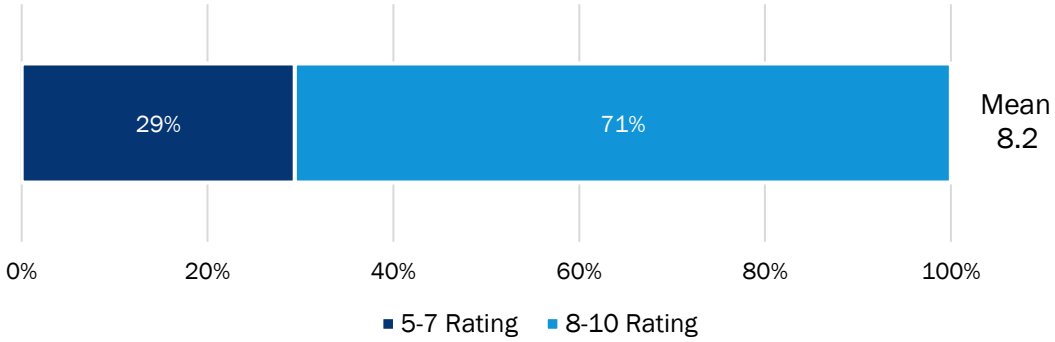
Figure 6. Top Five Energy Actions Taken (n=38)



Note: Percentages do not sum to 100% and contain multiple responses

Participants provided positive feedback on the energy education received informally during agency audits or equipment installations, as 71% participants indicated the education they received was “extremely helpful” (Figure 7) and no respondents rated the training below a five.

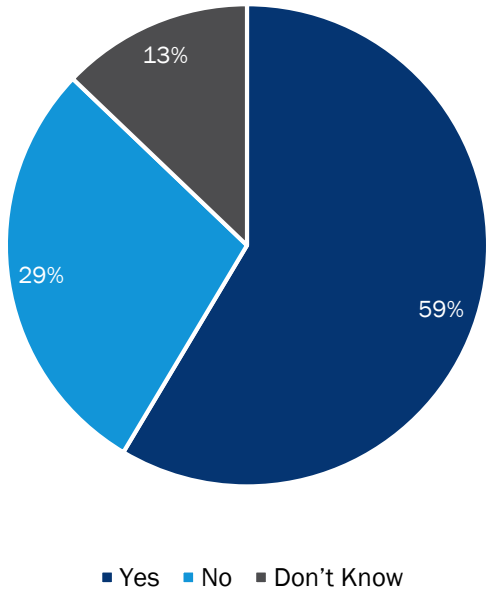
Figure 7. Helpfulness of Energy Education (n=51)



Scale from 0 to 10 where 0 is "Not at All Helpful" and 10 is "Extremely Helpful"

In addition to ways to save energy in the house, 59% of participants indicated the weatherization staff discussed ways to improve health and safety in the home (Figure 8). These results show the additional efforts made by the agencies to improve home conditions as they implement the Program to Rocky Mountain Power customers.

Figure 8. Staff Discussed Ways to Improve Health and Safety in the Home (n=70)



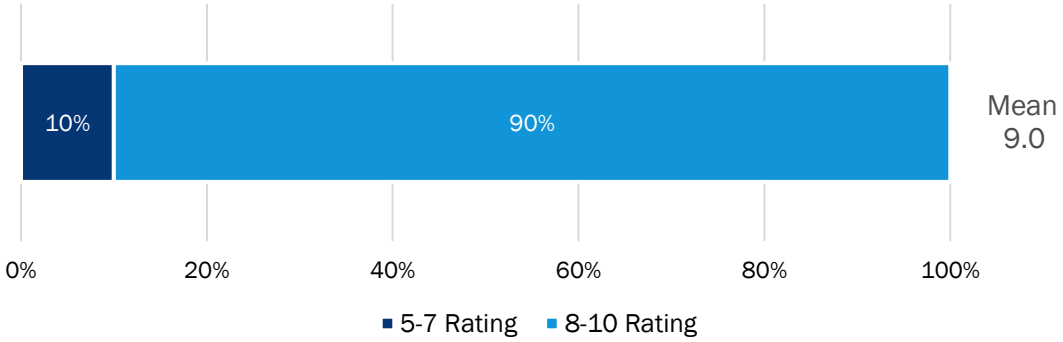
5.2.3 Program Delivery and Satisfaction

Participant feedback was extremely positive as 90% participants were "completely satisfied" with the Program (Figure 9). There were seven participants not completely satisfied with the Program (score of 7 or lower) and

the reasons most cited were related to measures not working correctly and agency staff not making a return visit to fix items they felt were not installed properly. We list the verbatim responses as to why these customers were not completely satisfied in

Table 9.

Figure 9. Program Satisfaction (n=70)



Scale from 0 to 10 where 0 is "Completely Dissatisfied" and 10 is "Completely Satisfied"

Table 9. Program Dissatisfaction Comments from Surveyed Participants

Verbatim Reponses of participants who were not completely satisfied (Program satisfaction less than or equal to 7)
[The agency staff] said they are going to come back to do a confirmation to check if [I had] saved energy and do a before and after analysis.
The furnace wasn't working and not installed right.
[The agency staff] didn't come out and fix what they were asked to.
[The agency staff] has to come back and fix some stuff.
[I was not completely satisfied] due to time factor that it took. It was almost 2 years [to receive services].
We had a few things that happened after that they should have fixed but never did.
I did not notice a huge difference in [my energy] bill.

Of the respondents who were not completely satisfied with the Program, half stated they saw no change in their electric bill. Regardless, all surveyed customers said they would recommend the Program to others.

Reflecting high program satisfaction, just above half of respondents (51%, n=36) had no suggestions for improving the Program. Amongst those who did provide suggestions (n=34), participants most often requested a shorter wait time to receive services (n=10). As previously stated, 36% of respondents waited more than a year to receive services after applying. Respondents also noted the program would benefit from further marketing and awareness outreach (n=4). Table 10 includes some verbatim suggestions from survey respondents.

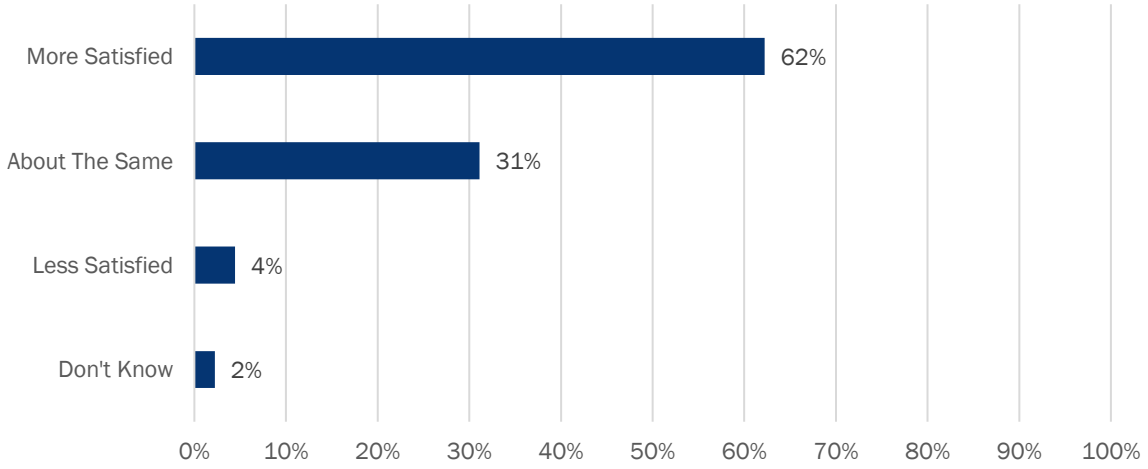
Table 10. Recommendations to Improve the Program

Participant Recommendations for Program Improvements	
Time to Receive services	Be quicker in getting the services done.
	If the wait was shorter that would be better.
	Shorter wait time, and people doing the work being held more accountable, no new people, people that know what they are doing.
	The timeline to come to home from time of approval of application especially if have small children.
	Took way too long to get services.
	Please be quicker in getting the services done.
Marketing	Advertise the program more.
	[The program could be improved if there was] more advertisement and accessibility.
	The program could be improved by better marketing to inform households in need. Make [the program] more known so it is more available for people in need.
Complete a Follow-up	Complete the follow up on the final check of home.
	A lot of the stuff wasn't finished, trim work and painting wasn't complete, and patches were made.
	Make sure everything is complete. [The agency] replaced a door and I am still get lighting and a draft through the door.

Half of participants were pleased with the application process, with 51% stating the process was "extremely easy". Participants who reported difficulty with the application (i.e., those who rated it between a 0 and 4 where 0 means "extremely difficult") noted that they were required to complete a lot pf paperwork and that they experienced long wait times to receive services. Further, all participants were very pleased with the weatherization staff with virtually all (99%) stating "Yes" when asked if the agency staff was courteous and respectful towards them and their family members.

Of the 61 customers who were flagged as receiving CFL bulbs through the program, 45 participants recalled receiving them through the Program and verified that agency staff installed at least one bulb. Of those 45 participants, 62% (n=28 out of 45) reported higher levels of satisfaction with the CFLs than their previous lighting, as Figure 10 shows. The two customers not satisfied with the new lighting both reported the bulbs burnt out. We inquired as to whether the CFLs remained installed in the homes and found that in about half the cases, participants removed at least some of the bulbs installed through the Program. Given this feedback, we fully support Rocky Mountain's decision to add LEDs to its list of measures as it should help reduce bulb removals.

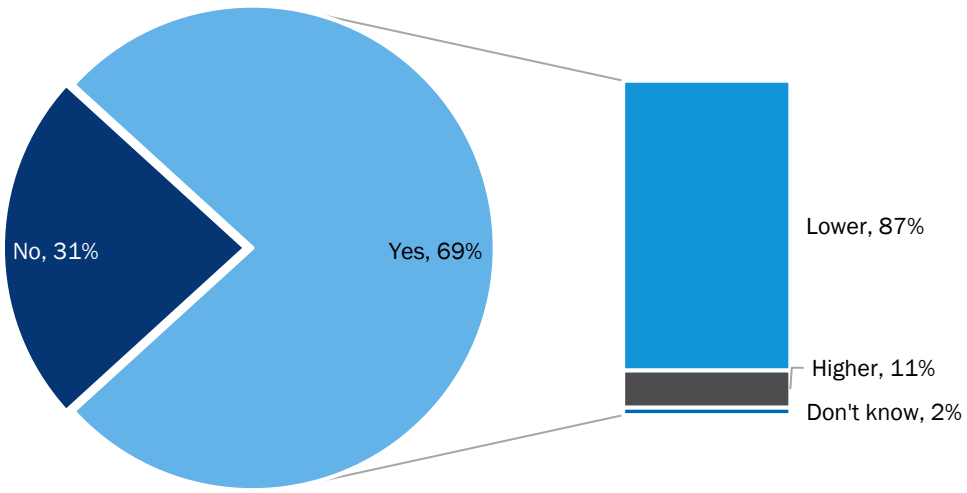
Figure 10. Satisfaction with CFLs Over Previous Bulbs in the Home (n=45)



5.2.4 Non-Energy Benefits

Participants were also asked if they noticed a change in their electric bill after receiving weatherization services and nearly two thirds did. Of this set of participants, 87% said their bills were lower and just 11% said their bills rose (see Figure 11).

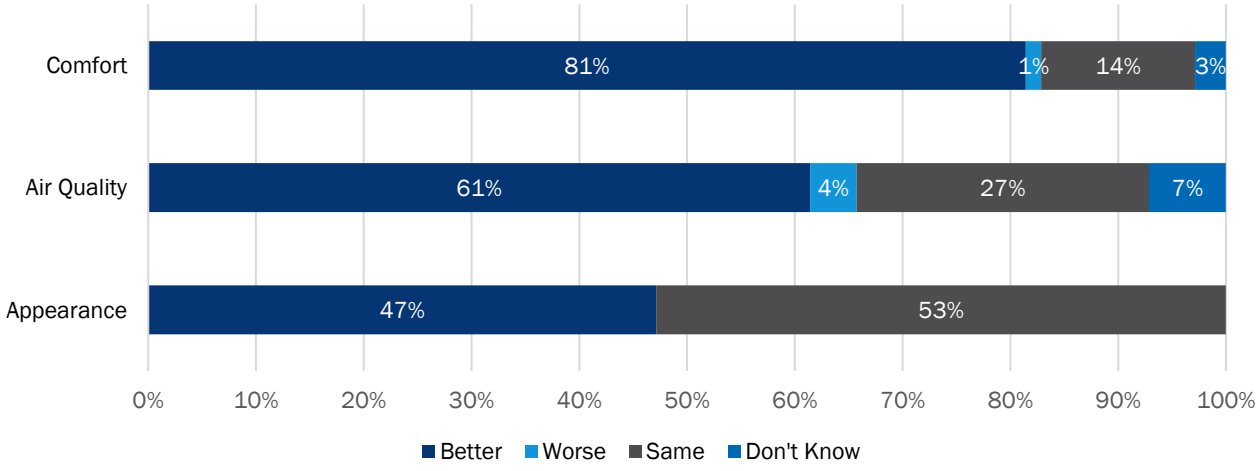
Figure 11. Change Noticed in Electric Bill (n=70)



We also explored non-energy impacts experience by Program clients. In the telephone survey, we asked participants if the air quality, appearance, and comfort improved, stayed the same, or worsened after they received services. As Figure 12 shows, 81% of participants reported an improvement in home comfort. Air

quality and appearance of the home were better for 61% and 47% of participants, respectively. This provides further evidence of the positive impact of the Program beyond energy saving benefits.

Figure 12. Impact of Measures on Home Characteristics (n=70)



6. Cost Effectiveness

This section presents the cost-effectiveness findings for Navigant's analysis of the Utah Low Income Weatherization Program for program years 2013-2015. Navigant completed cost-effectiveness tests of the Program using various approaches: PacifiCorp Total Resource Cost (PTRC) test, Total Resource Cost (TRC) test, Utility Cost Test (UCT), Ratepayer Impact Measure (RIM) test, and the Participant Cost Test (PCT). Each scenario is analyzed using modeled assumptions provided by PacifiCorp. Note that program cost-effectiveness is determined by the UCT test.

All scenarios utilize the following assumptions:

- ***Avoided Costs:*** Navigant performed a custom analysis of calculating avoided costs by using the Residential Whole House decrement cost and the Residential Cooling load shape for program years 2013-2014 and the Residential Lighting decrement cost and the Residential Lighting load shape for program year 2015. The decrements values were populated using the 2013 PacifiCorp Integrated Resource Plan (IRP) for program years 2013-2014 and the 2015 PacifiCorp IRP for program year 2015.
- ***Modeling Inputs:*** Navigant utilized program level savings provided by Opinion Dynamics and administration costs provided by PacifiCorp in the file *UT LIW Evaluation Cost Effectiveness Inputs.xlsx*.
- ***Benefit/Cost Tests:*** PacifiCorp Total Resource Cost Test (PTRC), Total Resource Cost Test (TRC), Utility Cost Test (UCT), Rate Impact Test (RIM), and Participant Cost Test (PCT).

The cost-effectiveness inputs are as follows:

Table 11. Low Income Weatherization Program Inputs

Parameter	2013	2014	2015
Discount Rate	6.88%	6.88%	6.66%
Residential Line Loss	9.32%	9.32%	9.32%
Residential Energy Rate ($/kWh) [1]	$0.1056	$0.1084	$0.1105
Inflation Rate	1.90%	1.90%	1.90%

[1] Future rates determined using a 1.9% annual escalator

Table 12. Low Income Weatherization Program Annual Program Costs

Program Year	Utility Admin	Admin Program Delivery	Eval, Marketing, Prog Devel.	Incentives	Total Utility Costs	Gross Customer Costs
2013	$20,571	$7,499	$2,808	$98,219	$129,097	$0
2014	$21,310	$4,177	$83,704	$53,668	$162,859	$0
2015	$15,713	$2,382	$15,818	$26,143	$60,056	$0
2013-2015	$57,594	$14,057	$102,330	$178,030	$352,011	$0

Table 13. Low Income Weatherization Program Annual Program Savings

Program Year	Gross kWh Savings	Realization Rate	Adjusted Gross kWh Savings	Net to Gross Ratio	Net kWh Savings	Measure Life
2013	475,374	111%	525,342	100%	525,342	11
2014	383,040	108%	415,149	100%	415,149	11
2015	225,327	102%	229,012	100%	229,012	11
2013-2015	1,083,741	108%	1,169,503	100%	1,169,503	11

The benefit/cost ratios for each of the cost-effectiveness tests are presented in Table 14.

Table 14. Benefit/Cost Ratios - Low Income Weatherization

Program Year	PTRC	TRC	UCT	RIM	PCT
2013	3.97	3.61	3.61	0.74	n/a
2014	2.59	2.35	2.35	0.67	n/a
2015	2.23	2.02	2.02	0.42	n/a
2013-2015	3.03	2.76	2.76	0.65	n/a

Table 15 provides the cost-effectiveness results for the combination of program years 2013 through 2015.

Table 15. LIW Program Level Cost-Effectiveness Results – PY2013-2015

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.0361	$352,011	$1,067,291	$715,280	3.03
Total Resource Cost Test (TRC) No Adder	$0.0361	$352,011	$970,265	$618,253	2.76
Utility Cost Test (UCT)	$0.0361	$352,011	$970,265	$618,253	2.76
Rate Impact Test (RIM)		$1,485,904	$970,265	($515,640)	0.65
Participant Cost Test (PCT)		$0	$1,311,923	$1,311,923	n/a
Lifecycle Revenue Impacts ($/kWh)					$ 0.0000019620
Discounted Participant Payback (years)					n/a

Table 16, Table 17, and Table 18 provide the cost-effectiveness results for each individual program year.

Table 16. LIW Program Level Cost-Effectiveness Results – PY2013

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.0296	$129,097	$512,158	$383,061	3.97
Total Resource Cost Test (TRC) No Adder	$0.0296	$129,097	$465,598	$336,502	3.61
Utility Cost Test (UCT)	$0.0296	$129,097	$465,598	$336,502	3.61
Rate Impact Test (RIM)		$629,192	$465,598	($163,593)	0.74
Participant Cost Test (PCT)		$0	$598,314	$598,314	n/a
Lifecycle Revenue Impacts ($/kWh)					$ 0.0000006333
Discounted Participant Payback (years)					n/a

Table 17. LIW Program Level Cost-Effectiveness Results – PY2014

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.0472	$162,859	$421,451	$258,592	2.59
Total Resource Cost Test (TRC) No Adder	$0.0472	$162,859	$383,138	$220,279	2.35
Utility Cost Test (UCT)	$0.0472	$162,859	$383,138	$220,279	2.35
Rate Impact Test (RIM)		$568,535	$383,138	($185,398)	0.67
Participant Cost Test (PCT)		$0	$459,344	$459,344	n/a
Lifecycle Revenue Impacts ($/kWh)					$ 0.0000007020
Discounted Participant Payback (years)					n/a

Table 18. LIW Program Level Cost-Effectiveness Results – PY2015

Cost-Effectiveness Test	Levelized $/kWh	Costs	Benefits	Net Benefits	Benefit/Cost Ratio
Total Resource Cost Test (PTRC) + Conservation Adder	$0.0312	$60,056	$133,682	$73,626	2.23
Total Resource Cost Test (TRC) No Adder	$0.0312	$60,056	$121,529	$61,473	2.02
Utility Cost Test (UCT)	$0.0312	$60,056	$121,529	$61,473	2.02
Rate Impact Test (RIM)		$288,178	$121,529	($166,649)	0.42
Participant Cost Test (PCT)		$0	$254,265	$254,265	n/a
Lifecycle Revenue Impacts ($/kWh)					$ 0.0000006170
Discounted Participant Payback (years)					n/a

7. Conclusions and Recommendations

Rocky Mountain Power is adhering to best practices by delivering the Program through the Utah Department of Workforce Services, Housing and Community Development Division (HCD).[11] HCD has spent many years serving as a Program implementer on behalf of Rocky Mountain Power by subcontracting with multiple non-profit agencies in Utah to provide weatherization services to qualified. It is regular practice for utilities to work with one or more community action agencies to bring their energy efficiency programs to low income households since these organizations generally have well-established relationships with them already. Additionally, HCD is knowledgeable about using funding from utilities in combination with government funding to expand the reach of programs. The implementing agency demonstrates its understanding of Program processes, requirements and funding mechanisms. Leveraging these types of agencies is a best practice in low income weatherization programs. **Rocky Mountain Power should continue to use the same Program implementer moving forward.**

Participants continue to be highly satisfied with the Program. Nine of every ten participants reported "complete satisfaction" with the Program and virtually all participants agreed that weatherization staff were courteous and respectful towards their homes. In most cases, Program implementers provide customized customer energy conservation recommendations that allows customers to go beyond measure savings with behavior savings as well. Three out of every four surveyed participants recall this education and of those, 75% took recommended actions. The most common actions taken include turning off lights when not in use and installing energy efficient light bulbs. On a scale from 0 to 10 where 0 means "not at all helpful" and 10 means "extremely helpful", all surveyed participants rated the helpfulness of the energy education at a 5 or higher, with an average rating equal to 8.2. The one-on-one interactions that occur through the Program provide a fortuitous opportunity to provide customers with useful behavioral related tips to become more energy efficient. **Though not a formal part of the Program, this education may lead customers to save energy beyond the savings from the installed weatherization measures and should continue.**

While satisfaction with the program is high, just under half the surveyed customers provided feedback about ways the Program could better serve its customers. One area of improvement mentioned by some surveyed participants included incomplete weatherization services. One participant recommended that the program makes sure that staff complete the follow up visit to perform a final check of the home services provided, as he did not receive one. Another noted that the Program would benefit if weatherization staff made sure everything was completed. **Given this feedback, we recommend a re-examination of the existing quality assurance procedures associated with the Program. Rocky Mountain Power could provide customers with a 1-800 contact number to call if they find issues with the weatherization services received or if they have concerns about the quality of work completed.**

While Rocky Mountain Power relies on several agencies that subcontract through HCD to provide weatherization services, the backlog of customers on its waitlist tends to be long. Servicing these customers is a challenge because of shortages of staff who provide weatherization services. Wait times for services reported by HCD were 12-24 months, which is supported by feedback provided in during the participant telephone survey. At the time of the agency interview, HCD had 470 approved and eligible customers on its waitlist, of which 70% were Rocky Mountain Power customers. Some customers wait for several years to receive services because households with children, disabled, or elderly residents are prioritized. As a result,

[11] Two sub-grantee agencies are contracted with Rocky Mountain Power to deliver weatherization services on its behalf (CCS and WWS), but CCS completed no low income weatherization projects for the utility.

other households get pushed down on the waiting list as new customers who are prioritized send in applications for services. The HCD representative we interviewed noted that there is no performance standard for timeliness. The agencies are not given a time goal but rather are given production goals at the beginning of the fiscal year. **Based on the agency's feedback and the reported wait times for certain customers to receive services, Rocky Mountain Power should consider developing goals related to shortening wait times for customers to receive services. For example, Rocky Mountain Power could establish a goal to service a certain percentage of its customers within a year.**

Rocky Mountain Power has tried to increase awareness about its funding of the program, given that the utility provides at least 50% of the costs of measures installed in participants' homes. However, based on feedback from surveyed customers, 3% identified Rocky Mountain Power as a funding source and close to three-fourth of participants reported that they did not know the source of the funding. In 2015, Rocky Mountain Power started to send letters and magnets to participants to thank customers for participating and to increase awareness of the utilities' role in the program. However, no difference in recognition of Rocky Mountain Power as a source funding was detected between 2014 and 2015 program participants. The effect of these outreach efforts may be seen in the next evaluation period. **If it is a priority for Rocky Mountain Power to make sure they are recognized for their sponsorship of the Program, Rocky Mountain Power might also consider branding the agency staff who conduct the audits and installation services by wearing shirts that note the Program's affiliation with Rocky Mountain Power.**

We conducted a deemed savings review to estimate the energy savings from the Program. The results show that the average annual net energy savings per participant for the 2013-2015 program years is 922 kWh. Overall, the Program achieved 108% of its ex-ante gross savings for the evaluation period. We did not have insight into all ex-ante savings assumptions and therefore cannot identify the exact reasons behind the ex-ante and ex-post differences. **We do believe that the ex-post values used in the impact analysis better improve upon the ex-ante values and therefore recommend using the unit energy savings (UES) values for individual measures for this program based on the deemed values provided in Appendix A.**

The ex-post impact evaluation relied on many high-level engineering assumptions to estimate impacts because participant- or program-specific data was not available. For example, information on results of refrigerator testing; capacity of equipment serviced by furnace fan, programmable thermostat, and insulation measures; square footages of insulation installed per home; R-values of pre- and post-insulation; and type of heating and cooling equipment in participant homes was not available so we relied on state-wide averages and other sources to make estimates for these and other parameters. We understand that this is a relatively small program with a desire to minimize burden on agencies in collecting these data, but collecting and providing this type of information for the measures that contribute the most to the overall program savings can greatly improve the accuracy of ex-post savings estimates. **We recommend collecting and providing these data to the evaluator moving forward to improve the accuracy of ex-post savings estimates.**

Appendix A.

A.1. Compact Fluorescent Lamps

Table 19 documents the inputs and methodology for estimating CFL savings.

Table 19. Algorithms and Inputs for CFLs

Algorithms Used		
kWh Savings	= (Baseline Watts – CFL Watts)/1,000*Hours*WHFe*ISR	
Source of Algorithm: Standard lighting savings equation.		
Parameter	**Value**	**Source/Notes**
Baseline Watts (14W CFL)	43	Halogen baseline based on ENERGY STAR website[12]
Baseline Watts (23W CFL)	72	Halogen baseline based on ENERGY STAR website[1]
CFL Watts (14W CFL)	14	Assumed wattage of CFLs.
CFL Watts (23W CFL)	23	Assumed wattage of CFLs.
Hours of use/year	913	Assume 2.5 hours per day (365 days/year). The program requires at least 2 hours per day and most residential lighting studies find operating hours in this range.
WHFe	1.06	From IL TRMv6.
ISR	0.76	Utah participant survey.

Table 20 provides the deemed savings CFLs, based on the assumptions from Table 19.

Table 20. CFL Deemed Savings

Metric	14W	23W	Gross kWh (weighted)
kWh per CFL	21.4	36.2	25.1

A.2 Refrigerator Replacement

Table 21 documents the inputs and methodology for estimating refrigerator replacement savings.

Table 21. Algorithms and Inputs for ENERGY STAR Refrigerators

Algorithms Used	
kWh	= (Baseline Energy – ENERGY STAR Energy)*ISR
Source of Algorithm: Current Federal standards for refrigerators and current ENERGY STAR requirements[13].	

[12] http://www.energystar.gov/ia/products/lighting/cfls/downloads/EISA_Backgrounder_FINAL_4-11_EPA.pdf

[13] The current Federal refrigerator standards are based on 76 FR 57516 (September 15, 2011). The current ENERGY STAR requirements for refrigerators were effective as of September 15, 2014.

Parameter	Value	Source/Notes
Baseline Energy Consumption (kWh/year)	1,654	Average participant level test result metered data provided by similar program for another customer (n=87).
ENERGY STAR Energy Consumption	425 (15 ft³) **448 (18 ft³)** 472 (21 ft³)	ENERGY STAR Standards requiring 10% reduction in current federal standard.[14]
ISR	100%	In-service rate from 2015 participant survey.

Table 22 provides the deemed savings for refrigerators, using the assumptions from Table 21.

Table 22. Refrigerator Deemed Savings

Metric	15 ft³	18 ft³	21 ft³
kWh per refrigerator	1,229	**1,206**	1,182

A.3 Furnace Fan

Table 23 documents the inputs and methodology for estimating furnace fan savings.

Table 23. Algorithms and Inputs for Furnace Fans

Algorithms Used		
kWh Savings	= Heating Savings + Cooling Savings + Shoulder Season Savings	
Source of Algorithm: common to most TRMs. Used IL TRM and adjusted based on available information.		
Parameter	**Value**	**Source/Notes**
Heating Savings	418	IL TRM v6.0 vol 3 (5.3.5)
%AC	36%	From Utah Participant Survey (25 participants with central AC out of 70 total)
Cooling Savings with CAC	263	IL TRM v6.0 vol 3 (5.3.5)
Cooling Savings without CAC	175	IL TRM v6.0 vol 3 (5.3.5)
Total Cooling Savings	206	Calculated
Shoulder Season Savings	51	IL TRM v6.0 vol 3 (5.3.5)

Table 24 provides the deemed savings for furnace fans, based on the assumptions from Table 23.

Table 24. Furnace Fans Deemed Savings

Metric	Deemed Savings
kWh per Home	675

A.4 Programmable Thermostats

Table 25 documents the inputs and methodology for estimating programmable thermostat savings.

[14] https://www.energystar.gov/products/appliances/refrigerators/key_product_criteria

Table 25. Algorithms and Inputs for Programmable Thermostats

Algorithms Used		
Cooling kWh Savings	= (1/SEER) * FLHcool * BtuHcool / 1000 * ESF cool*%AC	
Heating kWh Savings	= FLHheat * BtuHheat / ηHeat / 3412 * ESFheat*%electric heat	
Source of Algorithm: Indiana TRMv2.2		
Parameter	**Value**	**Source/Notes**
SEER	13	Assume 13 SEER based on several TRMs. Assume equipment installed after 2006.
FLHcool	785	EPA Calculator. Assume average between cities in Utah.
BTUHcool	34,800	Capacity not available for Utah customers. Assume average capacity based on installed capacity through a similar program for a confidential utility (n=992).
ESFcool	9.00%	Indiana TRMv2.2.
%AC	35.7%	From Utah Participant Survey (25 participants with central AC out of 70 total)
FLHheat	2,443	EPA Calculator. Assume average between cities in Utah.
nHeat	1.28	Weighted average based on RECS 2015 data.
%heat pump	22%	From RECS 2015 data for Utah (Mountain North). Value is too small to register in data. Assume non-resistance heaters are heat pump to be conservative.
nHeat	1.28	Weighted average based on RECS 2015 data.
% resistance	78%	From RECS 2015 data for Utah (Mountain North).
Btuhheat	52,080	Assume 35 Btu/sf based on an average of 50 Btu/sf required from climate zone data[15] and 20 Btu/sf based on a US Department of Energy study[16]. For average square footage, assume 1,488 sf. This comes from RECS 2009 data for Utah and is the average of heated and cooled space.
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.00	Mid-Atlantic TRM.
ESFheat	6.80%	Indiana TRMv2.2.
% Electric heat	4.3%	From Utah low income survey by Opinion Dynamics (3 participants with electric heating out of the 70 total)
Cooling kWh	68	Calculated
Heating kWh	85	Calculated

Table 26 provides the deemed savings for programmable thermostats, using the assumptions from Table 25.

[15] https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/

[16] http://www.nrel.gov/docs/fy12osti/52991.pdf

Table 26. Programmable Thermostat Deemed Savings

Metric	kWh Savings
Total kWh	152

A.5 Duct Sealing

Table 27 documents the inputs and methodology for estimating duct sealing savings.

Table 27. Algorithms and Inputs for Duct Sealing

Algorithms Used		
kWh (cooling)	= (DEafter – DEbefore)/(DEafter)*FLHcool*Btuhcool/SEER/1000*%AC*ISR	
kWh (heating)	= (DEafter – DEbefore)/(DEafter)*FLHheat*Btuhheat/nheat/3412*ISR*%electric heat	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 54.		
Parameter	**Value**	**Source/Notes**
Deafter	85%	From duct distribution efficiency table. Assume average of all conditioned space possibilities for ducts sealed with mastic and no observable leaks.
Debefore	81%	From duct distribution efficiency table. Assume average of all conditioned space possibilities for all non-sealed duct possibilities., except for the most extreme possibilities as they skew savings too high.
FLHcool	785	EPA Calculator. Assume average between cities in Utah.
Btuhcool	34,800	Capacity not available for Utah customers. Assume average capacity based on installed capacity through a similar program for a confidential utility (n=992).
SEER	13	Assume 13 SEER based on several TRMs. Assume equipment installed after 2006.
%AC	35.7%	From Utah Participant Survey (25 participants with central AC out of 70 total)
FLHheat	2,443	EPA Calculator. Assume average between cities in Utah.
Btuhheat	52,080	Assume 35 btu/sf based on an average of 50 Btu/sf required from climate zone data[17] and 20 Btu/sf based on a US Department of Energy study[18]. For average square footage, assume 1,488 sf. This comes from RECS 2009 data for Utah and is the average of heated and cooled space.
Nheat	1.28	Weighted average based on RECS 2015 data.
%heat pump	22%	From RECS 2015 data for Utah (Mountain North). Value is too small to register in data. Assume non-resistance heaters are heat pump to be conservative.
% resistance	78%	From RECS 2015 data for Utah (Mountain North).
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.00	Mid-Atlantic TRM.
EER	11.18	Conversion from SEER.

[17] https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/

[18] http://www.nrel.gov/docs/fy12osti/52991.pdf

% Electric heat	4.3%	From Utah low income survey by Opinion Dynamics (3 participants with electric heating out of the 70 total)
ISR	100%	

Table 28 provides the duct sealing deemed savings based on the assumption presented in Table 27.

Table 28. Duct Sealing Deemed Savings

Metric	Deemed Savings
kWh per system	98

A.6 Duct Insulation

Table 29 documents the inputs and methodology for estimating duct insulation savings.

Table 29. Algorithms and Inputs for Duct Insulation

Algorithms Used		
kWh (cooling)	= (DEafter – DEbefore)/(DEafter)*FLHcool*Btuhcool/SEER/1000*%AC*ISR	
kWh (heating)	= (DEafter – DEbefore)/(DEafter)*FLHheat*Btuhheat/nheat/3412*ISR	
Source of Algorithm: Indiana TRM. July 2015. Version 2.2. Page 54.		
Parameter	**Value**	**Source/Notes**
DEafter	79%	From duct distribution efficiency table. Assume average of all distribution efficiencies > R-4[19]
DEbefore	77%	From duct distribution efficiency table. Assume average of all distribution efficiencies < R-42
FLHcool	785	EPA Calculator. Assume average between cities in Utah.
Btuhcool	34,800	Capacity not available for Utah customers. Assume average capacity based on installed capacity through a similar program for a confidential utility (n=992).
SEER	13	Assume 13 SEER based on several TRMs. Assume equipment installed after 2006.
%AC	35.7%	From Utah Participant Survey (25 participants with central AC out of 70 total)
FLHheat	2,443	EPA Calculator. Assume average between cities in Utah.
Btuhheat	52,080	Assume 35 btu/sf based on an average of 50 Btu/sf required from climate zone data[20] and 20 Btu/sf based on a US Department of Energy study[21]. For average square footage, assume 1,488 sf. This comes from RECS 2009 data for Utah and is the average of heated and cooled space.
Nheat	1.28	Weighted average based on RECS 2015 data.

[19] http://www.bpi.org/files/pdf/DistributionEfficiencyTable-BlueSheet.pdf

[20] https://energy.ces.ncsu.edu/hvac-heating-and-cooling-systems/

[21] http://www.nrel.gov/docs/fy12osti/52991.pdf

%heat pump	22%	From RECS 2015 data for Utah (Mountain North). Value is too small to register in data. Assume non-resistance heaters are heat pump to be conservative.
% resistance	78%	From RECS 2015 data for Utah (Mountain North).
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1.00	Mid-Atlantic TRM.
EER	11.18	Conversion from SEER.
% Electric heat	4.3%	From Utah low income survey by Opinion Dynamics (3 participants with electric heating out of the 70 total)
ISR	100%	

Table 30 provides the deemed savings for duct insulation using the assumptions from Table 29. We provide the deemed savings per system.

Table 30. Duct Insulation Deemed Savings

Metric	Deemed Savings per Participant
kWh per system	38

A.7 Insulation

Table 31 documents the inputs and methodology for estimating insulation savings.

Table 31. Algorithms and Inputs for Insulation

Algorithms Used		
kWh (cooling)	= CDD*24*DUA/SEER/1,000*(1/Rexisting – 1/Rnew)*ADJcool*ISR*Area	
kWh heating (heat pump)	= HDD*24/1,000/HSPF*(1/Rexisting – 1/Rnew)*ADJheat*ISR*%electric heat*Area	
kWh heating (electric resistance)	= HDD*24/3,412 *(1/Rexisting – 1/Rnew)*ADJheat*ISR*%electric heat*Area	
Source of Algorithm: Pennsylvania TRM. PA PUC. June 2016 with adjustments based on IL TRM V5. Vol 3. Page 293.		
Parameter	**Value**	**Source/Notes**
CDD	1,244	ASHRAE Fundamentals 2017 for Utah.
HDD	5,517	
DUA	0.75	Discretionary Use Adjustment for cooling. Common to most TRMs. Accounts for fact that all cooling systems will not operate 100% of time requiring cooling.
SEER	13	Assume 13 SEER based on several TRMs. Assume equipment installed after 2006.
HSPF	7.75	Per the IL TRM, the average SEER/HSPF ratio for AHRI directory data is 0.596. Applied this ratio to the assumed SEER value.
%AC	35.7%	From Utah Participant Survey (25 participants with central AC out of 70 total)
% Electric heat	4.3%	From Utah low income survey by Opinion Dynamics (3 participants with electric heating out of the 70 total)
%heat pump	22%	From RECS 2015 data for Utah (Mountain North).
% resistance	78%	From RECS 2015 data for Utah (Mountain North).
COP heat pump	2.26	Mid-Atlantic TRM.
COP electric resistance	1	Mid-Atlantic TRM.
ADJcool	80%	IL TRM. Adjustment for cooling savings from insulation to account for engineering algorithms over claiming savings. As demonstrated in two years of metering evaluation by Opinion Dynamics for homes in Illinois. From Memo: "Results for AIC PY6 HPwES Billing Analysis", dated February 20, 2015.
ADJheat	60%	IL TRM. Adjustment for cooling savings from insulation to account for engineering algorithms over claiming savings. As demonstrated in two years of metering evaluation by Opinion Dynamics for homes in Illinois. From Memo: "Results for AIC PY6 HPwES Billing Analysis", dated February 20, 2015.
ISR	100%	
Area (SF)	797	Area of insulation. Actual square footages of insulation per home were not provided. In the absence of these data, we applied average square footages per home of insulation for a similar low-income weatherization program for a confidential customer. We reduced the assumed areas by 25% to be conservative and avoid potential overlap of savings with related measures.

Table 32 provides the new R-value assumptions for the insulation measures.

Table 32. Existing and New Assumed R-values for Insulation Measures

Insulation Type	R-Existing	R-New	Source/Notes
Attic/Ceiling Insulation	20	49	According to WY Low Income Weatherization Analysis, Quantec 2006.pdf, they allow insulation to be installed in ceilings with less than R-30. We assume some ceilings will already have some insulation in place and therefore assume an existing R-value of R-20 for the average to be conservative. For R-New, we rely on Utah state efficiency code.

Table 33 provides the deemed savings for insulation, using the assumptions from Table 31 and Table 32.

Table 33. Insulation Deemed Savings

Metric	kWh Savings/square foot	kWh Savings/Home
Attic/Ceiling Insulation	0.04	32.2

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