2023 Virginia Residential Portfolio EM&V Report

Volume I of II

Prepared for:
Appalachian Power Company

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Table of Contents

Table of Tables

Table of Figures

1 Introduction

Under contract with Appalachian Power Company (herein referred to as the "Company" or "APCo"), ADM Associates, Inc., (herein referred to as "the Evaluation Team") performed evaluation, measurement and verification (EM&V) activities to confirm the energy savings (kWh) and demand reduction (kW) realized through the energy efficiency and demand response programs that the Company implemented in Virginia during 2023. This report details the EM&V activities and findings relating to programs the Company offered in the residential sector.

This chapter provides a brief description of the residential programs offered by the Company, a summary of evaluation findings, and information regarding the organization of the report.

1.1 Program Year 2023 Residential Program Offerings

The Company offered residential customers six energy efficiency programs and one demand response program during program year 2023 (PY2023). A brief description of each program is provided below.

The Home Performance Program provides energy assessments to all residential customers, direct installation of energy efficiency improvements including LED lighting, low-flow devices, and air sealing, along with rebates for energy efficiency improvements that are available to customers with electric heating.

Efficient Products Program promotes retail consumer usage of high-efficiency LED lighting, ENERGY STAR® appliances, and DIY weatherization measures to promote long-term electric energy reduction in their residences. Rebates are provided for several efficient products:

- ENERGY STAR® pool pumps;
- ENERGY STAR® computer monitors;
- ENERGY STAR® electric clothes dryers;
- ENERGY STAR® central air conditioners;
- ENERGY STAR® clothes washers;
- ENERGY STAR® refrigerators and freezers;
- ENERGY STAR® heat pump water heaters;
- ENERGY STAR® air purifier and cleaners;
- ENERGY STAR® electric vehicle supply equipment;
- ENERGY STAR® dehumidifiers;
- Central furnace efficient fan motors;
- Shower thermostatic restriction valves;
- DIY insulation;
- Room air conditioners; and
- Ductless mini-split heat pumps.

The program also provided retail discounts for the following products:

- LED lighting;
- Caulk window and door sealant;
- Spray foam insulating sealant; and
- Electrical outlet and switch gasket.

The program educates customers and retailers about the energy and money saving benefits associated with energy efficient products.

The Energy Efficient Kits Program focuses on helping homeowners improve the efficiency of their homes. The program mails an energy efficiency kit at no cost to residential customers when they request a kit. Depending on the fuel used to heat the homes' water, the kits may include efficient lighting, water saving devices, water temperature card, and LED nightlights.

The Home Energy Reports Program provides residential customers with information on their household energy use to encourage them to alter their electricity using habits. The reports compare the participants' energy usage with similar homes to motivate the customer to take action to save energy and maintain those savings. Customers may receive paper and email reports, or paper-only reports if they do not have an email in the Company's billing information system. Customers with an email address in the Company's billing information system are delivered a streamlined digital experience about their energy usage and tips on how they can be more energy conscious. Customers can also access the online web portal, which allows customers to analyze and explore their energy usage, get energy efficiency tips, and manage their home profile.

Bring Your Own Thermostat Program: The Bring Your Own Thermostat (BYOT) program is a voluntary demand response program that offers customers a one-time $50 incentive to enroll a qualifying smart thermostat and a $5 a month incentive, up to $25 per year, for allowing adjustments to their thermostat to reduce air conditioner usage during peak event periods between May and September. Google Nest, Emerson Sensi, Honeywell Home and TCC, ecobee, Alarm.com, Amazon, and Lux thermostats are eligible for the program.

The program sets a maximum of 30 load management events, with 5 events reserved for emergencies during the program year. The events typically last two to three hours. During an event, a signal is sent to the enrolled thermostat to either cycle the unit on and off or raise the thermostat set point to reduce consumption during the event period. Twelve events were called during PY2023. The events were called during periods when forecasted electricity demand on the PJM regional transmission organization (RTO) was high.

Low-Income Single-Family Program (LISF): The LISF Program is designed to provide home energy services to the Company's Virginia customers with limited income to assist them in reducing their electric energy usage and managing their utility costs. The LISF Program provides funding to support the state weatherization program's implementation of electric energy-saving measures in residential low-income single-family households.

The program reduces energy consumption by educating residential customers about the energy and money-saving benefits associated with energy efficiency in the home. The program provides all customers participating in this program educational materials and an opportunity to discuss ways that they can continue to conserve and maintain the energy efficiency of their homes after the weatherization process has been completed.

The LISF Program targets measures that have been proven to save energy, reduce consumption, and protect the health and safety of occupants while helping to lower their electric bills. Eligible measures include, but are not limited to, those listed below.

- Energy efficient lighting
- Water saving devices (for homes with electric water heaters)
- Water heater pipe wrap insulation (for homes with electric water heaters)
- HVAC replacement and maintenance
- ENERGY STAR® appliance upgrades
- Insulation and air sealing measures
- Electrical system upgrades and maintenance
- Home ventilation measures
- Programmable thermostat upgrades
- General health and safety measures

Equipment and installation costs for all measures are provided at no cost to eligible customers and properties.

Low-Income Multifamily Program (LIMF): The LIMF Program aims to reduce energy consumption by installing energy efficiency measures in multifamily properties and educating residential customers about the energy and money saving benefits associated with energy efficiency in the home. The program works with property managers and owners to implement energy efficiency measures at the property and tenants receive educational materials and an opportunity to discuss ways that they can continue to conserve and maintain the efficiency of their home after the services have been performed.

The LIMF Program targets measures which have been proven to save energy, reduce consumption, and protect the health and safety of occupants while helping to lower their electric bills. Eligible measures include, but are not limited to, those listed below.

Electric Baseload Reduction

- Energy efficient lighting
- Electric water heating measures (aerators, pipe wrap, showerheads, etc.)
- ENERGY STAR® appliance upgrades

Electric Weatherization Measures

- HVAC replacement and maintenance
- Insulation and air sealing measures
- Duct system sealing and replacement

Health and Safety

- Electrical system upgrades and maintenance
- Home ventilation

In general, equipment and installation costs for all measures will be provided at no cost to eligible customers and properties.

Program evaluation findings are summarized in the following sections. The evaluation findings refer to expected and realized as well as gross and net impacts. For this report, these impacts are defined as:

- **Ex Ante Impacts:** Energy savings (kWh) and peak demand (kW) reduction estimates based on customer participation in PY2023, before program evaluation activities.
- **Rx Post Impacts:** Energy savings (kWh) and peak demand (kW) reduction estimates for PY2023 developed through the Evaluation Team's evaluation, measurement and verification (EM&V) activities.
- **Gross Impacts:** Changes in energy consumption/demand that result directly from program-promoted actions regardless of the extent or nature of program influence on these actions.
- **Net Impacts:** The portion of gross impacts that is directly attributable to the actions of the Company's energy efficiency and/or demand response programs.

The evaluation of the Company's programs complies with the rules for evaluation, measurement, and verification (EM&V) set forth in Case No. PUR-2017-00047.

Table 1-1 Compliance with Case No. PUR-2017-00047 EM&V Rules

Subsection	*Requirement*	*Response*
20VAC5-318-40 (A)	In all filings required by 20VAC5-318-30, the sources of all data or estimates used as inputs for proposed DSM measures or programs, in descending order of preference, shall be: 1. Utility-specific data; 2. Virginia-specific data if utility-specific data is unavailable or impracticable. When Virginia-specific data is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable; 3. Data from non-Virginia jurisdictions or sources, if neither utility-specific data nor Virginia-specific data is available or practicable: a. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why utility-specific data is unavailable or impracticable. b. When data from non-Virginia jurisdictions or sources is used, the utility shall provide an explanation as to why Virginia-specific data is unavailable or impracticable as well as the sources of all data, to include: (1) Titles, version numbers, publication dates, and page numbers of all source documents, as appropriate; and (2) An explanation as to why, in the utility's assessment, use of this data is appropriate.	The methods used to evaluate program impacts are provided in the methodology sections of each program chapter of this report. The methods comply with the order of preferred data inputs cited in code 20VAC5-318-40 (A). Primary data may be supplemented by secondary data to facilitate cost efficient allocation of EM&V resources. Titles, version numbers, publication dates, and page numbers of all source documents are cited, as appropriate.
20VAC5-318-40 (B)	EM&V reports shall include relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.	The program chapters describe the methodologies used to estimate savings for the program measures and include citations of relevant workpapers, support documents, assumptions, and equations used in developing the measurement and verification methodologies of measures or programs reported.
20VAC5-318-40 (C)	EM&V reports shall include measure-level estimates of kilowatt, kilowatt-hour, dekatherm, and pipeline capacity savings as appropriate. An estimate that has been adjusted for free-ridership as well as an estimate that has not been adjusted for free-ridership should be included as appropriate.	The cost-effectiveness analysis file submitted with the EM&V report presents measure-level estimates of peak kW and kWh energy savings.
20VAC5-318-50 (A)	EM&V of approved DSM measures or programs should be consistent with and contrasted to the preliminary EM&V plan set forth in the filings for approval of such measures or programs or as otherwise specified in a commission order approving such measures or programs. The commission recognizes that each utility has unique characteristics, and new or modified energy	The EM&V reports detail any deviations from the approach submitted in the EM&V plan set forth in the filings and the reasons for that deviation.

Subsection	*Requirement*	*Response*
	efficiency measures are constantly being developed. As such, alternative methodologies may be included in reporting provided that sufficient supporting documentation and explanation of appropriateness of alternative methodologies is provided.	
20VAC5-318-50 (B)	EM&V reports of existing measures or programs shall utilize utility-specific data or other data in conformance with 20VAC5-318-40 A when updating the analysis of the cost effectiveness of each measure, program, or portfolio as appropriate and practicable. EM&V reports of existing measures or programs shall include the information required by 20VAC5-318-40 B and C.	The EM&V report includes this information.
20VAC5-318-50 (C)	Any changes to or variances from originally approved measure-level inputs and assumptions shall be documented and explained, and the impact of such changes on original cost/benefit estimates for DSM programs or measures shall be quantified.	The EM&V report presents cost effectiveness analysis based on the expected savings estimates to characterize the discrepancy between the benefits resulting from the expected estimates and the ex-post estimates. The presentation of savings results includes discussion of the reasons for differences between the expected savings and ex post savings estimates.
20VAC5-318-50 (D)	EM&V reports shall describe the methodologies by which the measured data was collected, including at a minimum: 1. The sampling plan; and 2. Statistical calculations upon which the reported data is based when applicable.	The sampling approach is presented in the methodology section of the program chapters.
20VAC5-318-50 (E)	EM&V reports for ongoing DSM measures or programs shall include an explanation of eligibility requirements for each rate schedule to which the measures or programs are being offered.	The program chapters provide a description of the program that includes information on the measure or program eligibility requirements as provide by the Company.
20VAC5-318-50 (F)	EM&V reports for ongoing DSM measures or programs shall include a comparison of the measured annual measure or program savings estimates to the annual usage of the average rate schedule usage and eligible customer in each rate schedule to which the measures or programs is being offered. A comparison to originally approved estimated savings for the measures or programs that were approved by the commission shall also be provided. This will include a calculation of the expected savings as a percentage of the annual usage of the average rate schedule usage and eligible customer as appropriate and practicable.	The program chapters present a table for each program and rate class, based on data provided by the Company, that summarizes the following information: Program Name, Rate Class, Total kWh Savings, Number of Participating Customer Accounts, Average kWh Savings per Customer Account, and Average Consumption per Account for the Rate Schedule

Subsection	*Requirement*	*Response*
20VAC5-318-50 (G)	EM&V reports for ongoing DSM measures or programs shall include a description of the controls undertaken by the utility to verify proper installation of the measures or programs, as appropriate. Additionally, utilities shall require the contractors and subcontractors that will be implementing the measures or programs, if applicable and practicable, to record details of serviced or replaced equipment, to include at a minimum: 1. Nameplate efficiency ratings; 2. Serial numbers; and 3. Model numbers. This information will be made available to commission staff upon request.	The program chapters include the following information was provided by the Company or otherwise determined through the evaluation effort: 1) a description of program installation quality controls. 2) a description of equipment specification data recorded by the program.
20VAC5-318-50 (H)	EM&V reports should include actual costs incurred by the utility and each EM&V contractor for (i) the development of the most recent EM&V plan and (ii) the administration of EM&V activities for the reporting period.	Unless otherwise noted, where applicable, costs presented in the cost effectiveness analysis chapter of the EM&V report are inclusive of actual costs incurred by the utility and each EM&V contractor for the development of the most recent EM&V plan and the administration of EM&V activities for the reporting period.

1.2 Summary of Data Collection

Table 1-2 summarizes survey data collection activities that supported the PY2023 evaluation of the Company's residential programs.

Table 1-2 Summary of Survey and Interview Data Collection

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Efficient Products Participant Survey	Email	November 2023	1939	294
Efficient Products Participant Survey	Phone	November 2023	113	21
Home Performance Participant Survey	Email	August 2023, January 2024	975	225
Low Income Multi Family -- Property Manager	Email	December 2023	6	5
Low Income Multi Family -- Tenant	Email	December 2023	63	5
Low Income Single Family Participant Survey	Phone	December 2023	431	79

1.3 Impact Evaluation Findings

The Evaluation Team performed EM&V activities for each of the seven residential programs offered by the Company during PY2023.

As shown in Table 1-3, the Company's residential programs achieved gross realized energy savings of 43,894,911 kWh, with a gross realization rate of 88%. The residential programs achieved net realized energy savings of 40,344,025 kWh, with an average residential program net-to-gross ratio of 92%.

As shown in Table 1-4, the Company's residential programs achieved gross realized peak demand reductions of 14,112.72 kW, with a gross realization rate of 81%. The residential programs achieved net realized peak demand reductions of 13,723.68, with an average residential program net-to-gross ratio of 97%.

Table 1-3 Summary of Residential Portfolio Energy Savings

Program Name	*Ex Ante kWh Savings*	*Ex Post Gross kWh Savings*	*Gross kWh Savings Realization Rate*	*Ex Post Net kWh Savings*	*Estimated Net-to-Gross Ratio*	*Lifetime Gross Ex Post kWh Savings*	*Lifetime Net Ex Post kWh Savings*
Home Performance Program	3,994,280	2,694,520	67%	2,148,128	80%	34,196,631	28,102,957
Low-Income Single-Family Program	1,824,555	1,459,126	80%	1,459,126	100%	14,977,607	14,977,607
Low-Income Multifamily Program	564,565	320,034	57%	320,034	100%	3,798,382	3,798,382
Efficient Products Program	10,287,307	6,681,231	65%	3,614,889	54%	91,100,817	49,197,581
Energy Efficiency Kits Program	1,332,164	1,071,855	80%	1,062,492	99%	11,037,166	10,849,568
Home Energy Reports Program	31,578,044	31,578,044	100%	31,578,044	100%	31,578,044	31,578,044
Bring Your Own Thermostat Program	90,101	90,101	100%	161,312	179%	90,101	161,312
Residential Portfolio Totals	**49,671,016**	**43,894,911**	**88%**	**40,344,025**	**92%**	**186,778,749**	**138,665,452**

Table 1-4 Summary of Residential Portfolio Peak Demand Impacts

Program Name	*Ex Ante Gross kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Home Performance Program	3,259.62	455.56	14%	399.71	88%
Low-Income Single Family-Program	514.55	259.58	50%	259.58	100%
Low-Income Multifamily Program	78.36	98.79	126%	98.79	100%
Efficient Products Program	1,002.60	727.82	73%	395.48	54%
Energy Efficiency Kits Program	78.66	90.00	114%	89.15	99%
Home Energy Reports Program	6,690.44	6,690.44	100%	6,690.44	100%
Bring Your Own Thermostat Program	5,790.53	5,790.53	100%	5,790.53	100%
Residential Portfolio Totals	**17,414.77**	**14,112.72**	**81%**	**13,723.68**	**97%**

1.4 Process Evaluation Findings

This section presents the high-level findings and recommendations developed through process evaluation activities for the PY2023 residential portfolio. Key process related findings and recommendations from the PY2023 evaluation are summarized below:

1.4.1 Home Performance Program

The Home Performance program has undergone minimal changes over the past year, with a notable shift in funding allocation being the most significant modification. The coordinator's focus on improving customer experience through streamlined enrollment processes and clearer communication of program benefits has been evident. Efforts to simplify the customer journey, such as one-click access to the program portal and including account numbers in emails, have proven successful in enhancing participant understanding and engagement.

The program's marketing approach targets a broad audience without specific demographic or community-based targeting. The strategies lack segmentation or customization for specific communities or customer segments. While simplifying communication and emphasizing program value have been effective strategies, longer emails and complex enrollment processes have shown less success. Notably, gift card promotions for home energy assessments have generated positive responses.

Feedback-driven improvements have been made to home assessment reports, including additional tips and cross-promotion with other programs. The format of the reports was also modified for better delivery. Although there were no significant changes to the application process, efforts to address delays through improved contractor training have enhanced the efficiency of the assessment process. Excel sheets remain the primary tool for program monitoring and management, with the coordinator open to learning from other program managers for potential enhancements. The feedback collection process, both through in-house surveys and external evaluations, has played a role in identifying areas for improvement and refining the overall program.

Communications from the Company drove participation, with most finding the scheduling process to be easy and reporting a positive experience with the home assessment. Participants primarily became aware of the program through communications from the Company, including newsletters, email communications, and the program website. Survey respondents typically initiated their involvement by enrolling via the Home Performance portal. The most common motivation for participating in the program was saving money on energy costs. Participants found little difficulty in scheduling their home energy assessment, with high satisfaction levels for both the assessment process and the Energy Advisor. The majority agreed that the assessment information was easy to understand and useful. Ratings for the Energy Advisor highlighted positive feedback regarding courtesy, professionalism, and timeliness.

Survey results highlight the positive experiences among participants. The survey results indicate generally positive feedback from participants regarding their experiences with the program's contractor, with unanimous agreement on the contractor's timeliness, work quality, and professionalism. Overall satisfaction with the program and the installed measures was high among participants.

Some participants were dissatisfied with the program and the reasons given for their dissatisfaction tended to relate to the assessment or improvements made not meeting their expectations. Respondents reported expecting a more thorough assessment and analysis of home energy use or expected that more extensive efficiency improvements would be made.

- **Recommendation 1:** Enhance communication and set realistic expectations: Improved pre-engagement communication can help align participant expectations with the program's offerings. This would include communication on the scope of assessments and improvements that the program offers from the outset. Detailed descriptions of the assessment process describing what is done during an assessment to understand how the energy performance of the home can be improved may help customers understand what will happen during the visit.[1] Additionally, conveying the types of efficiency improvements typically made may help set expectations. These improvements could be made to the website description of the program and/or communicated to participants via email when they sign up for an assessment.

Video content could be added that delivers both information about the assessment process but could also include statements from participants who valued the service. Similarly, video content could be used to communicate how the air sealing measures, for example, are important in helping keep the home more comfortable and helping them save energy.[2]

1.4.2 Efficient Products Program

LED lighting retail discounts sales accounted for most of the program savings. LED lighting discounts drove energy savings for the program in PY2023. Program staff are focused on identifying savings from for non-lighting measures due to the decreased potential for lighting savings resulting from baseline changes.

Satisfaction with the energy efficient products rebated through the program and the program overall was high. Ninety-five percent of respondents were somewhat or very satisfied with their new energy efficient products and 85% were satisfied with the program overall.

Though most respondents found the application process easy to navigate, feedback revealed opportunities for improvements. Common issues include difficulties with the online submission process, usability concerns with the website, unclear instructions, and problems with tracking and status updates.

1.4.3 Energy Efficiency Kits Program

Realization rates were consistent with PY2022 evaluation results, aside from LED light bulbs. LED light bulbs had a lower realization rate due to the new baseline energy use effected by the EISA standard for lamp efficacy that went into place on July 1st, 2023. The impact of the changing baseline was mitigated by the program's successful efforts to distribute more LEDs prior to the baseline change than after.

- **Recommendation 1:** For planning purposes, revise ex ante savings estimates to align with PY2022 and PY2023 evaluation results.

1.4.4 Home Energy Reports Program

Program savings increased from PY2022. The Evaluation Team found that savings increased from 26,612,523 kWh to 31,578,044 kWh, which aligns with the program planning assumption of an increase in savings during the second year.

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[1] See for example the "What does a Home Energy Assessment Entail?" section of this NYSERDA website: https://www.nyserda.ny.gov/Featured-Stories/The-Complete-Guide-to-Home-Energy-Assessments

[2] See for example: https://www.esource.com/10274-002/how-do-you-use-customer-testimonials-promote-residential-energy-efficiency-programs

In addition to directly driving energy savings, HER increases participation in other Company programs. The Evaluation Team found that a larger share of HER treatment group customers (1.25%) participated in a rebate program than control group customers (1.08%).

Enhancements were made to improve quality assurance and enhance the customer experience. Program staff introduced a tracking system to record customer inquiries and comments to inform future program improvements. Additionally, the program is seeking to improve customer completion of profiles to improve the perceived accuracy of the home energy report information and has refined the home assessment and HER report.

1.4.5 Bring Your Own Thermostat Program

Events were timed with all 5 PJM coincident peak hours. Twelve events were called during the year and events overlapped with each of the PJM coincident peak hours. The program realized kW reductions of 5,790.53 kW.

1.4.6 Low-Income Single-Family Program

The Low-Income Single-Family program faced high demand with waitlists, requiring staffing expansion to address processing delays. Challenges stemming from labor shortages and extensive training requirements have limited participation, prompting a balanced, low-key promotion strategy to manage intake while sustaining customer interest. Ongoing proactive measures, such as team expansion and improved promotional activities, are directed at mitigating the waitlist backlog and addressing potential obstacles, including labor shortages and certification reluctance. The program remains dedicated to ensuring accessibility for all low-income participants.

The program staff has identified certain barriers to participation, with a specific focus on the challenges associated with the application process. In response, the program is actively working to enhance application accessibility. This initiative aligns with the program's broader commitment to support inclusivity and ensure that all participants can navigate the application process effectively.

Participant awareness is primarily driven by word-of-mouth, as the program is not actively marketing due to the existing waitlist. Most survey respondents learned of the program through friends, family, coworkers, or neighbors. Additionally, community action agencies or weatherization service providers contribute to program awareness, while landlords also play a role. Other sources of awareness include social service programs, the Company mailings or newsletters, program representatives, and internet searches. The two main motivations for participation are to improve home comfort and save money on energy bills. Because there is a waitlist, program staff indicate that there is no active need for additional promotional efforts to attract more applicants. The main marketing activity involves the inclusion of a banner in emails, serving as a notification to customers and directing them to the program's website for applications and program details. While the marketing focus isn't on generating a significant influx of applicants, there have been inquiries from customers seeking information about the application process.

Participants universally found scheduling the energy audit easy, with none finding it difficult. Additionally, the majority engaged in discussions about energy-saving strategies during the home visit, and all participants were present during the visit. Survey respondents generally agreed that the work was completed in a timely and efficient manner, the work crew demonstrated courtesy and professionalism, and the information about their home's energy use was both useful and easy to understand.

Survey respondents showed high satisfaction with the Low Income Single Family Program, with 94% very satisfied overall and 82% very satisfied with home improvements. Varied open-ended feedback included positive comments on program satisfaction and efficient work, along with suggestions for improvement such as coverage of additional measures, better communication, and addressing delays or contractor-related issues. Despite some suggestions for improvement, nearly all participants were satisfied with the program and the work performed.

1.4.7 Low Income Multifamily Program

The Low-Income Multifamily Weatherization program in Virginia has experienced no significant changes in design or operations. CHP leads outreach efforts, collaborating with property managers, while the Company contributes through email banners. No notable challenges in engaging multifamily properties were identified, and the program has maintained a consistent number of applications for PY2023 compared to the previous year.

1.5 Cost Effectiveness Evaluation Findings

Company cost effectiveness models were updated to account for ex post savings determined by the evaluation team. The following cost effectiveness tests were updated for the programs: Total Resource Cost (TRC) test, Program Administrator Cost Test (PACT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A test score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The test results for each program and the overall residential portfolio are presented in Table 1-5.

Table 1-5 Summary of Benefit-Cost Ratios – PY2023

Program	*Total Resource Cost Test*	*Program Administrator Cost Test*	*Ratepayer Impact Measure*	*Participant Cost Test*
Home Performance Program	1.31	1.01	0.35	8.09
Efficient Products Program	2.02	1.43	0.31	19.36
Energy Efficiency Kits Program	6.33	2.13	0.30	N/A
Home Energy Reports Program	2.94	2.94	0.37	N/A
Bring Your Own Thermostat Program	1.56	1.09	1.06	N/A
Low-Income Single-Family Program	0.61	0.23	0.17	N/A
Low-Income Multifamily Program	0.41	0.12	0.10	N/A

1.6 Organization of Report

This report is divided into two volumes providing information on the impact, process, and cost effectiveness evaluation of the Company's portfolio of residential programs implemented in Virginia during the 2023 program year. Volume I is organized as follows:

- Chapter 2: Home Performance Program
- Chapter 3: Efficient Products

- Chapter 4: Energy Efficiency Kits
- Chapter 5: Home Energy Reports
- Chapter 6: Bring Your Own Thermostat Program
- Chapter 7: Low-Income Single-Family Program
- Chapter 8: Low-Income Multifamily Family Program
- Chapter 9: Cost Effectiveness Evaluation
- Chapter 10: Carbon Emissions Reduction

See report Volume II for chapters presenting data collection instruments and tabulated survey results.

2 Home Performance Program

2.1 Program Description

The Home Performance Program provides home energy assessments and direct installation of energy savings measures to all residential customers, along with rebates for energy efficiency improvements that are available to customers with electric heating.

2.1.1 Program Eligibility Requirements

Eligible Home Performance participants include active residential customers served by the Company in existing single-family residential detached homes, townhomes, and duplexes. Eligible homes include owner-occupied and non-owner-occupied (renters) with electrical service in the occupant's name and with the written consent of the owner.

Measures must be purchased, installed, and for HVAC equipment, operable prior to submitting a rebate application. The measure eligibility requirements are as follows:

- **LED Lighting:** All LED lighting measures must be Consortium for Energy Efficiency (CEE), Design Lights Consortium (DLC) or ENERGY STAR® certified and replace an incandescent bulb.
- **Aerators and showerheads:** Aerators and shower heads must be WaterSense certified.
- **Attic insulation**: Insulation must increase by at least R-20 and meet the R-38 building codes.
- **Air filter and filter whistle:** Homes must be electrically heated.
- **Air sealing**: Blower door test-in and test-out required, unless there is suspected mold or asbestos present. Contractors' target the highest sources of air leakage first, such as major penetrations in the attic, basement, or crawlspace. Measured leakage reduction must be 20% or greater to qualify. Homes must be electrically heated.
- **Duct sealing**: Accessible joints, seams, connections, and penetrations sealed with approved mastics. Homes must be electrically heated.
- **Mini split ductless:** Replace an existing air source heat pump or electric resistance heating. Equipment must be new, ENERGY STAR rated, and meet the minimum efficiency requirement.

2.1.2 Summary of Savings by Eligible Rate Schedule

Table 2-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 2-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	2,148,128	1953	1,100	12,719	8.65%

2.2 Data Collection

This section outlines data collection performed to support evaluation of the Home Performance Program.

2.2.1 Participant Survey

Data collection from a participant survey was used to:

- Verify measures to estimate gross savings impacts;
- Collect data on participant decision making to estimate net impacts; and
- Collect data on participants' experience with the program to inform the process evaluation.

To estimate the sufficiency of the sample size, the Evaluation Team calculated the sample size needed to meet the 90/10 precision and confidence level. The sample size to meet 90/10 requirements is calculated using the coefficient of variation defined as:

$$CV(x) = \frac{Standard\ Deviation\ (x)}{Mean(x)}$$

Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated by the following equation:

$$n_0 = \left(\frac{1.645 * CV}{RP}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

RP = Required Precision, 10% in this evaluation

A sample of 68 is sufficient to achieve at least 10% precision at the 90% level of confidence. The Evaluation Team met this target through 225 completed surveys.

The survey was administered online and by telephone to Home Performance participants. Participants were contacted in August 2023 and in January 2024 to complete the survey. The Evaluation Team sent a subset of customers that received rebates for implementing major measures a letter asking them to complete the survey in November. These customers were also contacted by email after the letter was sent. The Evaluation Team contacted all participants with valid email addresses and two reminder emails were sent in addition to the initial email contact. Table 2-2 summarizes the number of customers contacted and the number of survey completions received.

Table 2-2 Survey Response Summary

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Home Performance Participant Survey	Email	August 2023	546	119
Home Performance Participant Survey	Email	January 2024	429	106
Total			975	225

2.3 Impact Evaluation

This chapter addresses the kWh savings and peak kW reductions resulting from measures installed in homes of customers that received measures through the Home Performance Program during the period January 2023 through December 2023.

The M&V approach for the 2023 Home Performance Program is aimed at the following:

- Determining the number of measures reported as being installed through the program;
- Verifying the number of measures that are currently installed;
- Estimating annual gross and net kWh savings for measures implemented; and
- Estimating annual gross and net kW reduction for measures implemented.

2.3.1 Methodology for Estimating Gross Savings

Table 2-3 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 2-3 Data Sources for Gross Impact Parameters – Home Performance Program

Parameter	*Source*
Number of Participants	Program Tracking Data
Measures Installed	Program Tracking Data/ Participant Surveys
Measures Still in Use	Participant Survey
Measure Characteristics	Program Tracking Data/ Mid-Atlantic TRM/ Virginia Weather Data
Home Characteristics	Program Tracking Data

2.3.1.1 Measure Attributes Tracked

For homes that received direct install measures under this program, home characteristics were documented including heating and cooling system type and water heating type. Program staff also maintained a catalog of measure attributes of direct installation measures including, where applicable, manufacturer model, and ENERGY STAR model identifier.

Table 2-4 presents information on the equipment specification data tracked by the program.

Table 2-4 Gross Impact Attributes Tracked by Program – Home Performance Program

Measure	*Attributes Tracked*
HVAC Measures	Heating and Cooling System Types and Efficiency Levels
Lighting Measures	Wattage, Lumens
	HVAC Equipment
	Installation Location (Room)
Water Heating Measures	Water Heating Type, Installation Location (Room) for Aerators
Envelope Measures	Existing and New Insulation Levels, Heating and Cooling System Types

2.3.1.2 Verification of Measure Installation

The Evaluation Team took several steps in verifying the number of measures installed, which consists of the following:

- Validating program tracking data by checking for duplicate or erroneous entries;
- Verifying that participants were part of the program according to the agreed-upon process between the implementation contractor and the Company; and
- Conducting verification surveys with a statistically valid sample of program participants (the focus of these verification surveys is to confirm that customers listed in the program tracking database did indeed participate and that the measures installed was accurate).

Table 2-5 summarizes the in-service and verification rates used in savings estimations for the Home Performance Program. Most measures were verified as installed as reported in the program data, but some customers reported removing measures after installation. The low in-service rate for night lights was largely due to the installation of night lights in empty sockets rather than replacing incandescent night lights.

Table 2-5 Installation Rates by Measure Type – Home Performance Program

Measure	*In-Service/ Verification Rate*	*Number of Responses*	*ISR/Verification Rate Source*
Bathroom Faucet Aerator	86%	14	Measure specific survey responses
Kitchen Faucet Aerator	86%	6	Measure specific survey responses
Low Flow Showerhead	85%	48	Measure specific survey responses
Water Heater Pipe Wrap	98%	49	Measure specific survey responses
Water Heater Tank Wrap	98%	1	Average direct install
Water Heater Temperature Setback	98%	0	Average direct install
Direct Install Lighting	96%	156	Measure specific survey responses
Caulked Penetration	98%	143	Measure specific survey responses
Duct Sealing	98%	103	Measure specific survey responses

Measure	In-Service/ Verification Rate	Number of Responses	ISR/Verification Rate Source
LED Nightlight	43%	53	Measure specific survey responses
Outlet Gaskets	98%	143	Measure specific survey responses
Weather Stripping, Caulking and Sealing	98%	143	Measure specific survey responses
Attic Insulation	100%	6	Measure specific survey responses
Mini Split Heat Pump	86%	1	Average major measure
Duct Insulation	86%	14	Measure specific survey responses

2.3.1.3 Weather Dependent Inputs

Many measures utilize common weather-dependent factors, such as effective full load heating hours and cooling hours (EFLH), cooling degree hours (CDH), heating degree days (HDD) and cooling degree days (CDD).

The method utilized by the Mid-Atlantic TRM to estimate full load hours (EFLH) from the EmPower metering study multiplied by the ratio of the ENERGY STAR full load hours of the analyzed city to the study city, was developed for the eight Virginia and West Virginia cities referenced in the ENERGY STAR full load data.

The heating degree days were developed for 932 zip codes in Virginia from TMY3 weather data and the Mid-Atlantic TRM method with the referenced base balance point outdoor air temperature. The data from 11 weather stations with TMY3 data were obtained along with the TRM heating balance point of 60F and a TRM cooling balance point of 65F to develop CDD and HDD. From these 11 weather stations, the HDD and CDD values were assigned by the nearest radial distance to 932 zip codes. The CDH was determined for each zip code by a similar Mid-Atlantic TRM method, with the referenced balance point of 75F.

2.3.1.4 Measure Specific Calculations

Table 2-6 summarizes the equations and inputs used to estimate the savings of the program measures. The savings calculated using the approaches outlined in the table were adjusted by the verification and in-service rates developed from the survey of program participants to estimate the gross program savings.

Table 2-6 Measure Calculations and Inputs

Variable Type	Variable Name	Variable Value	Variable Value Source
Measure Name: Bathroom Faucet Aerator			
Savings	ΔkWh		(((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412
Savings	ΔkW		((((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412) / Hours * CF
Input	#people	2.39	Mid-Atlantic TRM V10.0, p. 133.
Input	GPM_base	2.2	Mid-Atlantic TRM V10.0, p. 133.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*Throttle_base*	0.83	Mid-Atlantic TRM V10.0, p. 134.
Input	*GPM_low*	Varies	Tracking data. Varies by aerator type.
Input	*Throttle_low*	0.95	Mid-Atlantic TRM V10.0, p. 134.
Input	*Time_faucet*	1.6	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_faucet*	86	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 134.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 134.
Input	*DR*	0.7	Mid-Atlantic TRM V10.0, p. 134.
Input	*Hours*	Varies	Calculation: #people * Time_faucet / 60 * 365.
Input	*CF*	0.00262	Mid-Atlantic TRM V10.0, p. 135.
EUL		10	Mid-Atlantic TRM V10, p. 136.
Inc Cost		Varies	Total measure cost.
Measure Name: Kitchen Faucet Aerator			
Savings	*ΔkWh*		*(((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*((((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 133.
Input	*GPM_base*	2.2	Mid-Atlantic TRM V10.0, p. 133.
Input	*Throttle_base*	0.83	Mid-Atlantic TRM V10.0, p. 134.
Input	*GPM_low*	Varies	Tracking data. Varies by aerator type.
Input	*Throttle_low*	0.95	Mid-Atlantic TRM V10.0, p. 134.
Input	*Time_faucet*	4.5	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_faucet*	93	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 134.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 134.
Input	*DR*	0.5	Mid-Atlantic TRM V10.0, p. 134.
Input	*Hours*	Varies	Calculation: #people * Time_faucet / 60 * 365.
Input	*CF*	0.00262	Mid-Atlantic TRM V10.0, p. 135.
EUL		10	Mid-Atlantic TRM V10, p. 136.
Inc Cost		Varies	Total measure cost.
Measure Name: Low Flow Showerhead			
Savings	*ΔkWh*		*((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*(((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMbase*	2.5	Mid-Atlantic TRM V10.0, p. 137.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*GPMlow*	Varies	Tracking data.
Input	*Time_shower*	7.8	Mid-Atlantic TRM V10.0, p. 137.
Input	*TEMP_sh*	105	Mid-Atlantic TRM V10.0, p. 138.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 138.
Input	*Showers_per_person*	0.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*ShowerHeads_per_home*	Varies	Project documentation or Mid-Atlantic TRM V10.0, p. 138.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 138.
Input	*Hours*	Varies	Calculation: (TimeShower * #people * Showers_per_person) / (ShowerHeads_per_home * 60) * 365.
Input	*CF*	0.00371	Mid-Atlantic TRM V10.0, p. 139.
EUL		10	Mid-Atlantic TRM V10, p. 140.
Inc Cost		Varies	Total measure cost.
		Measure Name: Water Heater Pipe Wrap	
Savings	*ΔkWh*		*(((1 / Rexist) - (1 / Rnew)) * L * C * ΔT * 8760) / n_DHW / 3413*
Savings	*ΔkW*		*(((1 / Rexist) - (1 / Rnew)) * L * C * ΔT) / n_DHW / 3413*
Input	*Rexist*	Varies	Mid-Atlantic TRM V9.0, p. 186.
Input	*Rnew*	Varies	Tracking data.
Input	*L*	Varies	Tracking data.
Input	*C*	Varies	Tracking data.
Input	*ΔT*	65	Mid-Atlantic TRM V9.0, p. 187.
Input	*n_DHW*	0.98	Mid-Atlantic TRM V9.0, p. 187.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
Inc Cost		Varies	Total measure cost.
		Measure Name: Water Heater Tank Wrap	
Savings	*ΔkWh*		*(((U_base * A_base) - (U_insul * A_insul)) * ΔT * Hours) / (3412 * ηDHW)*
Savings	*ΔkW*		*((((U_base * A_base) - (U_insul * A_insul)) * ΔT * Hours) / (3412 * ηDHW)) / 8760*
Input	*U_base*	Varies	Mid-Atlantic TRM V10.0, p. 141.
Input	*A_base*	23.18	Mid-Atlantic TRM V10.0, p. 142, based on WH capacity
Input	*U_insul*	Varies	Mid-Atlantic TRM V10.0, p. 142.
Input	*A_insul*	25.31	Mid-Atlantic TRM V10.0, p. 142.
Input	*ΔT*	60	Mid-Atlantic TRM V10.0, p. 142.
Input	*Hours*	8760	Mid-Atlantic TRM V10.0, p. 142.
Input	*ηDHW*	0.98	Mid-Atlantic TRM V10.0, p. 142.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
Inc Cost		Varies	Total measure cost.
		Measure Name: Water Heater Temperature Setback	
Savings	*ΔkWh*		*U * A * (Tpre - Tpost) * Hours / (3412 * RE)*
Savings	*ΔkW*		*U * A * (Tpre - Tpost) / (3412 * RE)*

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*U*	0.083	Mid-Atlantic TRM V10.0, p. 160.
Input	*A*	Varies	Mid-Atlantic TRM V10.0, p. 160.
Input	*Tpre*	135	Mid-Atlantic TRM V10.0, p. 161.
Input	*Tpost*	120	Mid-Atlantic TRM V10.0, p. 161.
Input	*RE*	0.98	Mid-Atlantic TRM V10.0, p. 161.
Input	*Hours*	8760	Mid-Atlantic TRM V10.0, p. 161.
EUL		2	Mid-Atlantic TRM V10.0, p. 162.
Inc Cost		Varies	Total measure cost.
			Measure Name: Direct Install Lighting
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.34.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	*ηHeat*	Varies	Tracking data.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	*CF*	0.058	Mid-Atlantic TRM V9.0, p. 37.
Input	*WHFd*	1.17	Mid-Atlantic TRM V9.0, p. 36.
EUL		Varies	For direct installations occurring before July 1, 2023, the duration is 18 year (Mid-Atlantic TRM V10.0, p. 34); for direct installations on or after July 1, 2023, the duration is 1.8 years.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 38.
			Measure Name: Caulked Penetration
Savings	*ΔkWh*		*((((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + (((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000)) * %Electric_Heat)) * Linear_Ft*
Savings	*ΔkW*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor * Linear_Ft*
Input	*ΔCFM_50*	10.9	PA TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per penetration).
Input	*CDD*	Varies	Applicable weather data.
Input	*SEER*	Varies	Tracking data.
Input	*LM*	Varies	Based on location: Mid-Atlantic TRM method.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153.
Input	*HDD*	Varies	Applicable weather data.
Input	*HSPF*	Varies	Tracking data.
Input	*%Electric_Heat*	Varies	Tracking data.
Input	*Linear_Ft*	Varies	Linear feet insulated.
Input	*Peak_Conversion_Factor*	0.000017	PA TRM V2021 Vol. 2, p. 154.

Variable Type	Variable Name	Variable Value	Variable Value Source
Input	N	16.7	PA TRM V2021 Vol. 2, p. 153.
EUL		15	PA TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
			Measure Name: Duct Sealing
Savings	ΔkWh		((DE_post_cooling + DE_adder_cooling) - (DE_pre_cooling + DE_adder_cooling)) / (DE_post_cooling + DE_adder_cooling) * EFLH_cool * kBTUH_cool / SEER + ((DE_post_heating + DE_adder_heating) - (DE_pre_heating + DE_adder_heating)) / (DE_post_heating + DE_adder_heating) * EFLH_heat * kBTUH_heat / HSPF
Savings	ΔkW		((DE_post_cooling + DE_adder_cooling) - (DE_pre_cooling + DE_adder_cooling)) / (DE_post_cooling + DE_adder_cooling) * kBTUH_cool / SEER * CF
Input	DE_pre_cooling	Varies	PA TRM V2021 Vol. 2, p. 44. Auditor inspection data.
Input	DE_post_cooling	Varies	PA TRM V2021 Vol. 2, p. 44. Auditor inspection data.
Input	DE_pre_heating	Varies	PA TRM V2021 Vol. 2, p. 44. Auditor inspection data.
Input	DE_post_heating	Varies	PA TRM V2021 Vol. 2, p. 44. Auditor inspection data.
Input	DE_adder_cooling	Varies	PA TRM V2021 Vol. 2, p. 45. Auditor inspection data.
Input	DE_adder_heating	Varies	PA TRM V2021 Vol. 2, p. 45. Auditor inspection data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	kBTUH_cool	Varies	Tracking data.
Input	SEER	Varies	Tracking data.
Input	EFLH_heat	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	kBTUH_heat	Varies	Tracking data.
Input	HSPF	Varies	Tracking data.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 116.
EUL		15	PA TRM V2021 Vol. 2, p. 42.
Inc Cost		Varies	Total measure cost.
			Measure Name: LED Nightlight
Savings	ΔkWh		(WattsBase * HoursBase - WattsEE * HoursEE) * 365 / 1000
Savings	ΔkW		0
Input	WattsEE	0.5	Product characteristics.
Input	WattsBase	7	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	HoursEE	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	HoursBase	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
EUL		8	PA TRM V2021 Vol. 2, p. 8.
Inc Cost		3.35	Illinois TRM V11.0 Vol. 3, p. 349.
			Measure Name: Outlet Gaskets
Savings	ΔkWh		(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + ((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000) * %Electric_Heat)
Savings	ΔkW		(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*ΔCFM_50*	6.49	PA-TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per electrical outlet).
Input	*CDD*	Varies	Calculated using regional weather data.
Input	*SEER*	Varies	Tracking data.
Input	*LM*	Varies	PY2019 EM&V Results. Latent multiplier to convert the calculated sensible load to the total (sensible and latent) load.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153. Discretionary use adjustment to account for uncertainty in predicting cooling system usage patterns of occupants.
Input	*HDD*	Varies	Calculated using regional weather data.
Input	*HSPF*	Varies	Tracking data.
Input	*Peak_Conversion_Factor*	0.000017	PA-TRM V2021 Vol. 2, p. 154.
Input	*N*	16.7	PA-TRM V2021 Vol. 2, p. 153. Correlation factor. This factor accounts for four environmental characteristics that may influence infiltration, which include climate, building height, wind shielding and building leakiness.
Input	*%Electric_Heat*	Varies	Tracking data.
EUL		15	PA-TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
Measure Name: Weather Stripping, Caulking and Sealing			
Savings	*ΔkWh*		*((((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + (((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000)) * %Electric_Heat)) * Linear_Ft*
Savings	*ΔkW*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor * Linear_Ft*
Input	*ΔCFM_50*	0.664	PA TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per penetration).
Input	*CDD*	Varies	Applicable weather data.
Input	*SEER*	Varies	Tracking data.
Input	*LM*	Varies	Based on location: Mid-Atlantic TRM method.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153.
Input	*HDD*	Varies	Applicable weather data.
Input	*HSPF*	Varies	Tracking Data
Input	*%Electric_Heat*	Varies	Tracking Data
Input	*Linear_Ft*	Varies	Linear feet insulated.
Input	*Peak_Conversion_Factor*	0.000017	PA TRM V2021 Vol. 2, p. 154.
Input	*N*	16.7	PA TRM V2021 Vol. 2, p. 153.
EUL		15	PA TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
Measure Name: Attic Insulation			
Savings	*ΔkWh*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool * ADJcool) + ((1 / Rexist - 1 / Rnew) * HDD * 24 * Area / 1000000 / ηHeat * 293.1 * ADJheat)*

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Savings	*ΔkW*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool) / EFLH_cool * CF*
Input	*Rexist*	Varies	Tracking data.
Input	*Rnew*	Varies	Tracking data.
Input	*CDH*	Varies	Applicable weather data.
Input	*DUA*	0.75	Mid-Atlantic TRM V9.0, p. 261.
Input	*Area*	Varies	Tracking data.
Input	*ηCool*	Varies	Tracking data.
Input	*ADJcool*	0.8	Mid-Atlantic TRM V9.0, p. 261.
Input	*HDD*	Varies	Applicable weather data.
Input	*ηHeat*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*ADJheat*	0.6	Mid-Atlantic TRM V9.0, p. 263.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 263.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Inc Cost		Varies	Total measure cost.
Measure Name: Mini Split Heat Pump			
Savings - 1	*ΔkWh Baseline 1*		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Heating_kwh_exist - ((Capacity_heat_ee / HSPF_base) / 1000 * EFLH_heat)) * ER_Factor) + (((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * ER_Factor * EFLH_cool)*
Savings - 2	*ΔkW Baseline 1*		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF + ((Capacity_cool_exist / EER_exist) - (Capacity_cool_exist / EER_base)) / 1000 * CF * ER_Factor*
Savings - 2	*ΔkWh* (Baseline 2)		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool)*
Savings - 2	*ΔkW* (Baseline 2)		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF*
Input	*Capacity_cool_exist*	Varies	Tracking data.
Input	*Capacity_cool_ee*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*SEER_exist*	Varies	Tracking data.
Input	*SEER_base*	14	Mid-Atlantic TRM V10.0, p. 88.
Input	*SEER_ee*	Varies	Tracking data.
Input	*EER_exist*	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	*EER_base*	11.8	Mid-Atlantic TRM V10.0, p. 88.
Input	*EER_ee*	Varies	Tracking data.
Input	*Capacity_heat_ee*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*HSPF_base*	8.2	Mid-Atlantic TRM V10.0, p. 88.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*HSPF_ee*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 124.
Input	*Heating_kwh_exist*	Varies	Pre-project annual electric energy usage. Based on econometric analysis of interval meter data and capped at estimate of electric resistance baseline usage.
Input	*ER_Factor*	0.27	Illinois TRM V11.0 Vol. 3, p. 176.
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 94.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 94.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 125.
		Measure Name: Duct Insulation	
Savings	*ΔkWh*		*(DI_heat_supply_basement * A_supply_basement + DI_heat_return_basement * A_return_basement + DI_heat_supply_attic * A_supply_attic + DI_heat_return_attic * A_return_attic + DI_cool_supply_basement * A_supply_basement + DI_cool_return_basement * A_return_basement + DI_cool_supply_attic * A_supply_attic + DI_cool_return_attic * A_return_attic) * Adjustment_Factor*
Savings	*ΔkW*		*(DI_cool_supply_basement * A_supply_basement + DI_cool_return_basement * A_return_basement + DI_cool_supply_attic * A_supply_attic + DI_cool_return_attic * A_return_attic) * Adjustment_Factor / EFLH_cool * CF*
Input	*DI_heat_supply_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_return_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_supply_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_return_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_supply_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_return_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_supply_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_return_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*A_supply_basement*	Varies	Surface area of ducts (ft2) insulated - basement supply ducts.
Input	*A_return_basement*	0	Surface area of ducts (ft2) insulated - basement return ducts.
Input	*A_supply_attic*	0	Surface area of ducts (ft2) insulated - attic supply ducts.
Input	*A_return_attic*	0	Surface area of ducts (ft2) insulated - attic return ducts.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 263.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*Adjustment_Factor*	1	ADM. Factor to adjust savings estimate to account for diminishing marginal benefits. Value between 0 and 1.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Inc Cost		Varies	Total measure cost.

2.3.2 Methodology for Estimating Net Savings

This section presents the approach used to evaluate the net energy impacts of the Home Performance Program.

Survey responses were used to estimate the net savings ratio of the Home Performance program. The survey data collection methodology is described in Section 2.2.1.

Of the 225 respondents that completed the survey, 224 received direct install measures and were asked free ridership questions about those measures, and seven received major measures and were asked questions about those measures.

2.3.2.1 Free Ridership Estimation – Direct Install Measures

The Evaluation Team developed free ridership estimates for the direct install measures based on survey responses to questions about the following factors:

- Prior planning to purchase energy efficiency measures that were provided through the program;
- The likelihood of having installed the items in the absence of the program;
- The number of items the customer planned on purchasing; and
- Demonstrated behavior in purchasing similar equipment absent program assistance.

2.3.2.1.1 Prior Planning

The presence of prior plans to install the items was determined based on respondents' stated presence of prior plans and the participants' previous experience installing the items. Specifically, evidence of prior plans was based on responses to the following questions:

- Had you purchased and installed any [MEASURE] before you received them for free through the program?
- Did you have plans to purchase and install [MEASURE] before you learned about the Home Performance program?

Participants who indicated that they did not have prior plans to install the measures or indicated that they had not previously purchased them were assigned a free ridership score of 0%. For all other respondents, a free ridership score was developed based on their likelihood of installing the item and the number of items they expected to install.

2.3.2.1.2 Likelihood of Purchasing Items without the Program

Participants were asked about the likelihood of installing the items had they not been provided for free through the program. Specifically, participants were asked:

- If you had not received them for free through the program, how many of the [MEASURE] that you received would you have purchased and installed on your own within 12 months?

A likelihood of installing the measure in the absence of the program score was developed by dividing the participants' 0 to 10 responses by 10.

2.3.2.1.3 Quantity Adjustment

Participants were asked to report on the number of measures that they believed they would purchase in the next 12 months had they not been provided through the program. The response to this question was used to calculate a quantity adjustment that was equal to the number of items the respondent believed they would purchase divided by the total number of items that they received.

2.3.2.1.4 Overall Free Ridership Score

The overall free ridership score was equal to 0 for participants who did not meet the criteria for the presence of prior plans. For all other respondents, the free ridership score was calculated as equal to the likelihood of installing the items score, multiplied by the quantity adjustment.

2.3.2.2 Free Ridership Estimation – Major (Rebated) Measures

The Evaluation Team developed free ridership estimates for the major measures based on survey responses to questions about the following factors:

- Financial ability to install the measures;
- Prior planning to purchase energy efficiency measures that were provided through the program;
- The likelihood of having installed the items in the absence of the program; and
- The program impact on timing of measure installation.

2.3.2.2.1 Financial Ability

Participants were asked the following question about their financial ability to pay for the rebated measure:

- Would you have been financially able to install the [MEASURE] without the financial assistance provided through the program?

Participants who indicated that they would not have been able to install the measures were deemed to not be free riders.

2.3.2.2.2 Prior Planning

Two questions were used to assess the presence of prior plans to install the measure before learning about the program:

- Prior to learning about the Home Performance program, did you have plans to install the [MEASURE]?
- And, as applicable: Just to be clear, did you have plans to specifically install an energy efficient [MEASURE] as opposed to a standard efficiency [MEASURE]?

For participants that installed measures for which a standard efficiency option was available, such as air conditioning equipment, a determination of the presence of plans was made based on participants stating "Yes" to both questions listed above. For all other respondents, the presence of plans was based on respondents stating "Yes" to the first question.

Participants who indicated that they did not have prior plans to install the measures were assigned a free ridership score of 0%.

2.3.2.2.3 Likelihood of Purchasing Items without the Program

Participants were asked about the likelihood of installing the items had they not been provided for free through the program. Specifically, participants were asked:

- On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have installed the same [MEASURE] if it was not recommended through the home energy assessment?
- On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have installed the same [MEASURE] if the financial assistance was not available?

A likelihood of installing the measure in the absence of the program score was developed by dividing the minimum of the participants' 0 to 10 responses to the two questions listed above by 10.

2.3.2.2.4 Timing Adjustment

The following two questions were asked to assess program impacts on the deferral of free ridership:

- Did you install the [MEASURE] sooner than you would have if the information and financial assistance from the program had not been available?
- When might you have installed the same [MEASURE] if you had not participated in the program?

Based on responses to this question, a timing adjustment score was developed in the following manner:

Table 2-7 Timing Score

Response Option	*Timing Score*
Within 6 months of when you purchased it	0.75
Between 6 months and 1 year	0.25
In more than 1 year to 2 years	0
In two years or more	0
Don't know	0.5

2.3.2.2.5 Overall Free Ridership Score

Participants who indicated that they could not have afforded to install the efficiency measures without the financial support of the program, or who indicated that they did not have prior plans to install the measures were assigned a free ridership score of 0. For all other respondents, a free ridership score was developed by multiplying the likelihood of implementing the measure in the absence of the program by the timing score. Table 2-8 summarizes the average free ridership values developed from the methods described above.

Table 2-8 Free Ridership Values Applied

Measure Name	*Survey Response Count*	*Average Free Ridership*	*Source Applied*
Mini Split Heat Pump	6	0.47	Average rebated measure
Central Air Conditioner	3	0.47	Average rebated measure
Room Air Conditioner	5	0.47	Average rebated measure
Heat Pump Water Heater	22	0.31	Measure specific survey responses
Refrigerator	70	0.48	Measure specific survey responses
Freezer	3	0.47	Average rebated measure
Clothes Washer	54	0.58	Measure specific survey responses
Clothes Dryer	40	0.53	Measure specific survey responses
Air Purifier	27	0.33	Measure specific survey responses
Dehumidifier	67	0.40	Measure specific survey responses
Pool Pump	2	0.47	Average rebated measure
EV Charging Equipment	9	0.47	Average rebated measure
Standard LED	0	0.35	Price response
Specialty LED	0	0.72	Price response
Downlight LED	0	0.45	Price response
LED Nightlight	0	0.45	Price response
Window and Door Caulk	0	0.51	2022 General pop survey
Spray Foam	0	0.45	2022 General pop survey
Electrical Outlet Gasket	0	0.56	2022 General pop survey
Computer Monitor	0	0.47	Average rebated measure
Furnace Fan Motor	0	0.47	Average rebated measure
DIY Insulation - Ceiling/Attic	1	0.47	Average rebated measure
Shower Thermostatic Restriction Valve	0	0.47	Average rebated measure
DIY Insulation - Above-Grade Wall	1	0.47	Average rebated measure
DIY Insulation - Basement Sidewall	1	0.47	Average rebated measure

2.3.2.3 Spillover Estimation

For the Home Performance Program, the Evaluation Team used the participant survey to conduct a spillover savings assessment for program participants. The survey questions were designed to gather information regarding:

- Whether program participants have purchased and installed additional, non-incentivized energy saving measures since participating in the program;
- Which additional, non-incentivized energy saving measures program participants have purchased and installed since participating in the program; and
- The extent to which the Home Performance Program influenced the purchase of these additional non-incentivized energy saving measures.

Survey respondents were first asked the following question:

- "Because of your experience with the [Home Performance Program], have you bought any additional energy efficient items on your own without a financial incentive or utility rebate?"

Respondents answering "Yes" to the above question were then provided with a list of common residential energy efficiency measures such as energy efficient lighting, appliances, and air sealing improvements, and were asked to indicate which of the items they had purchased, and how many they had purchased, since participating in the Home Performance Program.[3] Respondents were then asked whether they had installed all, some, or none of the items they indicated, and were asked to state the month and year that they installed the items.

Respondents who indicate that they have installed at least one additional energy efficient measure since participating in the program were then asked two questions to determine the level of influence that the program may have had on the decision to purchase and install the item(s). These two questions were used to calculate the program attribution variable, and are as follows:

- SO1: "On a scale of 0 to 10, where 0 represents "Not at all important" and 10 represents "Extremely important", how important was your experience with the Home Performance Program in your decision to purchase and install these additional items?"
- SO2: "On a scale of 0 to 10, where 0 represents "Not at all likely" and 10 represents "Extremely likely", how likely would you have been to purchase these additional non-rebated energy efficient items if you had never participated in the Home Performance Program?"

The Program Influence Score (PI Score) was then calculated as the average of the responses to these two questions, where the numeric scale from SO2 is reversed by subtracting the SO2 score from 10 total possible points:

$$\text{PI Score} = ((\text{SO1 Score}) + (10 - \text{SO2 Score}))/2$$

For example, a respondent providing a rating of 9 to SO1 and a rating of 3 to SO2 would receive a PI Score as follows:

$$\text{PI Score} = (9 + (10 - 3))/2$$

$$\text{PI Score} = 8$$

Respondents whose PI Scores were above 7 are considered to have made additional energy efficiency purchases that were significantly influenced by the program. The savings associated with these purchases were counted as program spillovers.

Energy savings of additional program-attributable measures purchased and installed by these respondents were then calculated by applying the methodologies listed in the Mid-Atlantic TRM V9.0, referencing measure characteristics associated with program participants or stipulated savings calculation input data.

Table 2-11 summarizes the spillover measures reported by the sample. A two-step process was used to extrapolate these spillover savings to the entire population of program participants. Initially, for survey respondents who reported spillover, their reported spillover savings were directly included in the program's total spillover. For participants not included in the sample, a spillover ratio was computed based on kWh energy savings and kW reductions. This ratio was derived by dividing the reported spillover savings by the kWh savings or kW reductions from the survey sample. The spillover ratio was

[3] A full list of the energy efficiency measures included in this question can be found in Appendix A.

then applied to estimate spillover savings for unsampled participants by multiplying their ex post gross savings by this ratio. Table 2-10 details the calculations of these spillover ratios.

Table 2-9 Spillover Savings Measure Estimates

Measure	*Quantity*	*kWh Total*	*kW Total*
Freezer	1	35.5	0.009
Showerheads	1	203.6	0.011
Room AC	1	42.8	0.040
Smart Thermostat	1	252.6	0.000
Refrigerator	1	55.5	0.010
Dryer	1	177.2	0.020

Table 2-10 Spillover Savings Ratio Calculation

Metric	*kWh*	*kW*
Spillover Sample Savings	55.7	0.01
Sample Gross Savings	54,340.60	6.11
Spillover Ratio	0.25%	0.18%

2.3.3 Impact Evaluation Results

The following subsections summarize the results of the impact evaluation conducted for the 2023 Home Performance Program.

2.3.3.1 Energy Savings and Demand Reduction Results

Table 2-11 below presents the annual gross and net savings for each energy efficiency measure in the 2023 Home Performance Program.

Table 2-11 Home Performance Program Realized Gross and Net Energy Savings

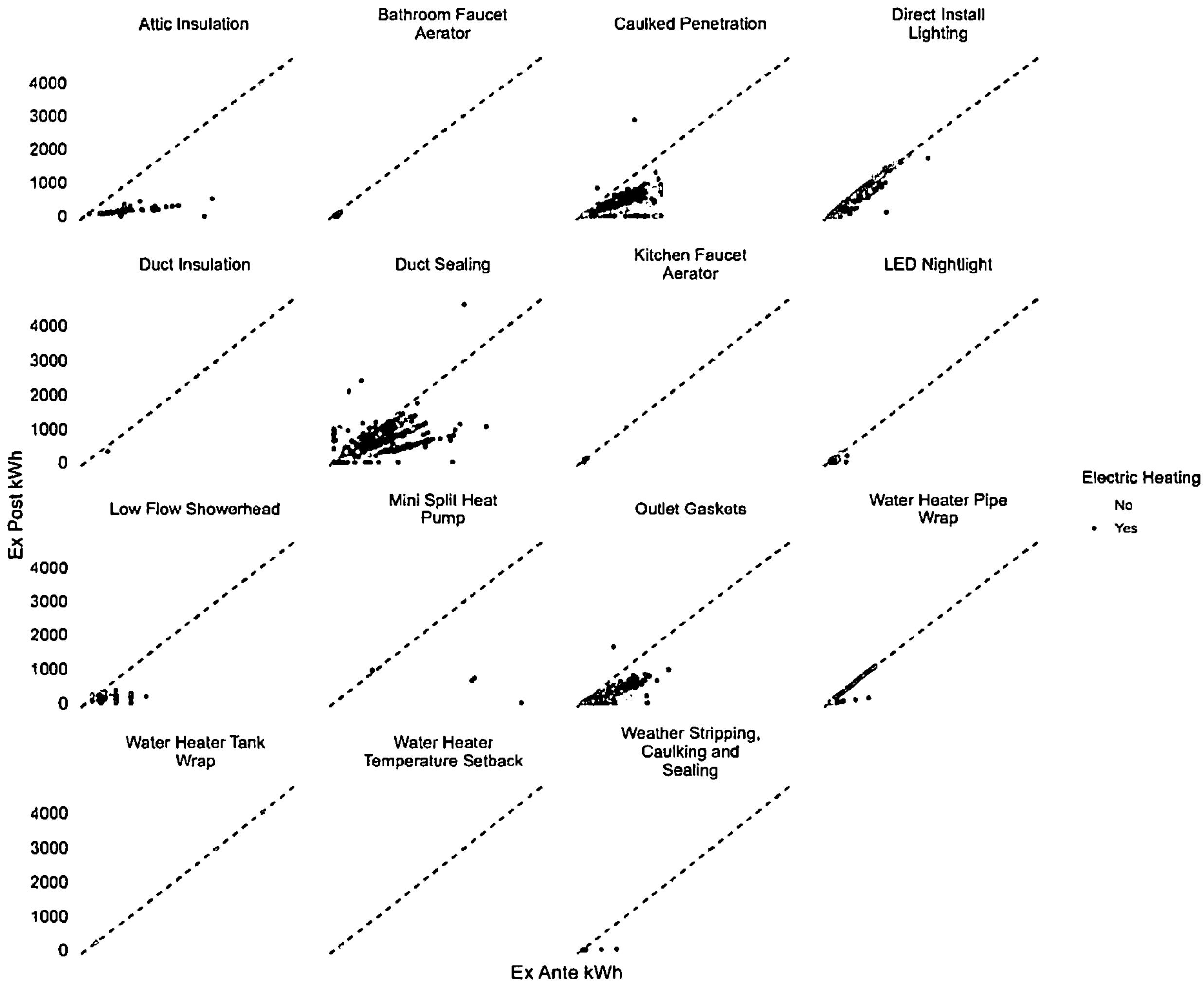
Category	*Measure Name*	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Free Ridership kWh*	*Participant Spillover kWh*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
Envelope	Duct Sealing	1,103,959	803,345	73%	27,553	2,028	777,820	97%	11,667,305
	Air Sealing	0	0	N/A	-	-	0	N/A	0
	Attic Insulation	38,795	6,440	17%	3,042	16	3,414	53%	51,215
	Caulked Penetration	636,496	282,981	44%	42,771	714	240,925	85%	3,613,870
	Duct Insulation	499	332	66%	159	1	174	52%	2,604
	Outlet Gaskets	532,914	247,967	47%	36,150	626	212,443	86%	3,186,644
	Weather Stripping, Caulking and Sealing	1,652	69	4%	10	0	59	86%	883
HVAC	Mini Split Heat Pump	24,406	4,202	17%	2,014	11	2,199	52%	36,300
	Air Handler Filter and Filter Whistle	0	0	N/A	-	-	0	N/A	0

Category	*Measure Name*	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Free Ridership kWh*	*Participant Spillover kWh*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
Lighting	Standard A-Type (medium- base)	625,741	634,893	101%	244,384	1,603	392,111	62%	4,004,238
	R, PAR, ER, BR, BPAR or similar bulb shapes with medium screw bases w/ diameter >2.5"	216,724	158,808	73%	61,764	401	97,445	61%	992,232
	Globe (any base, < 500 lumens)	56,069	55,683	99%	21,318	141	34,505	62%	362,661
	Globe (candelabra or intermediate base, ≥ 500 lumens)	285,872	276,793	97%	106,445	699	171,046	62%	1,706,079
	LED Nightlight	98,871	46,509	47%	4,821	117	41,806	90%	334,447
Water Heating	Water Heater Pipe Wrap	91,601	85,013	93%	956	215	84,272	99%	1,264,077
	Water Heater Tank Wrap	234	234	100%	-	1	235	100%	3,525
	Bathroom Faucet Aerator	7,930	5,345	67%	173	13	5,185	97%	51,854
	Kitchen Faucet Aerator	5,957	5,107	86%	1,316	13	3,804	74%	38,038
	Low Flow Showerhead	259,884	78,005	30%	-	197	78,202	100%	782,020
	Water Heater Temperature Setback	6,677	2,794	42%	319	7	2,482	89%	4,964
Total		3,994,280	2,694,520	67%	553,194	6,801	2,148,128	80%	28,102,957

Figure 2-1 provides additional detail on the realization rates by showing a plot of the ex post and ex ante savings by measure type and if the customer had electric heating. As shown:

- Ex ante savings estimates for attic insulation and low flow showerheads consistently exceeded the ex post savings estimates.
- Air sealing measures (caulked penetration, outlet gaskets) ex ante estimates were consistently lower than ex post, but by a smaller magnitude difference.
- Direct install lighting ex ante savings tracked ex post savings estimates.
- Water heater pipe insulation ex ante savings tracked ex post estimates, except in a few cases where they were overestimates. Savings for pipe insulation were near 100% for cases where the baseline R value was 1 and were substantially lower where the baseline R value was 4. While the addition of the pipe insulation increased the overall R value, the savings are smaller when the baseline value is higher.

Figure 2-1 Plot of Gross Ex Ante and Gross Ex Post kWh Savings by Measure and Heating Type (Red Line Indicates a Realization Rate of 100%)



Gross and net peak ex post kW reductions are summarized below in Table 2-12.

Table 2-12 Home Performance Program Peak kW Reductions Summary

Category	*Measure Name*	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*	*Free Ridership kW*	*Participant Spillover kW*	*Net Ex Post kW Savings*	*Net-to-Gross Ratio*
Envelope	Duct Sealing	1,072.74	316.07	29%	10.83	0.56	305.80	97%
	Air Sealing	-	-	N/A	-	-	-	N/A
	Attic Insulation	2.36	1.02	43%	0.49	0.00	0.53	52%
	Caulked Penetration	775.07	1.86	0%	0.28	0.00	1.58	85%
	Duct Insulation	-	0.02	N/A	0.01	0.00	0.01	52%

	Outlet Gaskets	648.94	1.52	0%	0.22	0.00	1.30	86%
	Weather Stripping, Caulking and Sealing	2.01	0.00	0%	0.00	0.00	0.00	85%
HVAC	Mini Split Heat Pump	4.00	2.66	66%	1.27	0.00	1.39	52%
	Air Handler Filter and Filter Whistle	-	-	N/A	-	-	-	N/A
Lighting	Standard A-Type (medium- base)	71.89	63.42	88%	24.41	0.11	39.12	62%
	R, PAR, ER, BR, BPAR or similar bulb shapes with medium screw bases w/ diameter >2.5"	24.90	15.86	64%	6.17	0.03	9.72	61%
	Globe (any base, < 500 lumens)	6.44	5.51	85%	2.11	0.01	3.41	62%
	Globe (candelabra or intermediate base, ≥ 500 lumens)	32.84	27.68	84%	10.64	0.05	17.09	62%
	LED Nightlight	-	-	N/A	-	-	-	N/A
Water Heating	Water Heater Pipe Wrap	-	9.70	N/A	0.11	0.02	9.61	99%
	Water Heater Tank Wrap	0.03	0.03	99%	-	0.00	0.03	100%
	Bathroom Faucet Aerator	7.49	0.60	8%	0.02	0.00	0.58	97%
	Kitchen Faucet Aerator	2.00	0.20	10%	0.05	0.00	0.15	74%
	Low Flow Showerhead	608.15	9.10	1%	-	0.02	9.11	100%
	Water Heater Temperature Setback	0.76	0.32	42%	0.04	0.00	0.28	89%
Total		3,259.62	455.56	14%	56.66	0.81	399.71	88%

2.3.3.2 Supplementary Econometric Analysis

To supplement the impact evaluation, the Evaluation Team utilized IPMVP Option C by performing regression analysis to assess the presence of energy savings during the period subsequent to implementation of program measures. The Evaluation Team obtained energy usage data of program participants from the Company. The analysis was performed using data associated with customers with energy usage data available for at least 11 months after implementation of program measures. For the Home Performance Program, such data was available for a total of 405 PY2023 program participants. The variables described in Table 2-13 were included in the analysis.

Table 2-13 Analysis Model Variables

Variable Name	*Variable Description*
kWh	Dependent variable; participant daily energy use.
CDH	MAX (Outdoor Temperature - 75°F, 0) calculated hourly and averaged across month.
HDH	MAX (55°F - Outdoor Temperature, 0) calculated hourly and averaged across month.
Post	1 during post-implementation period; otherwise 0.

A mixed effects regression model was employed to estimate the incremental impact of implementation of program measures on participant energy use. The following equation was modeled:

Equation 2.1

$$kWh_{it} = \beta_0 + \beta_1 Post_{it} + \beta_2 CDH_{it} + \beta_3 HDH_{it} + e_{it}$$

Table 2-14 presents the results of the regression analysis.

Table 2-14 Parameter Estimates for Regression Model

Variable Name	*Estimate*	*Standard Error*	*Z score*	*p value*	*90% Confidence Interval*	
					Lower Bound	*Upper Bound*
CDH	0.008	0	36.96	0	0.008	0.009
HDH	0.003	0	68.85	0	0.003	0.003
Post	-5.163	0.608	-8.49	0	-6.163	-4.162
Intercept	21.501	1.249	17.21	0	19.446	23.555
Number of Observations						9,303
Number of Groups						405

Intuitively, the weather variables (*CDH* and *HDH*) have positive coefficients indicating the presence of weather-sensitive energy usage and the *Post* variable has a negative coefficient indicating lower energy use during the post-implementation period. The coefficient of *Post* indicates that average daily energy use of Home Performance participants included in the analysis during the period after implementation of program measures is about 5.16 kWh lower, controlling for weather-related effects.

The energy savings estimate of 5.16 kWh associated with the Home Performance Program mixed effects regression model is equal to 129% of the average daily ex post gross kWh savings value of 4.01 kWh per account included in the econometric analysis. The average daily ex post gross kWh savings estimate is below the 90% confidence interval of the savings estimate associated with the model *Post* variable.

2.4 Process Evaluation

The following section presents key findings from the process evaluation conducted for the 2023 Home Performance Program.

2.4.1 Program Participation Findings

This section presents the results of the program database review conducted by the Evaluation Team. This analysis is based on an end-of-year tracking data file containing all projects completed during 2023.

Figure 2-2 summarizes the monthly and cumulative energy savings.

Figure 2-2 Ex Ante Savings During the Program Year

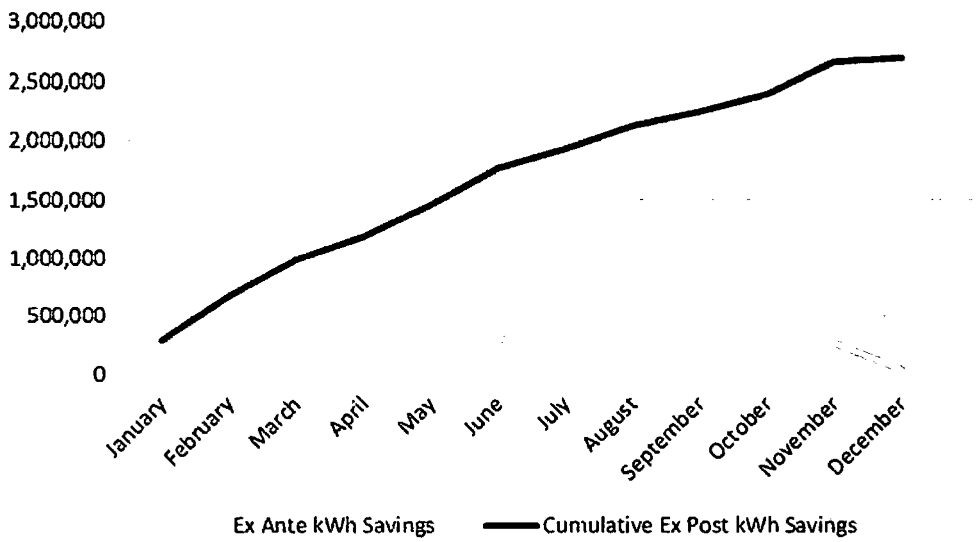


Table 2-15 displays the overall savings resulting from the program measures. Direct install measures provided during home energy assessments accounted for the largest share of expected program savings. This was due to the volume of homes receiving the measures. Although comparatively few participants installed HVAC systems, these systems accounted for the second largest share of energy savings because of the amount of savings associated with each installation.

Table 2-15 Number of Participating Homes and Expected Savings per Home by Measure Type

Measure Type	*Number of Participants*	*Ex Post kWh Savings*	*Ex Post kWh per Home*
Direct Install-Lighting	1670	1,172,686	702
Direct Install-Envelope	1505	531,017	353
Direct Install-Heating and cooling	1147	803,345	700
Direct Install-Water heating	965	176,499	183
Major Measure-Envelope	36	6,440	179
Major Measure-Heating and cooling	6	4,534	756

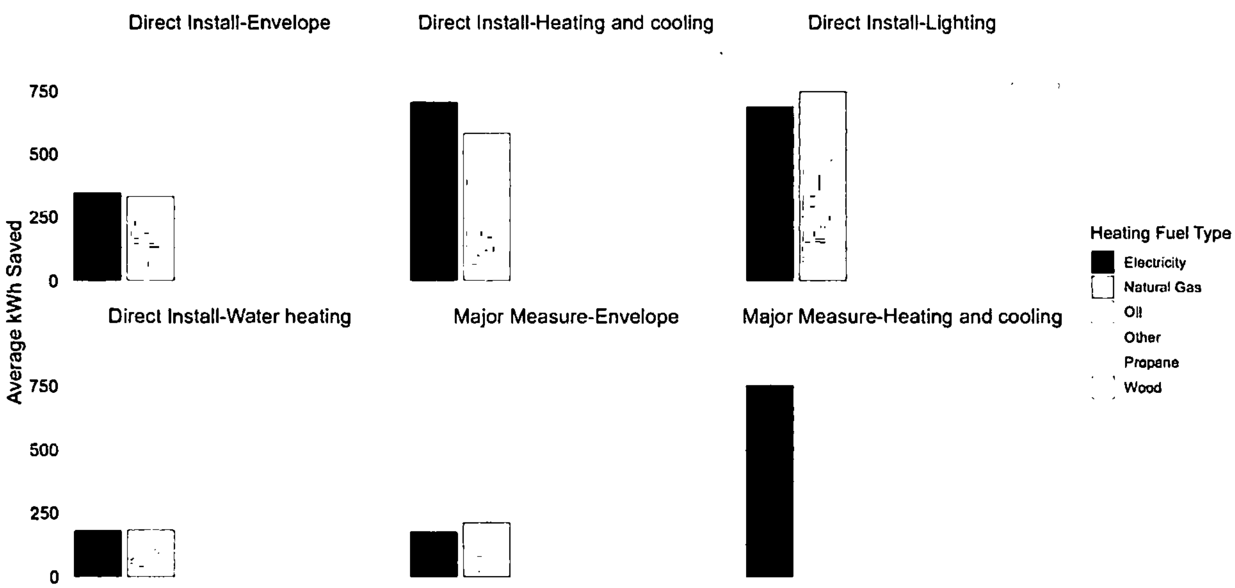
Table 2-16 summarizes the number end-use types addressed in participants' homes. On average, participants received measures covering 2.7 end-uses and about 87% received measures for more than one end-use.

Table 2-16 Number of End-Uses Addressed in Project during Program Year

Number of End-Uses Addressed	*Number of Participants*
1	245
2	521
3	708
4	477
5	2
Average Number of End-Uses Addressed	2.7

Figure 2-3 summarizes the average ex post savings per participant by measure type. As shown, direct install envelope and heating and cooling generated savings for those customers that do not have electric heating for their primary heating.

Figure 2-3 Ex Post Savings by Measure Type and Heating Fuel Type



To understand the types of measures that different participants received, the Evaluation Team clustered participants by measure type implemented through the program. The results are shown in Table 2-17. Overall, the primary participation tracks involve customers who:

- Receive direct install measures for two to four end uses, 87% of participants fell into this group.
- All but two participants that completed a major measure project also received direct install measures for at least one end-use (2% of participants received major measures).

Table 2-17 Summary of Measures Received by Participants

Number of Participants	Total Ex Post kWh Savings	Average kWh Savings per Participant	Direct Install Lighting	Direct Install Envelope	Direct Install Water Heating	Direct Install Heating and Cooling	Major Measure Building Envelope	Major Measure Heating and Cooling
461	766,818	1,663	•	•	•	•		
338	532,746	1,576	•	•		•		
221	268,736	1,216	•	•				
199	238,123	1,197	•	•	•			
166	143,196	863	•					
108	209,337	1,938	•		•	•		
85	89,204	1,049		•		•		
81	150,756	1,861	•			•		
72	90,477	1,257	•		•			
64	38,085	595		•				
56	50,618	904		•	•			
52	63,301	1,217		•	•	•		
6	8,074	1,346	•	•			•	
6	4,568	761				•		
6	1,216	203					•	
4	6,688	1,672	•	•		•	•	
4	6,065	1,516		•	•	•	•	
4	3,874	968	•	•	•		•	
3	4,217	1,406		•		•	•	
3	1,749	583		•			•	
2	4,191	2,096	•	•	•	•	•	
2	2,897	1,448	•	•	•			•
2	2,045	1,022	•				•	
2	236	118			•			
1	2,388	2,388	•	•				•
1	2,338	2,338	•		•	•	•	
1	763	763	•		•	•		•
1	359	359			•	•		
1	805	805	•				•	•
1	650	650						•

Table 2-18 summarizes trade ally participation in the program.. One trade ally completed 53% of the program projects, two completed 11-12% of the program projects each, and the remainder completed 3 to 7% of the projects. These values largely represent the results of the trade ally's availability program allocation of projects since trade allies were not permitted to actively recruit participants.

Table 2-18 Trade Ally Participation

Trade Alley	*Number of Projects Completed*	*Total Ex Post kWh*	*Average Project Ex Post Savings*
TA2	1,043	1,592,267	1,527
TA7	235	335,236	1,427
TA4	222	217,456	980
TA1	142	216,233	1,523
TA5	135	197,471	1,463
TA6	68	70,078	1,031
TA3	58	49,619	856
TA8	53	16,159	305

2.4.2 Program Design and Operations

The Evaluation Team conducted an in-depth interview with the Company program coordinator who is responsible for managing the Home Performance program. The coordinator's role includes overseeing day-to-day operations, scheduling meetings with contractors, and addressing any issues or questions that arise. The program coordinator meets with the implementation contractor for the home performance program biweekly. Additionally, the program coordinator tracks invoices, manages financials, and ensures budgets are on track. The program coordinator also assists with customer service by addressing questions or concerns raised by customers and either helping or redirecting them to the appropriate program contractor.

Overall, the Home Performance program has experienced minimal changes in the past year. The coordinator discussed efforts made to enhance the enrollment process and make the program benefits clearer to customers. The program coordinator has been focused on improving customer experience through marketing initiatives and email communication. They have aimed to simplify the enrollment process by reducing the number of steps required. For example, they have worked on ensuring that customers can access the program portal with just one click instead of navigating through multiple pages. Additionally, in some instances, the customer account number has been included in the email to streamline the enrollment process. These efforts are intended to make it easier for customers to understand and participate in the program.

The marketing efforts for the program are not segmented or customized to cater to specific communities or customer segments. The approach is to reach a broad audience without specific targeting based on demographics or community characteristics.

Simplifying the customer journey and clearly communicating the benefits have proven to be successful strategies, while longer emails and multiple steps in the process have shown less effective for marketing the program. The program coordinator indicated that the following elements work well: 1) keeping the marketing message simple and straightforward, with clear steps and easy-to-follow links for customers; 2) highlighting the value of the program, emphasizing potential savings and benefits to attract customers; 3) providing the customer's account number directly in the email to make it easy for them to sign up for the program; and 4) conducting gift card promotions for scheduling and completing home energy assessments, which have generated a good response.

Based on the feedback received from the home assessment reports and surveys, revisions were made to the reports, including the addition of more tips related to appliances and different parts of the home. Cross-promotion with other programs was also introduced. Furthermore, the format of the report was changed from a link to a PDF to ensure better delivery and reduce complaints. These improvements have addressed previous issues and enhanced the participant experience.

There were not any specific process changes to the application process, but delays in the participation process were addressed through improved contractor training and implementation. These efforts have helped to enhance the efficiency of the assessment process, but no significant process changes have been made to shorten the overall timeline.

Excel sheets serve as the primary tool for monitoring and managing the program. Excel is used to track program applications, invoices, project details, and any other associated data (e.g., kWh and kW savings). The program coordinator indicated that the current tracking system used for developing reporting and program management is working well. However, the coordinator did acknowledge that there is always room for improvement and was open to learning from other program managers to enhance the current tracking system. Additionally, the program collects feedback from program participants through an in-house survey, which is typically sent out via email and consists of about 10 to 12 questions. After a period of two to three weeks, the feedback is collected and analyzed. This feedback, along with the survey data from the evaluation, provides valuable insights to identify areas for improvement and make necessary changes in collaboration with the program contractors. According to the program coordinator, the feedback received has been instrumental in making improvements and enhancing the program.

2.4.2.1 Project Quality Assurance and Control Processes

Applications are reviewed by staff. The application review includes the following steps:

- Verifying that the account is eligible for the program;
- None of the measures listed on the application have been submitted under a different application;
- Verifying that all the fields for the home energy assessment are completed by the contractor;
- Verifying that specification sheets are included with the application submission; and
- Verifying that there is a customer signature.

Staff verifies that measure savings are calculated correctly. Up to 10% of projects are inspected by program staff. Once projects have been verified and approved, the payment is batched with other completed projects for payment.

The implementation of the QA/QC procedures involves the following elements:

- QA/QC Reporting: The program implementation contractor reports any issues or deviations from program requirements to the program management team. These reports could include instances where installations or practices are not in compliance with regulatory requirements or industry best practices.

- Internal Discussions and Process Improvement: When issues or deviations arise, the program management team engages in internal discussions to address specific cases and determine appropriate actions. This may involve setting up processes or guidelines to ensure compliance moving forward.
- Trust in the Program Contractor: There is a level of trust placed in the program implementation contractor, with the expectation that they will follow the established rules and practices. However, if concerns arise or if actions are not aligned with program requirements, discussions are held to rectify the situation and ensure adherence to compliance standards.
- Case-by-case Approach: Each issue or deviation may be treated on a case-by-case basis, where the program management team discusses and determines the best course of action. This approach allows for tailored solutions to address specific situations while maintaining overall program compliance.
- Monitoring customer complaints and concerns: By actively monitoring and addressing customer complaints and concerns, the program aims to ensure customer satisfaction and continuously improve the program's operations. Customer complaints or concerns are addressed and resolved through a structured process. When a customer registers a complaint or raises a concern, they typically reach out to customer service or use a designated mailbox for such issues. These complaints are then forwarded to the program manager, who reviews and assesses them. The program manager will determine the nature of the complaint and its relevance to the program. If necessary, the complaint is shared with the implementation contractor so that they can address the issue. In cases where a particular issue has been reported multiple times, it is treated as a recurring problem. These recurring issues are discussed during biweekly calls between the Company and the implementation contractor with the goal of finding ways to improve the process and preventing the issue from happening again in the future.

2.4.2.2 Program Tracking

Project applications, projects, and rebates are tracked in a custom database. An online application number is used to track a project from start to finish. TRC staff described the current system as comprehensive and used for reporting. There were not any issues identified by TRC or the Company with the current system and believe it is working well for program management.

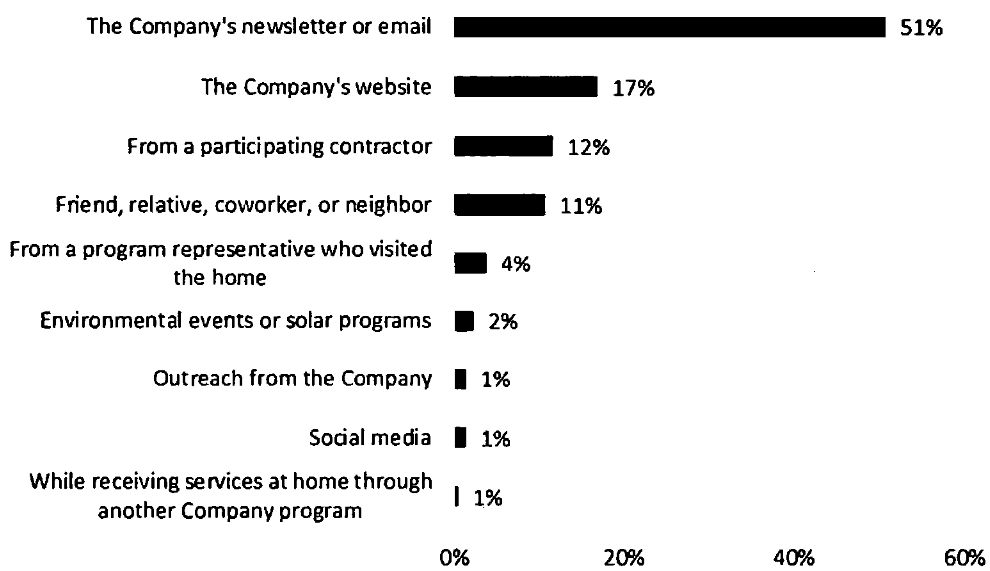
2.4.3 Participant Survey Results

The Evaluation Team conducted surveys with customers who participated in the Home Performance Program. The purpose of the survey was to gather information from participants regarding how they learned about the program, satisfaction with program elements, implementation of energy efficiency recommendations, and other program-related information. Many of the questions included in the survey were used to inform the gross and net impact analyses for the program. These data are discussed in Section 2.3.3 of the report, while this section summarizes participant feedback about their experience participating in the program.

2.4.3.1 Customer Awareness and Initiating Participation

The primary sources of initial program awareness were communications from the Company. Fifty-one percent of respondents became aware of the program through newsletters or email communications from the Company, while 17% discovered it through the program website. Other sources of program awareness included interactions while receiving services at home through another Company program, social media, outreach efforts from the Company, attendance at environmental events or solar programs, information from program representatives who visited homes, recommendations from friends, relatives, coworkers, or neighbors, and referrals from participating contractors. See Figure 2-4 for additional information.

Figure 2-4 Source of Initial Program Awareness (n = 213)



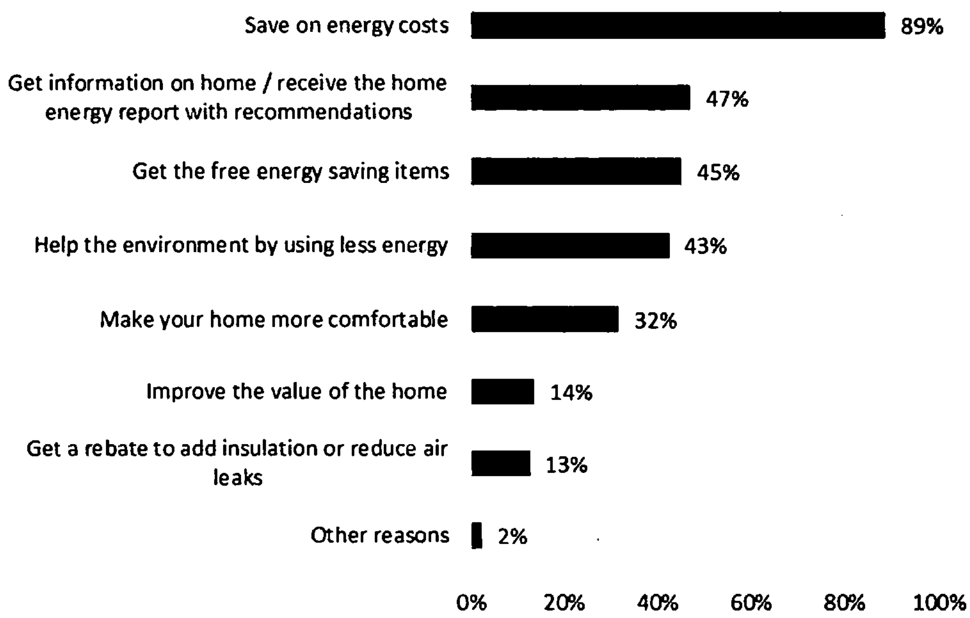
Participants in the program initiated their involvement through distinct channels. The most common way customers began participating was enrolling via the Home Performance portal. Thirty-seven percent of respondents began their participation by directly contacting the program's contact phone number, followed by 17% of participants who enrolled by the contractor responsible for implementing efficiency improvements (see Table 2-19).

Table 2-19 How Customers began Participation in the Program

Rating	*Percent of Respondents (n = 192)*
You called the program contact number	37%
You enrolled using the Home Performance portal	46%
The contractor that completed the efficiency improvements enrolled you	17%

Saving on energy costs was the most common motivation for participating in the program. As depicted in Figure 2-5, the leading motivation for program participation was saving on energy costs, with 89% of respondents indicating this. Additionally, 47% of participants sought information about their homes. Additional motivations for participation included securing rebates for insulation or addressing air leaks, enhancing home value, increasing overall home comfort, contributing to environmental conservation by reducing energy usage, and availing free energy-saving items.

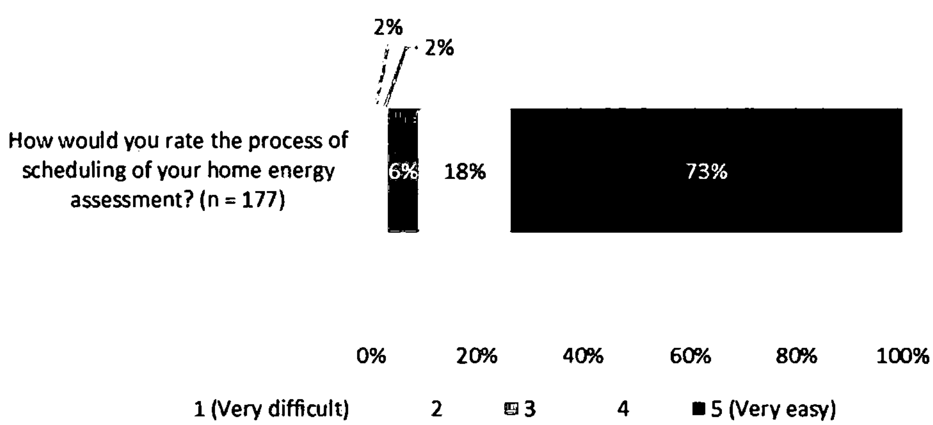
Figure 2-5 Motivations for Participating in the Program (n = 221)



2.4.3.2 Experience with Home Energy Assessment

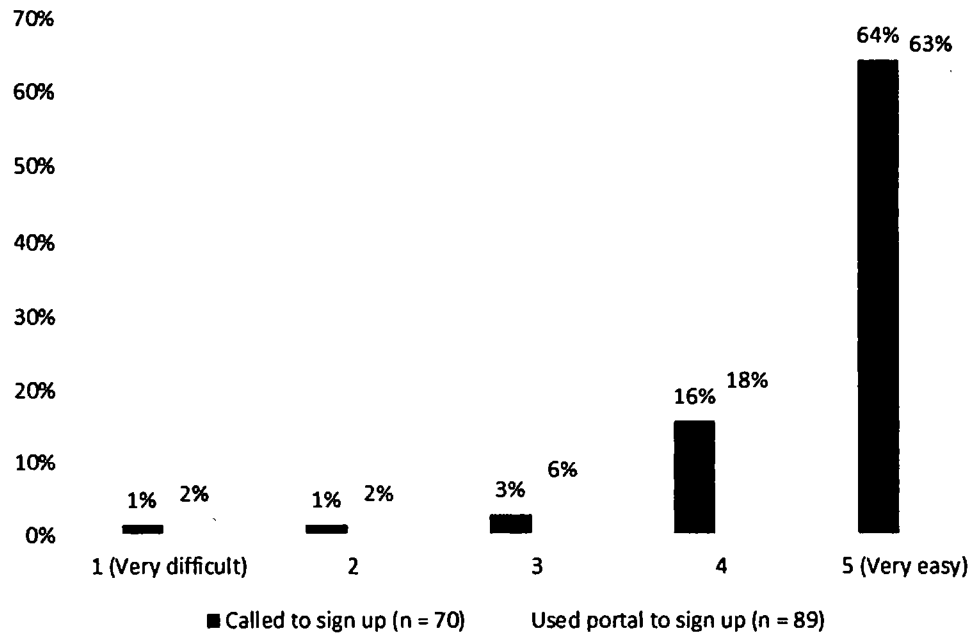
Participants generally found scheduling the energy assessment to be easy. Eighty-one percent of respondents stated that they scheduled the home energy assessment and 98% reported being home during the assessment. The majority of all respondents (73%) rated the process of scheduling their home energy assessment as very easy and an additional 18% rated it as somewhat easy (cited as 4 on a 5-point scale). See Figure 2-6 for more details.

Figure 2-6 Ease of Scheduling Home Energy Assessment



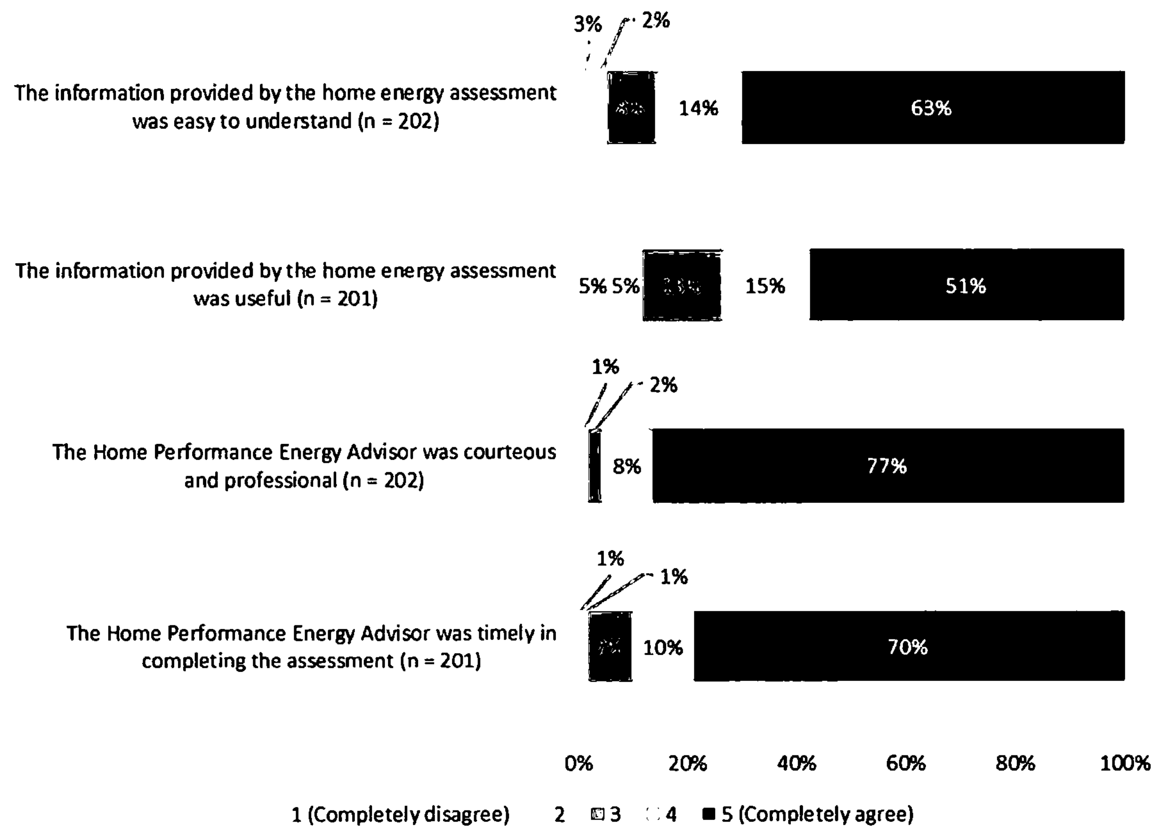
Breaking out the responses for those who signed up using the portal or signed up by telephone, customers who utilized the portal for sign-up reported comparable levels of ease compared with those who opted for phone registration (see Figure 2-7).

Figure 2-7 Ease of Scheduling Assessment by Mode of Sign-up



Most participants expressed satisfaction with both the home energy assessment and the Energy Advisor. As indicated in Figure 2-8, 77% of respondents agreed that the assessment information was easy to understand, and 66% found it to be useful. However, 12% disagreed with the assessment's usefulness. Ratings for the Energy Advisor were generally positive, with 86% fully agreeing on the advisor's courtesy and professionalism, and 80% acknowledging their timeliness in completing the assessment.

Figure 2-8 Perception of Home Energy Assessment

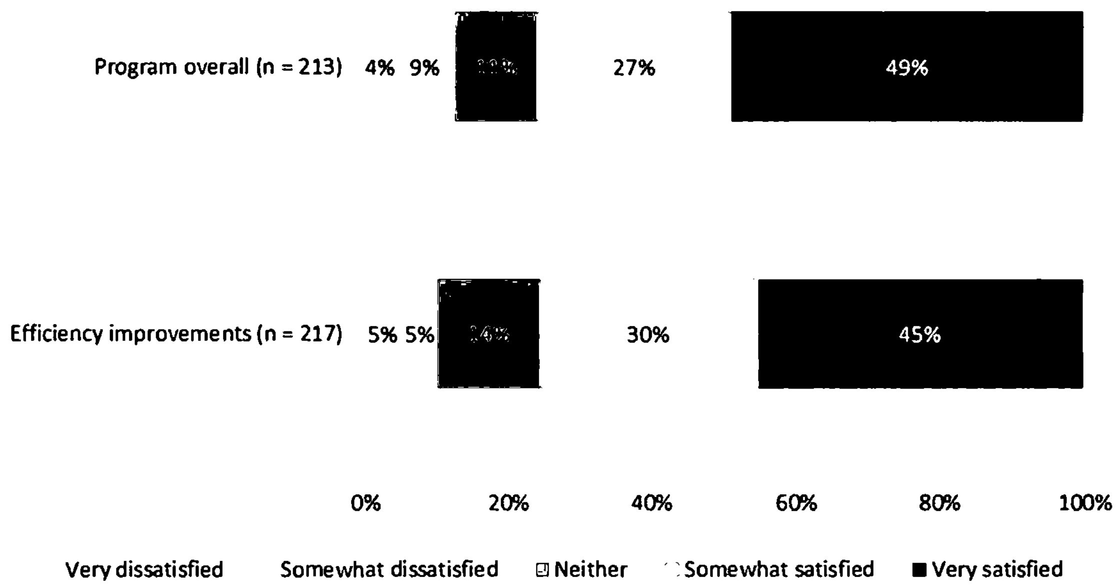


Approximately 27% of respondents reported that the Energy Advisor recommended installing insulation in their homes, while 8% received a recommendation to perform a blower door test to see if there were opportunities for air sealing improvements. Thirty-nine percent of survey respondents indicated they were either somewhat or extremely likely to install the recommended attic insulation in the next 12 months, whereas 41% indicated that they were unlikely to install.

2.4.3.3 Satisfaction with Program

Satisfaction with the installed measures and the program overall was fairly high. Seventy-eight percent of respondents were somewhat or very satisfied with the measures installed and 77% were satisfied with the program overall, as shown in Figure 2-9.

Figure 2-9 Satisfaction of the Home Performance Program



Participants that worked with contractors to complete major measures reported positive experiences with the contractors. All seven survey respondents that worked with a contractor to install major measures either somewhat or completely agreed that the contractor they worked with was timely in completing the work, the contractor's work was high quality, and the contractor was courteous and professional.

Some participants expressed dissatisfaction with the efficiency improvements program, citing various concerns. Although dissatisfied participants were in the minority, there were some common themes in the reasons for their dissatisfaction. The main themes in the comments were that some participants thought that assessment was not thorough/did not learn enough, that the improvements made were minor or did not meet expectations, or that they had not noticed any energy savings (see Table 2-22 for the summary of comments). Example comments included:

> *I was hoping that it would have been more informative.*
>
> *I was hoping for some evaluations of air flow/entry/loss and recommendations of improvements that could be done to be more comfortable and save money. Was not impressed with visit at all.*
>
> *I was expect[ing]an assessment of our energy usage in our house. You guys looked at our HVAC outside units, swapped some light bulbs and installed weather sealers in some electrical outlets. I was expecting more than this...*
>
> *The LED bulbs were great but that is really all he did. He did check just the ductwork in the basement but did not check any door/window seals, or insulation in the crawlspace. I thought it would be a more through [sic] inspection to tell us how to better save money and make our home more energy efficient.*

Regression analysis of key drivers of program satisfaction. The Evaluation Team regressed overall program satisfaction on data related to customer perceptions of the home assessment, motivations for participating in the program, the number of measures installed, and water and space heating to understand what factors were most strongly related to overall program satisfaction. The regression model explained a moderate level of variation in overall program satisfaction ratings, as shown in the R-squared values presented in Table 2-20. Table 2-21 shows the results for the predictor variables. As shown, ratings of how useful the energy assessment was the strongest predictor of overall program satisfaction.

Table 2-20 Overall Model Fit

Sample Size	*R-squared*	*Adjusted R-squared*	*P-Value*	*Model Fit (AIC)*
213	42%	38%	< 0.01	576

Table 2-21 Regression Coefficients for Predictor Variables

Variable	*Relative Importance*	*Standardized Coefficient*	*P-Value*
The information provided by the home energy assessment was useful	0.49	0.29	<0.01
Help environment	0.04	0.08	0.06
Get free items	0.03	0.05	0.20
Energy Advisor was timely in completing the assessment	0.14	0.14	0.27
Energy Advisor was courteous and professional	0.05	0.05	0.28
Save on energy costs	0.00	0.01	0.41
Home has electric heating	0.01	-0.03	0.46
Improve home value	0.02	0.03	0.55
Improve comfort	0.01	-0.01	0.68
Get a rebate	0.01	0.00	0.69
Home has electric water heating	0.00	-0.04	0.80
Get information on home	0.01	0.03	0.80
Number of DI measure types installed	0.00	0.07	0.91
The information provided by the home energy assessment was easy to understand	0.19	0.17	0.99

Analysis of participant open-ended responses. Table 2-22 summarizes the types of responses respondents provided when asked their reasons for being dissatisfied with the program. The most commonly mentioned reasons for dissatisfaction were that participants did not see the value in the program and felt there was not much learned from the assessment, or it did not meet their expectation.

Table 2-22 Summary of Open-Ended Explanations for Dissatisfaction

Type of Comment	*Number of Responses*
Did not learn enough / assessment not thorough	16
Expected more energy efficiency improvements / improvements made not valued	15
Did not save on energy costs	6
Scheduling difficulty	1

2.5 Findings and Recommendations

The Home Performance program has undergone minimal changes over the past year, with a notable shift in funding allocation being the most significant modification. The coordinator's focus on improving customer experience through streamlined enrollment processes and clearer communication of program benefits has been evident. Efforts to simplify the customer journey, such as one-click access to the program portal and including account numbers in emails, have proven successful in enhancing participant understanding and engagement.

The program's marketing approach targets a broad audience without specific demographic or community-based targeting. The strategies lack segmentation or customization for specific communities or customer segments. While simplifying communication and emphasizing program value have been effective strategies, longer emails and complex enrollment processes have shown less success. Notably, gift card promotions for home energy assessments have generated positive responses.

Feedback-driven improvements have been made to home assessment reports, including additional tips and cross-promotion with other programs. The format of the reports was also modified for better delivery. Although there were no significant changes to the application process, efforts to address delays through improved contractor training have enhanced the efficiency of the assessment process. Excel sheets remain the primary tool for program monitoring and management, with the coordinator open to learning from other program managers for potential enhancements. The feedback collection process, both through in-house surveys and external evaluations, has played a role in identifying areas for improvement and refining the overall program.

Communications from the Company drove participation, with most finding the scheduling process to be easy and reporting a positive experience with the home assessment. Participants primarily became aware of the program through communications from the Company, including newsletters, email communications, and the program website. Survey respondents typically initiated their involvement by enrolling via the Home Performance portal. The most common motivation for participating in the program was saving money on energy costs. Participants found little difficulty in scheduling their home energy assessment, with high satisfaction levels for both the assessment process and the Energy Advisor. The majority agreed that the assessment information was easy to understand and useful. Ratings for the Energy Advisor highlighted positive feedback regarding courtesy, professionalism, and timeliness.

Survey results highlight the positive experiences among participants. The survey results indicate generally positive feedback from participants regarding their experiences with the program's contractor, with unanimous agreement on the contractor's timeliness, work quality, and professionalism. Overall satisfaction with the program and the installed measures was high among participants.

Some participants were dissatisfied with the program and the reasons given for their dissatisfaction tended to relate to the assessment or improvements made not meeting their expectations. Respondents reported expecting a more thorough assessment and analysis of home energy use or expected that more extensive efficiency improvements would be made.

- **Recommendation 1:** Enhance communication and set realistic expectations: Improved pre-engagement communication can help align participant expectations with the program's offerings. This would include communication on the scope of assessments and improvements that the program offers from the outset. Detailed descriptions of the assessment process describing what is done during an assessment to understand how the energy performance of the home can be improved may help customers understand what will happen during the visit.[4] Additionally, conveying the types of efficiency improvements typically made may help set expectations. These improvements could be made to the website description of the program and/or communicated to participants via email when they sign up for an assessment.

  Video content could be added that delivers both information about the assessment process but could also include statements from participants who valued the service. Similarly, video content could be used to communicate how the air sealing measures, for example, are important in helping keep the home more comfortable and helping them save energy.[5]

[4] See for example the "What does a Home Energy Assessment Entail?" section of this NYSERDA website: https://www.nyserda.ny.gov/Featured-Stories/The-Complete-Guide-to-Home-Energy-Assessments

[5] See for example: https://www.esource.com/10274-002/how-do-you-use-customer-testimonials-promote-residential-energy-efficiency-programs

3 Efficient Products

3.1 Program Description

The Efficient Products Program promoted and provided incentives for energy efficient LED lighting, weatherization measures, and appliances. The program included point-of-sale discounts and rebates based on applications submitted after the purchase of the energy efficient appliance.

Rebates were provided for several efficient products:

- ENERGY STAR pool pumps;
- ENERGY STAR computer monitors;
- ENERGY STAR electric clothes dryers;
- ENERGY STAR central air conditioners;
- ENERGY STAR clothes washers;
- ENERGY STAR refrigerators and freezers;
- ENERGY STAR heat pump water heaters;
- ENERGY STAR air purifier and cleaners;
- ENERGY STAR electric vehicle supply equipment;
- ENERGY STAR dehumidifiers;
- Central furnace efficient fan motors;
- Shower thermostatic restriction valves;
- Room air conditioners; and
- Ductless mini-split heat pumps.

The program also provided retail discounts for the following products:

- LED lighting;
- Caulk window and door sealant;
- Spray foam insulating sealant; and
- Electrical outlet and switch gasket.

3.1.1 Program Eligibility Requirements

Eligible Efficient Product participants include active residential customers served by the Company. To be eligible, customers must have purchased discounted measures from a participating retailer or submitted an application for an appliance rebate.

3.1.2 Summary of Savings by Eligible Rate Schedule

Table 3-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule. Note that this data is only applicable to the subset of program activity associated with program participants who received incentives directly, i.e., the analysis does not include retail discount incentives. The analysis does not include data associated with midstream program activity for which participant information was unavailable.

Table 3-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	309,161	2,392	129.2	12,719	1.02%

3.2 Data Collection

This section summarizes sampling and data collection procedures for the evaluation of the Efficient Products Program.

3.2.1 Survey Data Collection

The Evaluation Team collected data through three surveys to support the evaluation of the Efficient Products Program. A survey of participants in the downstream rebate component of the program was used to:

- Verify the measures installed or incentivized through the program;
- Collect data on decision making to estimate program net savings; and
- Collect feedback from participants on their experience with the program.

To estimate the sufficiency of the sample sizes, the Evaluation Team calculated the sample size needed to meet the 90/10 precision and confidence level. The sample size to meet 90/10 requirements is calculated using the coefficient of variation defined as:

$$CV(x) = \frac{Standard\ Deviation\ (x)}{Mean(x)}$$

Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated by the following equation:

$$n_0 = \left(\frac{1.645 * CV}{RP}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

RP = Required Precision, 10% in this evaluation

A sample of 68 is sufficient to achieve at least 10% precision at the 90% level of confidence. The data collection effort exceeded this target. Table 3-2 summarizes the data collection efforts.

Table 3-2 Survey Response Summary – Rebate Participant Survey

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Efficient Products Participant Survey	Email	November 2023	1,939	294
Efficient Products Participant Survey	Phone	November 2023	113	21
Total			2,052	315

The Evaluation Team also referenced data collected through the PY2022 Home Energy Report treatment and control group survey in estimating PY2023 energy impacts. The data collected were used to:

- Estimate the influence of discounts on the discounted weatherization products on the purchase decision for the purpose of estimating net savings; and
- Estimate the rate at which the discounted weatherization products are installed after purchase.

Similarly, the Evaluation Team collected data through a PY2022 general population survey of residential customers to estimate the rate at which purchased LED bulbs and nightlights are installed to develop an in-service rate for these discounted products.

3.3 Impact Evaluation Approach

This chapter addresses the kWh savings and peak kW reductions resulting from measures installed in the homes of customers that received measures through the Efficient Products Program during the period January 2023 through December 2023.

The M&V approach for the 2023 Efficient Products Program is aimed at the following:

- Determining the number of measures reported as being installed through the program;
- Verifying the number of measures that are currently installed;
- Estimating annual gross and net kWh savings for measures implemented; and
- Estimating annual gross and net kW reduction for measures implemented.

3.3.1 Methodology for Estimating Gross Savings

The methodology used for estimating gross savings is described in this section.

Table 3-3 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 3-3 Data Sources for Gross Impact Parameters – Efficient Products Program

Parameter	*Source*
Number of Participants	Program Tracking Data
Measures Installed	Program Tracking Data/ Participant Surveys
Measures Still in Use	Participant Survey
Measure Characteristics	Program Tracking Data/ Mid-Atlantic TRM/ Virginia Weather Data
Home Characteristics	Program Tracking Data

3.3.1.1 Estimation of Gross Savings and Peak Demand Reductions

The methodology used for estimating gross savings impacts is dependent upon the type of measure being analyzed. Categories of measures include the following:

- Efficient central furnace fan;
- Ductless mini-split replacement;
- ENERGY STAR air purifiers;
- ENERGY STAR computer monitors;
- ENERGY STAR central air conditioner;
- ENERGY STAR clothes dryer;
- ENERGY STAR clothes washer;
- ENERGY STAR dehumidifiers;
- ENERGY STAR freezers;
- ENERGY STAR heat pump water heaters;
- ENERGY STAR electric vehicle supply equipment (EVSE) – level 2;
- ENERGY STAR dehumidifier;
- LED lighting;
- LED nightlights;
- ENERGY STAR pool pumps – variable speed;
- ENERGY STAR refrigerators;
- ENERGY STAR room air conditioners;
- Electrical outlet covers;
- Window and door caulking;
- Spray foam insulation; and
- Insulation rolls.

3.3.1.2 Measure Attributes Tracked

Table 3-4 presents information on the equipment specification data tracked by the program.

Table 3-4 Gross Impact Attributes Tracked by Program – Efficient Products Program

Measure	*Attributes Tracked*
Efficient central furnace fan	Site location cooling and heating system type.
Ductless mini-split replacement	Capacity, unit efficiency, site location.
ENERGY STAR air purifiers	Clean air delivery rate
ENERGY STAR computer monitors	Number of units
ENERGY STAR central air conditioner	Capacity, unit efficiency, site location.
ENERGY STAR clothes dryer	ENERGY STAR product ID (Product specifications)
ENERGY STAR clothes washer	ENERGY STAR product ID (Product specifications)
ENERGY STAR dehumidifiers	Capacity (pints/day)
ENERGY STAR freezers	ENERGY STAR product ID (Product specifications)
ENERGY STAR heat pump water heaters	Unit efficiency, site location.
ENERGY STAR electric vehicle supply equipment (EVSE) – level 2	ENERGY STAR product ID (Product specifications)
ENERGY STAR dehumidifier	Model/manufacturer (Product specifications)
LED lighting	Watts, lumens
LED nightlights	Watts
ENERGY STAR pool pumps – variable speed	Rated Horsepower (HP), type,
ENERGY STAR refrigerators	ENERGY STAR product ID (Product specifications)
ENERGY STAR room air conditioners	Capacity, unit efficiency.
Electrical outlet covers	Number of units
Window and door caulking	Number of units
Spray foam insulation	Number of units
Insulation rolls	Number of units, space and cooling system type, R-value

3.3.1.3 In-Service and Verification Rates

The Evaluation Team applied in-service rates developed through the PY2022 evaluation for the retail discount measures. These rates are summarized below in Table 3-5.

Table 3-5 In-Service Rates for Retail Discount Measures

Measure	*In-Service Rate*
Window and Door Caulk	86%
Spray Foam	81%
Electrical Outlet Gasket	99%
Retail LED Lighting	74%

Verification rates for rebate measures were developed from the survey of program participants. Measure specific in-service rates were developed for measures for which at least 10 survey responses were obtained. For all other measures, the average verification rate for all measures was applied. Table 3-6 summarizes the verification rates for the program measures.

Table 3-6 Verification Rates for Rebated Measures

Measure	*Number of Responses*	*Verification Rate*
Mini Split Heat Pump	7	100%
Central Air Conditioner	4	100%
Room Air Conditioner	7	100%
Heat Pump Water Heater	23	100%
Refrigerator	82	100%
Freezer	5	100%
Clothes Washer	71	100%
Clothes Dryer	48	100%
Air Purifier	30	100%
Dehumidifier	81	100%
EV Charging Equipment	8	100%
Shower Thermostatic Restriction Valve	1	100%

3.3.1.4 Measure Specific Calculations

Table 3-7 summarizes the equations and inputs used to estimate the savings of the program measures. The savings calculated using the approaches outlined in the table were adjusted by the verification and in-service rates developed from the survey of program participants to estimate the gross program savings.

Table 3-7 Measure Calculations and Inputs

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
			Measure Name: Mini Split Heat Pump
Savings - 1	*ΔkWh Baseline 1*		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Heating_kwh_exist - ((Capacity_heat_ee / HSPF_base) / 1000 * EFLH_heat)) * ER_Factor) + (((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * ER_Factor * EFLH_cool)*
Savings - 2	*ΔkW Baseline 1*		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF + ((Capacity_cool_exist / EER_exist) - (Capacity_cool_exist / EER_base)) / 1000 * CF * ER_Factor*
Savings - 2	*ΔkWh* (Baseline 2)		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool)*
Savings - 2	*ΔkW* (Baseline 2)		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF*
Input	*Capacity_cool_exist*	Varies	Tracking data.
Input	*Capacity_cool_ee*	Varies	Tracking data.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*SEER_exist*	12.1	PA TRM V2021 Vol. 2, p. 19.
Input	*SEER_base*	14	Mid-Atlantic TRM V10.0, p. 88.
Input	*SEER_ee*	Varies	Tracking data.
Input	*EER_exist*	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	*EER_base*	11.8	Mid-Atlantic TRM V10.0, p. 88.
Input	*EER_ee*	Varies	Tracking data.
Input	*Capacity_heat_ee*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*HSPF_base*	8.2	Mid-Atlantic TRM V10.0, p. 88.
Input	*HSPF_ee*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 124.
Input	*Heating_kwh_exist*	Varies	Pre-project annual electric energy usage. Based on econometric analysis of interval meter data and capped at estimate of electric resistance baseline usage.
Input	*ER_Factor*	0	Normal replacement baseline applied.
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 94.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 94.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 125.
Measure Name: Central Air Conditioner			
Savings - 1	*ΔkWh Baseline 1*		*(((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * Cooling_ER_Factor * EFLH_cool*
Savings - 2	*ΔkW Baseline 1*		*(((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF) + (((Capacity_cool_exist / EER_exist) - (Capacity_cool_ee / EER_base)) / 1000 * Cooling_ER_Factor * CF)*
Savings - 2	*ΔkWh* (Baseline 2)		*((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool*
Savings - 2	*ΔkW* (Baseline 2)		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF*
Input	*Capacity_cool_exist*	Varies	Set equal to Capacity_cool_ee.
Input	*Capacity_cool_ee*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*SEER_exist*	12.1	PA TRM V2021 Vol. 2, p. 42.
Input	*SEER_base*	14	Mid-Atlantic TRM V10.0, p. 74.
Input	*SEER_ee*	Varies	Tracking data.
Input	*EER_exist*	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	*EER_base*	11.8	Mid-Atlantic TRM V10.0, p. 74.
Input	*EER_ee*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 124.
Input	*Cooling_ER_Factor*	0	Normal replacement baseline applied.

Variable Type	Variable Name	Variable Value	Variable Value Source
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 74.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 74.
Inc Cost		Varies	PA Act 129 Phase IV Energy Efficiency and Peak Demand Reduction Market Potential Study Report, Appendix D1 Table D2.
			Measure Name: Room Air Conditioner
Savings	ΔkWh		(Hours_cool * Capacity_cool_ee * (1 / CEER_base - 1 / CEER_ee)) / 1000
Savings	ΔkW		(Capacity_cool_ee * (1 / CEER_base - 1 / CEER_ee)) / 1000 * CF
Input	Capacity_cool_ee	Varies	Tracking data.
Input	Hours_cool	325	Mid-Atlantic TRM V10.0, p. 70-71.
Input	CEER_base	Varies	Mid-Atlantic TRM V10.0, p. 70.
Input	CEER_ee	Varies	Tracking data.
Input	CF	0.3	Mid-Atlantic TRM V10.0, p. 71.
EUL		12	Mid-Atlantic TRM V10.0, p. 72.
Inc Cost		20	Mid-Atlantic TRM V9.0, p. 79.
			Measure Name: Heat Pump Water Heater
Savings	ΔkWh		((GPD * 365.25 * γWater * (Tout - Tin) * 1) / 3412) * (1 / UEFbase - 1 / UEFeff) + (((1 / UEFeff * GPD * 365.25 * γWater * (Tout - Tin) * 1) / 3412) * LFcool * 0.33 / COPcool) - ((((1 / UEFeff * GPD * 365.25 * γWater * (Tout - Tin) * 1) / 3412)) * LFheat * 0.47) / COPheat * %Electric_Heat
Savings	ΔkW		IF(GPD<=55,0.09 * UEFeff / 3.41,0.11 * UEFeff / 3.34)
Input	GPD	Varies	Mid-Atlantic TRM V10.0, p. 150.
Input	Tout	125	Mid-Atlantic TRM V10.0, p. 150.
Input	Tin	60.9	Mid-Atlantic TRM V10.0, p. 150.
Input	UEFbase	Varies	Mid-Atlantic TRM V10.0, p. 153.
Input	UEFeff	Varies	Product specifications.
Input	γWater	8.33	Mid-Atlantic TRM V10.0, p. 150.
Input	LFcool	Varies	Mid-Atlantic TRM V10.0, p. 152.
Input	LFheat	Varies	Mid-Atlantic TRM V10.0, p. 152.
Input	COPcool	3.08	Mid-Atlantic TRM V10.0, p. 151.
Input	COPheat	1.95	Mid-Atlantic TRM V10.0, p. 152.
Input	%Electric_Heat	0.2286432	Estimated share of installed heat pump water heater homes with electric space heating. 2020 RECS Middle Atlantic Census Region data.
EUL		13	Mid-Atlantic TRM V10.0, p. 153.
Inc Cost		460	Mid-Atlantic TRM V9.0, p. 200.
			Measure Name: Refrigerator
Savings	ΔkWh		kWhBASE - kWhEE
Savings	ΔkW		(kWhBASE - kWhEE) / 8760 * TAF * LSAF
Input	kWhBASE	Varies	ENERGY STAR database for applicable product ID.
Input	kWhEE	Varies	ENERGY STAR database for applicable product ID.
Input	TAF	1.23	Mid-Atlantic TRM V10.0, p. 60.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*LSAF*	1.15	Mid-Atlantic TRM V10.0, p. 60.
EUL		12	Mid-Atlantic TRM V10.0, p. 61.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 61.
Measure Name: Freezer			
Savings	*ΔkWh*		*kWhBASE - kWhEE*
Savings	*ΔkW*		*(kWhBASE - kWhEE) / 8760 * TAF * LSAF*
Input	*kWhBASE*	Varies	ENERGY STAR database for applicable product ID.
Input	*kWhEE*	Varies	ENERGY STAR database for applicable product ID.
Input	*TAF*	1.23	Mid-Atlantic TRM V10.0, p. 60.
Input	*LSAF*	1.15	Mid-Atlantic TRM V10.0, p. 60.
EUL		11	Mid-Atlantic TRM V10.0, p. 56.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 61.
Measure Name: Clothes Washer			
Savings	*ΔkWh*		*((Capacity * 1 / IMEFbase * Ncycles) * (%Cwbase + (%DHWbase * %Electric_DHW) + %Dryerbase * %Electric_dryer)) - ((Capacity * 1 / IMEFeff * Ncycles) * (%CWeff + (%DHWeff * %Electric_DHW) + (%Dryereff * %Electric_dryer)))*
Savings	*ΔkW*		*(((Capacity * 1 / IMEFbase * Ncycles) * (%Cwbase + (%DHWbase * %Electric_DHW) + %Dryerbase * %Electric_dryer)) - ((Capacity * 1 / IMEFeff * Ncycles) * (%CWeff + (%DHWeff * %Electric_DHW) + (%Dryereff * %Electric_dryer)))) / Hours * CF*
Input	*Capacity*	Varies	ENERGY STAR database for applicable product ID.
Input	*IMEFbase*	Varies	Mid-Atlantic TRM V10.0, p. 165.
Input	*IMEFeff*	Varies	ENERGY STAR database for applicable product ID.
Input	*Ncycles*	254	Mid-Atlantic TRM V10.0, p. 165.
Input	*%Cwbase*	0.07	Mid-Atlantic TRM V10.0, p. 165.
Input	*%CWeff*	Varies	Mid-Atlantic TRM V10.0, p. 165-166.
Input	*%DHWbase*	0.28	Mid-Atlantic TRM V10.0, p. 165.
Input	*%DHWeff*	Varies	Mid-Atlantic TRM V10.0, p. 165-166.
Input	*%Dryerbase*	0.65	Mid-Atlantic TRM V10.0, p. 165.
Input	*%Dryereff*	Varies	Mid-Atlantic TRM V10.0, p. 165-166.
Input	*%Electric_DHW*	0.31	Mid-Atlantic TRM V10.0, p. 166.
Input	*%Electric_dryer*	0.68	Mid-Atlantic TRM V10.0, p. 166.
Input	*Hours*	265	Mid-Atlantic TRM V10.0, p. 166.
Input	*CF*	0.029	Mid-Atlantic TRM V10.0, p. 166.
EUL		14	Mid-Atlantic TRM V10.0, p. 169.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 220.
Measure Name: Clothes Dryer			
Savings	*ΔkWh*		*(Load / CEFbase - Load / CEFeff) * Ncycles * %Electric*
Savings	*ΔkW*		*((Load / CEFbase - Load / CEFeff) * Ncycles * %Electric) / Hours * CF*
Input	*Load*	Varies	Mid-Atlantic TRM V10.0, p. 178.

Variable Type	Variable Name	Variable Value	Variable Value Source
Input	CEFbase	Varies	Mid-Atlantic TRM V10.0, p. 178.
Input	CEFeff	Varies	ENERGY STAR database for applicable product ID.
Input	Ncycles	311	Mid-Atlantic TRM V10.0, p. 178.
Input	%Electric	1	Mid-Atlantic TRM V10.0, p. 178.
Input	Hours	290	Mid-Atlantic TRM V10.0, p. 179.
Input	CF	0.029	Mid-Atlantic TRM V10.0, p. 179.
EUL		14	Mid-Atlantic TRM V10.0, p. 180.
Inc Cost		75	Mid-Atlantic TRM V9.0, p. 245.
Measure Name: Air Purifier			
Savings	ΔkWh		(Hours * (SmokeCADR_base / (SmokeCADR_per_watt_base * 1000)) + (8760 - Hours) * PartialOnModePower_base / 1000) - (Hours * (SmokeCADR_eff / (SmokeCADR_per_watt_eff * 1000)) + (8760 - Hours) * PartialOnModePower_eff / 1000)
Savings	ΔkW		((Hours * (SmokeCADR_base / (SmokeCADR_per_watt_base * 1000)) + (8760 - Hours) * PartialOnModePower_base / 1000) - (Hours * (SmokeCADR_eff / (SmokeCADR_per_watt_eff * 1000)) + (8760 - Hours) * PartialOnModePower_eff / 1000)) / Hours * CF
Input	SmokeCADR_base	Varies	Illinois TRM V11.0 Vol. 3, p. 8.
Input	SmokeCADR_eff	Varies	Product specifications.
Input	SmokeCADR_per_watt_base	Varies	Illinois TRM V11.0 Vol. 3, p. 8.
Input	SmokeCADR_per_watt_eff	Varies	Product specifications.
Input	PartialOnModePower_base	Varies	Illinois TRM V11.0 Vol. 3, p. 8.
Input	PartialOnModePower_eff	Varies	Product specifications.
Input	Hours	5840	Illinois TRM V11.0 Vol. 3, p. 8.
Input	CF	0.667	Illinois TRM V11.0 Vol. 3, p. 8.
EUL		9	Illinois TRM V11.0 Vol. 3, p. 6.
Inc Cost		Varies	Illinois TRM V11.0 Vol. 3, p. 8.
Measure Name: Dehumidifier			
Savings	ΔkWh		Capacity * 0.473 / 24 * Hours * (1 / L_per_kWh_Base - 1 / L_per_kWh_Eff)
Savings	ΔkW		Capacity * 0.473 / 24 * (1 / L_per_kWh_Base - 1 / L_per_kWh_Eff) * CF
Input	Capacity	Varies	Product specifications (pints/day).
Input	Hours	1632	Mid-Atlantic TRM V10.0, p. 182.
Input	L_per_kWh_Base	Varies	Mid-Atlantic TRM V10.0, p. 182.
Input	L_per_kWh_Eff	Varies	Product specifications.
Input	CF	0.37	Mid-Atlantic TRM V10.0, p. 183.
EUL		12	Mid-Atlantic TRM V10.0, p. 183.
Inc Cost		5	Mid-Atlantic TRM V9.0, p. 235.
Measure Name: Pool Pump			

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Savings	*ΔkWh*		*(Gallons * Turnovers * (1 / WEFbase - 1 / WEFeff) * Days) / 1000*
Savings	*ΔkW*		*(kWh_per_Day_base / Hrs_per_Day_base - kWh_per_Day_eff / Hours_per_Day_eff) * CF*
Input	*Gallons*	Varies	Illinois TRM V11.0 Vol. 3, p. 452.
Input	*Turnovers*	2	Illinois TRM V11.0 Vol. 3, p. 452.
Input	*WEFbase*	Varies	Illinois TRM V11.0 Vol. 3, p. 452.
Input	*WEFeff*	Varies	Product specifications.
Input	*Days*	122	Illinois TRM V11.0 Vol. 3, p. 452.
Input	*kWh_per_Day_base*	Varies	Illinois TRM V11.0 Vol. 3, p. 453.
Input	*Hrs_per_Day_base*	Varies	Illinois TRM V11.0 Vol. 3, p. 453.
Input	*kWh_per_Day_eff*	Varies	Illinois TRM V11.0 Vol. 3, p. 453.
Input	*Hours_per_Day_eff*	Varies	Illinois TRM V11.0 Vol. 3, p. 453.
Input	*CF*	0.831	Illinois TRM V11.0 Vol. 3, p. 453.
EUL		10	Mid-Atlantic TRM V10.0, p. 196.
Inc Cost		Varies	Illinois TRM V11.0 Vol. 3, p. 451.
Measure Name: EV Charging Equipment			
Savings	*ΔkWh*		*Miles_Driven_per_Year / Miles_Per_kWh * Savings_Rate*
Savings	*ΔkW*		*Miles_Driven_per_Year / Miles_Per_kWh * Savings_Rate / 8760*
Input	*Miles_Driven_per_Year*	13476	U.S. DOT
Input	*Miles_Per_kWh*	3.6	Based on CA CEC, CEC-999-2017-008, p. 4.
Input	*Savings_Rate*	0.1	Zero Emission Technology Development Nissan Technical Center North America Eloi Taha, Level 1 vs Level 2 EVSE Energy Consumption of Production Electric Vehicles.
EUL		10	Texas TRM Vol. 2, p. 393.
Inc Cost		100	U.S. DOE, Costs Associated With Non-Residential Electric Vehicle Supply Equipment, p. 3.
Measure Name: Standard LED			
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.34.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	*ηHeat*	1.74	Mid-Atlantic TRM V9.0, p.36.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	*CF*	0.058	Mid-Atlantic TRM V9.0, p. 37.
Input	*WHFd*	1.17	Mid-Atlantic TRM V9.0, p. 36.
EUL		13.6	Mid-Atlantic TRM V10.0, p. 34.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 38.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Measure Name: Specialty LED			
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.34.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	*ηHeat*	1.74	Mid-Atlantic TRM V9.0, p.36.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	*CF*	0.058	Mid-Atlantic TRM V9.0, p. 37.
Input	*WHFd*	1.17	Mid-Atlantic TRM V9.0, p. 36.
EUL		13.6	Mid-Atlantic TRM V10.0, p. 34.
Inc Cost		Varies	Mid-Atlantic TRM V9.0, p. 38.
Measure Name: Downlight LED			
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.20.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.21.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.22.
Input	*ηHeat*	1.74	Mid-Atlantic TRM V9.0, p.23.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 22.
Input	*CF*	0.058	Mid-Atlantic TRM V9.0, p. 24.
Input	*WHFd*	1.17	Mid-Atlantic TRM V9.0, p. 24.
EUL		20	Mid-Atlantic TRM V10.0, p. 25.
Inc Cost		1.35	Mid-Atlantic TRM V9.0, p.26.
Measure Name: LED Nightlight			
Savings	*ΔkWh*		*(WattsBase * HoursBase - WattsEE * HoursEE) * 365 / 1000*
Savings	*ΔkW*		*0*
Input	*WattsEE*	0.5	Product characteristics.
Input	*WattsBase*	7	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	*HoursEE*	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	*HoursBase*	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
EUL		8	PA TRM V2021 Vol. 2, p. 8.
Inc Cost		3.35	Illinois TRM V11.0 Vol. 3, p. 349.
Measure Name: Window and Door Caulk			

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Savings	*ΔkWh*		*((((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + ((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000) * %Electric_Heat)) * Conversion_Factor*
Savings	*ΔkW*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor * Conversion_Factor*
Input	*ΔCFM_50*	0.689	PA TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per linear foot).
Input	*CDD*	Varies	Calculated using regional weather data.
Input	*SEER*	13	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36.
Input	*LM*	Varies	PY2019 EM&V Results. Latent multiplier to convert the calculated sensible load to the total (sensible and latent) load.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153. Discretionary use adjustment to account for uncertainty in predicting cooling system usage patterns of occupants.
Input	*HDD*	Varies	Calculated using regional weather data.
Input	*HSPF*	Varies	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36 (COP converted to HSPF).
Input	*Conversion_Factor*	Varies	Estimated linear feet yield of product.
Input	*Peak_Conversion_Factor*	0.000017	PA-TRM V2021 Vol. 2, p. 154.
Input	*N*	16.7	PA-TRM V2021 Vol. 2, p. 153. Correlation factor. This factor accounts for four environmental characteristics that may influence infiltration, which include climate, building height, wind shielding and building leakiness.
Input	*%Electric_Heat*	0.2286432	Estimated share of homes with electric space heating. 2020 RECS Middle Atlantic Census Region data.
EUL		15	PA-TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
Measure Name: Spray Foam			
Savings	*ΔkWh*		*((((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + ((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000) * %Electric_Heat)) * Conversion_Factor*
Savings	*ΔkW*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor * Conversion_Factor*
Input	*ΔCFM_50*	0.689	PA TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per linear foot).
Input	*CDD*	Varies	Calculated using regional weather data.
Input	*SEER*	13	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36.
Input	*LM*	Varies	PY2019 EM&V Results. Latent multiplier to convert the calculated sensible load to the total (sensible and latent) load.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153. Discretionary use adjustment to account for uncertainty in predicting cooling system usage patterns of occupants.
Input	*HDD*	Varies	Calculated using regional weather data.
Input	*HSPF*	Varies	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36 (COP converted to HSPF).
Input	*Conversion_Factor*	Varies	Estimated linear feet yield of product.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*Peak_Conversion_Factor*	0.000017	PA-TRM V2021 Vol. 2, p. 154.
Input	*N*	16.7	PA-TRM V2021 Vol. 2, p. 153. Correlation factor. This factor accounts for four environmental characteristics that may influence infiltration, which include climate, building height, wind shielding and building leakiness.
Input	*%Electric_Heat*	0.2286432	Estimated share of homes with electric space heating. 2020 RECS Middle Atlantic Census Region data.
EUL		15	PA-TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
		Measure Name: Electrical Outlet Gasket	
Savings	*ΔkWh*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) + ((1.08 * ΔCFM_50 * HDD * 24) / (N * HSPF * 1000) * %Electric_Heat)*
Savings	*ΔkW*		*(((1.08 * ΔCFM_50 * CDD * 24) / (N * SEER * 1000)) * LM * DUA) * Peak_Conversion_Factor*
Input	*ΔCFM_50*	6.49	PA-TRM V2021 Vol. 2, p. 155. Table 2-116, Typical Reductions in Leakage (per electrical outlet).
Input	*CDD*	Varies	Calculated using regional weather data.
Input	*SEER*	13	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36.
Input	*LM*	Varies	PY2019 EM&V Results. Latent multiplier to convert the calculated sensible load to the total (sensible and latent) load.
Input	*DUA*	0.75	PA-TRM V2021 Vol. 2, p. 153. Discretionary use adjustment to account for uncertainty in predicting cooling system usage patterns of occupants.
Input	*HDD*	Varies	Calculated using regional weather data.
Input	*HSPF*	Varies	Estimate. Cited in Mid-Atlantic TRM V9.0, p.36 (COP converted to HSPF).
Input	*Peak_Conversion_Factor*	0.000017	PA-TRM V2021 Vol. 2, p. 154.
Input	*N*	16.7	PA-TRM V2021 Vol. 2, p. 153. Correlation factor. This factor accounts for four environmental characteristics that may influence infiltration, which include climate, building height, wind shielding and building leakiness.
Input	*%Electric_Heat*	0.2286432	Estimated share of homes with electric space heating. 2020 RECS Middle Atlantic Census Region data.
EUL		15	PA-TRM V2021 Vol. 2, p. 152.
Inc Cost		Varies	Total measure cost.
		Measure Name: Computer Monitor	
Savings	*ΔkWh*		*ESav*
Savings	*ΔkW*		*DSav*
Input	*ESav*	24	Mid-Atlantic TRM V10.0, p. 205.
Input	*DSav*	0.0032	Mid-Atlantic TRM V10.0, p. 206.
EUL		4	Mid-Atlantic TRM V10.0, p. 206.
Inc Cost		2	Mid-Atlantic TRM V9.0, p. 310.
		Measure Name: Furnace Fan Motor	
Savings	*ΔkWh*		*fans_season_kWh_savings + fan_kW * %CAC * EFLH_Cool*

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Savings	*ΔkW*		*ΔkW*
Input	*fans_season_kWh_savings*	168.9	Mid-Atlantic TRM V9.0, p. 73.
Input	*fan_kW*	0.182	Mid-Atlantic TRM V9.0, p. 73.
Input	*%CAC*	0.43	Estimated share of homes with central air conditioning. 2020 RECS Middle Atlantic Census Region data.
Input	*EFLH_Cool*	551	Based on Roanoke location: Mid-Atlantic TRM EFLH method.
Input	*ΔkW*	0	Mid-Atlantic TRM V9.0, p. 74.
EUL		18	Mid-Atlantic TRM V9.0, p. 75.
Inc Cost		98	Mid-Atlantic TRM V9.0, p. 75.
			Measure Name: DIY Insulation - Ceiling/Attic
Savings	*ΔkWh*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool * ADJcool) + ((1 / Rexist - 1 / Rnew) * HDD * 24 * Area / 1000000 / ηHeat * 293.1 * ADJheat)*
Savings	*ΔkW*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool) / EFLH_cool * CF*
Input	*Rexist*	Varies	Tracking data.
Input	*Rnew*	Varies	Tracking data.
Input	*CDH*	Varies	Applicable weather data.
Input	*DUA*	0.75	Mid-Atlantic TRM V9.0, p. 261.
Input	*Area*	Varies	Tracking data.
Input	*ηCool*	Varies	Tracking data.
Input	*ADJcool*	0.8	Mid-Atlantic TRM V9.0, p. 261.
Input	*HDD*	Varies	Applicable weather data.
Input	*ηHeat*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*ADJheat*	0.6	Mid-Atlantic TRM V9.0, p. 263.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 263.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Inc Cost		Varies	Total measure cost.
			Measure Name: Shower Thermostatic Restriction Valve
Savings	*ΔkWh*		*((((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412)) * %ElectricDHW + (%ElectricDHW * ((GPM_base_S * L_showerdevice) * #people * SPCD * 365 / SPH) * EPG_electric)*
Savings	*ΔkW*		*((((((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412) / Hours * CF)) * %ElectricDHW + (%ElectricDHW * ((GPM_base_S * L_showerdevice) * #people * SPCD * 365 / SPH) * EPG_electric) / Hours_Restrictor_Valve * CF)*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMbase*	2.5	Mid-Atlantic TRM V10.0, p. 137.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*GPMlow*	Varies	Product characteristics.
Input	*Time_shower*	7.8	Mid-Atlantic TRM V10.0, p. 137.
Input	*TEMP_sh*	105	Mid-Atlantic TRM V10.0, p. 138.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 138.
Input	*Showers_per_person*	0.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*ShowerHeads_per_home*	1.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 138.
Input	*Hours*	Varies	Calculation: (TimeShower * #people * Showers_per_person) / (ShowerHeads_per_home * 60) * 365.
Input	*CF*	0.00371	Mid-Atlantic TRM V10.0, p. 139.
Input	*%ElectricDHW*	0.31	Mid-Atlantic TRM V10.0, p. 166.
Input	*GPM_base_S*	1.5	GPM of new showerhead.
Input	*L_showerdevice*	0.89	Mid-Atlantic TRM V10.0, p. 156.
Input	*SPCD*	0.6	Mid-Atlantic TRM V10.0, p. 156.
Input	*SPH*	1.6	Mid-Atlantic TRM V10.0, p. 156.
Input	*EPG_electric*	0.11	Mid-Atlantic TRM V10.0, p. 157.
Input	*Hours_Restrictor_Valve*	18.1	Mid-Atlantic TRM V10.0, p. 157.
EUL		10	Mid-Atlantic TRM V10, p. 140.
Inc Cost		Varies	Total measure cost.

3.3.2 Methodology for Estimating Net Savings

The following sections discuss the approach used to evaluate the net impacts of the Efficient Products Program.

3.3.2.1 Retail Lighting Markdowns

Free ridership was estimated using a price response model to predict sales levels in the absence of the program for retail lighting purchases. The analysis utilized program tracking data, which included sales of both packages and individual bulbs, categorized by retailer, model number, and week of purchase. The Evaluation Team used a negative binomial model to account for the right-skewed relationship between prices and quantities. The dependent variable was the number of packages per week sold by the program. Independent variables used to predict sales were the month sold, program price, and a dummy variable for the model.

The calculation of free ridership ratios for the program began by using the coefficients from the price response model to estimate bulb package sales under both program and non-program pricing scenarios. The non-program scenario represents pricing at original retail levels, whereas the program scenario reflected the program pricing.

Bulb package sales under both scenarios were multiplied by the number of bulbs per package to arrive at total bulb sales under the program and non-program scenarios to calculate the total number of bulbs sold under the program and the non-program pricing scenarios. Using these values, the free ridership ratio was estimated as follows:

$$Free\ ridership\ ratio = \frac{\Sigma_i^n E\left[Bulbs_{NoProgram_i}\right]}{\Sigma_i^n E\left[Bulbs_{Program_i}\right]}$$

Where:

$E\left[Bulbs_{NoProgram_i}\right]$ = the expected number of bulbs of type, i, purchased given original retail pricing (as predicted by the model).

$E\left[Bulbs_{Program_i}\right]$ = the expected number of bulbs of type, i, given program discounted pricing (as predicted by the model).

The free ridership ratio was subtracted from one to calculate the net-to-gross ratio.

3.3.2.1.1 Retail Lighting Markdowns Results

The Evaluation Team estimated the overall free ridership rate for LEDs using the price response model, as reported in Table 3-8 below. The rates were determined to be 72% for standard LEDs and 35% for specialty LEDs.

Table 3-8 Free Ridership: Price-response Model Results

Bulb Type	*Free Ridership %*
Specialty LED	72%
Standard LED	35%
All	45%

The model coefficients are shown in Table 3-9 for specialty LED lamps and Table 3-10 for standard LED lamps. The key finding presented in the tables is that the coefficients for program price are negative (the expected direction) and statistically significant at the 99% level. This indicates that expected purchases of LEDs decline as the price increases. The other coefficients shown pertain to the other variables included in the model to control for other factors that affect the sold quantity (i.e., the model and the month of the year. The tables present a coefficient for a single LED model type to save space.

Table 3-9 Price-Response Model Final Specification (Specialty Lamps)

Coefficient	*Estimate*	*Std Err*	*Statistic*	*p.value*	*CI-low*	*CI-high*
(Intercept)	0.71	0.31	2.28	0.02	0.10	1.33
model.numSpecialty LED_BR_allwatts_200.00 to 650.00_2	0.51	0.32	1.60	0.11	-0.11	1.13
January	-0.30	0.06	-4.66	<0.01	-0.43	-0.17
February	-0.05	0.04	-1.31	0.19	-0.13	0.02
March	-0.02	0.04	-0.62	0.54	-0.09	0.05
May	0.08	0.04	2.24	0.03	0.01	0.15
June	-0.09	0.04	-2.57	0.01	-0.16	-0.02
ProPrice	-0.04	0.00	-9.41	<0.01	-0.05	-0.03

Table 3-10 Price-Response Model Final Specification (Standard Lamps)

Coefficient	*Estimate*	*Std Err*	*Statistic*	*p.value*	*CI-low*	*CI-high*
(Intercept)	2.71	0.19	14.63	<0.01	2.35	3.07
model.numStandard LED_Omni_allwatts_200.00 to 650.00_2	-1.35	0.20	-6.85	<0.01	-1.74	-0.96
January	-0.24	0.08	-2.98	<0.01	-0.40	-0.08
February	0.04	0.05	0.74	0.46	-0.06	0.13
March	0.02	0.05	0.39	0.70	-0.07	0.11
May	-0.05	0.05	-1.03	0.30	-0.14	0.04
June	-0.29	0.05	-6.33	<0.01	-0.38	-0.20
ProPrice	-0.19	0.00	-41.93	<0.01	-0.19	-0.18

3.3.2.2 Retail Markdowns for DIY Weatherization

The Evaluation Team applied free ridership estimates developed through the PY2022 evaluation for the retail discount measures.

Table 3-11 summarizes the free ridership estimates for the retail markdown weatherization measures.

Table 3-11 Retail Markdown Weatherization Free Ridership Estimates

Measure	*Free Ridership*
Window and Door Caulk	51%
Spray Foam	45%
Electrical Outlet Gasket	56%

3.3.2.3 Appliance Rebates

The Evaluation Team used a self-report methodology to assess the program's free ridership for the rebated appliances. The objective of the approach was to use responses to questions on how the program may have influenced the decision to determine the share of program savings that would have occurred in the absence of the program. The Evaluation Team assessed four factors to determine the net savings of the Efficient Product program appliances:

- The participant's financial ability to purchase the measure without the program incentive;
- The presence of plans to install the measure before learning of the rebate;
- The likelihood of installing the measure without the rebate, and
- The program influence on the timing of the purchase.

A score ranging between 0 and 1, with 1 indicating full free ridership and 0 indicating an absence of free ridership, was developed for each factor using the following approaches.

3.3.2.3.1 Financial Ability

Respondents were assigned a financial ability score of 1 (indicating full free ridership) if they stated that they were financially able to purchase the measure and if they confirmed that they would have paid the additional cost of the efficient measure if the rebate was not available.

3.3.2.3.2 Likelihood of Purchasing in the Absence of the Program

The Evaluation Team developed a score for the likelihood of purchasing the product using responses to the following questions:

- Which of the following best describes when you learned about the availability of the rebate for the [MEASURE]?
- On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely", how likely is it that you would have purchased the same [MEASURE] if you had not received rebate or informational assistance through the program?

Respondents who were aware of the rebate before deciding to purchase the measure and rated the likelihood of making the purchase without the rebate as four or lower were assigned a likelihood score of 0. All other respondents received a likelihood score of 1.

3.3.2.3.3 Prior Plans

The influence of prior plans to install the measure was assessed with the following two questions.

- Were you planning to purchase [MEASURE] before you learned that a rebate was available from the program?
- Just to be clear, did you have plans to specifically purchase an efficient [MEASURE] instead of a standard [MEASURE]?
- The customer indicated that they would have most likely installed a measure of the same efficiency if they had not participated in the program.

Respondents who indicated they had planned to purchase an efficient measure and confirmed that their intention was specifically to buy an efficient measure were assigned a 'prior plans' score of 1. All other respondents were assigned a free ridership value of 0 for this factor.

3.3.2.3.4 Influence on Timing

Respondents were asked if they purchased and installed the measure sooner than they would have if the program had not been available. Based on their responses, a timing score was assigned as shown in Table 3-12 assigned as follows:

Table 3-12 Timing Score

Response Option	*Timing Score*
Within 6 months of when you purchased it	0.75
Between 6 months and 1 year	0.25
In more than 1 year to 2 years	0
In two years or more	0
Don't know	0.5

3.3.2.3.5 Overall Free Ridership Score

Respondents scored as 0 (absence of free ridership) on the financial ability, prior plans, or likelihood of purchasing the measure in the absence of the program factors were assigned a free ridership value of 0. For all other respondents the final free ridership score is based on the likelihood of installing the measure without the program and the program's influence on the timing of the installation.

Table 3-13 summarizes the average free ridership for each measure. In calculating the program-level net savings, an average free ridership rate for rebated measures was applied in cases where the measures were not covered by the survey sample or when there were fewer than 10 responses.

Table 3-13 Appliance Rebate Free Ridership by Measure

Measure	*Number of Responses*	*Average Free Ridership*
Mini Split Heat Pump	6	67%
Central Air Conditioner	3	33%
Room Air Conditioner	5	60%
Heat Pump Water Heater	22	31%
Refrigerator	70	48%
Freezer	3	17%
Clothes Washer	54	58%
Clothes Dryer	40	53%
Air Purifier	27	33%
Dehumidifier	67	40%
Pool Pump	2	38%
DIY Insulation	1	100%

3.3.2.3.6 Spillover Estimation

The Evaluation Team used participant survey responses to assess participant spillover. The survey questions were designed to gather information regarding:

- Whether program participants have purchased and installed additional, non-incentivized energy saving measures since participating in the program;
- Which additional, non-incentivized energy saving measures program participants have purchased and installed since participating in the program; and
- The extent to which the program influenced the purchase of these additional non-incentivized energy saving measures.

Respondents who reported installing at least one additional energy-efficient measure due to their experience with the program were asked two questions to assess the program's influence on their decision to purchase and install these items.

- SO1: "On a scale of 0 to 10, where 0 represents "Not at all important" and 10 represents "Extremely important", how important was your experience with the program in your decision to purchase and install these additional items?"
- SO2: "On a scale of 0 to 10, where 0 represents "Not at all likely" and 10 represents "Extremely likely", how likely would you have been to purchase these additional non-rebated energy efficient items if you had never participated in the Efficient Products Program?"

The Program Influence Score (PI Score) was calculated as the average of the responses to these two questions, where the numeric scale from SO2 is reversed by subtracting the SO2 score from 10 total possible points:

$$\text{PI Score} = ((\text{SO1 Score})+(10-\text{SO2 Score}))/2$$

For example, a respondent providing a rating of 9 to SO1 and a rating of 3 to SO2 would receive a PI Score as follows:

$$\text{PI Score} = (9+(10-3))/2$$

$$\text{PI Score}=8$$

Respondents with PI Scores above 7 are considered to have made additional energy-efficient purchases significantly influenced by the program. The savings from these measures are then attributed to the program as spillover.

Table 3-14 summarizes the spillover measures reported by the sample. To extrapolate these spillover savings to the entire population, a spillover ratio was calculated based on kWh energy savings and kW reductions. This ratio was derived by dividing the reported spillover savings by the kWh savings or kW reductions from the survey sample. Table 3-15 details these spillover ratio calculations. Total program spillover was then estimated by multiplying the ex post gross savings by the calculated spillover ratio.

Table 3-14 Spillover Savings Measure Estimates

Measure	*Quantity*	*kWh Total*	*kW Total*
Air Purifier	1	55.7	0.009

Table 3-15 Spillover Savings Ratio Calculation

Metric	*kWh*	*kW*
Spillover Sample Savings	55.7	0.01
Sample Gross Savings	54,340.60	6.11
Spillover Ratio	0.10%	0.15%

3.3.3 Impact Evaluation Results

The following subsections summarize the results of the impact evaluation conducted for the 2023 Efficient Products Program.

3.3.3.1 Energy Savings and Demand Reduction Results

Table 3-16 below presents the annual gross and net savings for each energy efficiency measure in the 2023 Efficient Products Program.

Table 3-16 Efficient Products Program Realized Gross and Net Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Free Ridership kWh*	*Participant Spillover kWh*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
Air Purifier	81,551	55,204	68%	18,067	57	37,193	67%	334,739
Clothes Dryer	87,440	96,770	111%	50,804	99	46,065	48%	644,909
Clothes Washer	72,081	132,649	184%	77,613	136	55,172	42%	772,404
Computer Monitor	48	48	100%	23	0	26	53%	102
Dehumidifier	55,647	55,274	99%	22,026	57	33,305	60%	399,655
Pool Pump	22,287	4,933	22%	2,265	5	2,672	54%	26,724
Refrigerator	41,434	41,466	100%	19,800	42	21,709	52%	260,502
Freezer	2,508	2,211	88%	994	2	1,219	55%	13,414
EV Charging Equipment	14,223	14,225	100%	7,155	15	7,084	50%	70,842
Mini Split Heat Pump	47,111	32,130	68%	15,508	33	16,655	52%	299,790
Central Air Conditioner	6,038	7,898	131%	3,509	8	4,398	56%	79,156
Room Air Conditioner	1,809	1,970	109%	958	2	1,014	51%	12,165
Heat Pump Water Heater	137,219	116,028	85%	35,321	119	80,826	70%	1,050,741
Shower Thermostatic Restriction Valve	160	59	37%	28	0	31	53%	315
Furnace Fan Motor	1,283	1,060	83%	498	1	564	53%	10,143
Standard LED	5,816,115	3,732,934	64%	1,310,772	-	2,422,161	65%	32,941,395
Specialty LED	2,114,011	1,476,485	70%	1,063,948	-	412,537	28%	5,610,501
Downlight LED	8,077	4,691	58%	2,115	-	2,576	55%	51,528
LED Nightlight	103,832	110,985	107%	50,032	-	60,953	55%	487,625
Window and Door Caulk	158,350	376,779	238%	192,157	-	184,622	49%	2,769,328

Measure Name	Ex Ante kWh Savings	Gross Ex Post kWh Savings	Gross Realization Rate	Free Ridership kWh	Participant Spillover kWh	Net Ex Post kWh Savings	Net-to-Gross Ratio	Net Lifetime kWh Savings
Spray Foam	1,435,273	365,770	25%	164,597	-	201,174	55%	3,017,606
Electrical Outlet Gasket	69,230	49,195	71%	27,549	-	21,646	44%	324,684
DIY Insulation - Ceiling/Attic	11,582	2,467	21%	1,182	3	1,288	52%	19,313
Total	10,287,307	6,681,231	65%	3,066,920	578	3,614,889	54%	49,197,581

Gross and net peak ex post kW reductions are summarized below in Table 3-17.

Table 3-17 Efficient Products Program Peak kW Reductions Summary

Measure Name	Ex Ante kW Savings	Gross Ex Post kW Savings	Gross Realization Rate	Free Ridership kW	Participant Spillover kW	Net Ex Post kW Savings	Net-to-Gross Ratio
Air Purifier	13.44	6.30	47%	2.06	0.01	4.25	67%
Clothes Dryer	8.74	9.68	111%	5.08	0.01	4.61	48%
Clothes Washer	7.89	14.52	184%	8.49	0.02	6.04	42%
Computer Monitor	0.01	0.01	100%	0.00	0.00	0.00	53%
Dehumidifier	12.62	12.53	99%	4.99	0.02	7.56	60%
Pool Pump	32.60	4.08	13%	1.88	0.01	2.21	54%
Refrigerator	4.73	6.70	142%	3.20	0.01	3.51	52%
Freezer	0.40	0.36	88%	0.16	0.00	0.20	55%
EV Charging Equipment	1.62	1.62	100%	0.82	0.00	0.81	50%
Mini Split Heat Pump	3.51	3.51	100%	1.70	0.01	1.82	52%
Central Air Conditioner	7.23	4.17	58%	1.96	0.01	2.21	53%
Room Air Conditioner	1.67	1.82	109%	0.88	0.00	0.94	52%
Heat Pump Water Heater	10.65	7.18	67%	2.20	0.01	4.99	69%
Shower Thermostatic Restriction Valve	0.01	0.01	108%	0.00	0.00	0.00	53%
Furnace Fan Motor	-	-	N/A	-	-	-	N/A
Standard LED	656.78	462.36	70%	162.35	-	300.01	65%
Specialty LED	238.72	182.88	77%	131.78	-	51.10	28%
Downlight LED	0.91	0.58	64%	0.26	-	0.32	55%
LED Nightlight	-	-	N/A	-	-	-	N/A
Window and Door Caulk	-	4.33	N/A	2.21	-	2.12	49%
Spray Foam	-	4.21	N/A	1.90	-	2.32	55%
Electrical Outlet Gasket	-	0.56	N/A	0.32	-	0.25	44%
DIY Insulation - Ceiling/Attic	1.07	0.42	39%	0.20	0.00	0.22	52%
Total	1,002.60	727.82	73%	332.45	0.11	395.48	54%

Part 2

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3.3.3.2 Supplementary Econometric Analysis

To supplement the impact evaluation, the Evaluation Team utilized IPMVP Option C by performing regression analysis to assess the presence of energy savings during the period subsequent to implementation of program measures. The Evaluation Team obtained energy usage data of program participants from the Company. The analysis was performed using data associated with customers with energy usage data available for at least 11 months after implementation of program measures. For the Efficient Products Program, such data was available for a total of 58 PY2023 program participants who received incentives. The analysis does not include midstream program activity for which participant information was unavailable. The variables described in Table 3-18 were included in the analysis.

Table 3-18 Analysis Model Variables

Variable Name	*Variable Description*
kWh	Dependent variable; participant daily energy use.
CDH	MAX (Outdoor Temperature - 75°F, 0) calculated hourly and averaged across month.
HDH	MAX (55°F - Outdoor Temperature, 0) calculated hourly and averaged across month.
Post	1 during post-implementation period; otherwise 0.

A mixed effects regression model was employed to estimate the incremental impact of implementation of program measures on participant energy use. The following equation was modeled:

Equation 2

$$kWh_{it} = \beta_0 + \beta_1 Post_{it} + \beta_2 CDH_{it} + \beta_3 HDH_{it} + e_{it}$$

Table 3-19 presents the results of the regression analysis.

Table 3-19 Parameter Estimates for Regression Model

Variable Name	*Estimate*	*Standard Error*	*Z score*	*p value*	*90% Confidence Interval*	
					Lower Bound	*Upper Bound*
CDH	0.007	0	15.58	0	0.006	0.008
HDH	0.002	0	24.58	0	0.002	0.002
Post	-1.816	0.95	-1.91	0.056	-3.379	-0.253
Intercept	27.299	2.712	10.07	0	22.839	31.76
Number of Observations						1,331
Number of Groups						58

Intuitively, the weather variables (*CDH* and *HDH*) have positive coefficients indicating the presence of weather-sensitive energy usage and the *Post* variable has a negative coefficient indicating lower energy use during the post-implementation period. The coefficient of *Post* indicates that average daily energy use of Efficient Products participants included in the analysis during the period after implementation of program measures is about 1.82 kWh lower, controlling for weather-related effects.

The energy savings estimate of 1.82 kWh associated with the Efficient Products Program mixed effects regression model is equal to 88% of the average daily ex post gross kWh savings value of 2.07 kWh per account included in the econometric analysis. The average daily ex post gross kWh savings estimate is within the 90% confidence interval of the savings estimate associated with the model *Post* variable.

3.4 Process Evaluation

The following section presents key findings from the process evaluation of the Efficient Products Program.

3.4.1 Program Participation Findings

Lighting retail discounts accounted for 80% of the program savings with weatherization retail discounts and efficient product rebates accounting for roughly equal shares of the remainder of ex post savings (see Figure 3-1).

Figure 3-1 Summary of Program Component Share of Ex Post Savings

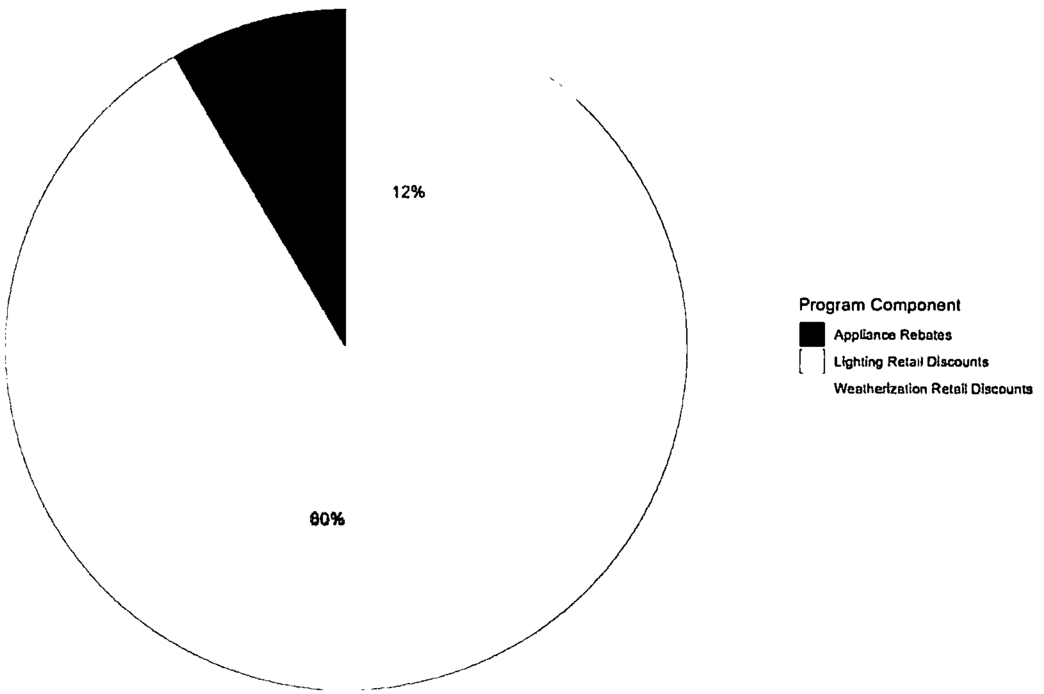


Figure 3-2 and Figure 3-3 provide two different summaries of the rebated efficient product measures. Figure 3-2 plots the count of measures rebated against the rebate dollars per ex post kWh saved. As shown refrigerators were a large volume measure that was relatively expensive in terms of dollars per kWh saved, whereas clothes washers, clothes dryers, and dehumidifiers were larger volume measures that resulted in fewer dollars spent to acquire the kWh savings. Figure 3-3 shows the savings per measure against incentive costs. Heat pump water heaters and mini split heat pumps delivered relatively large savings per measure at lower acquisition costs.

Figure 3-2 Count of Efficient Product Measures Rebated by Incentive Amount per kWh Saved

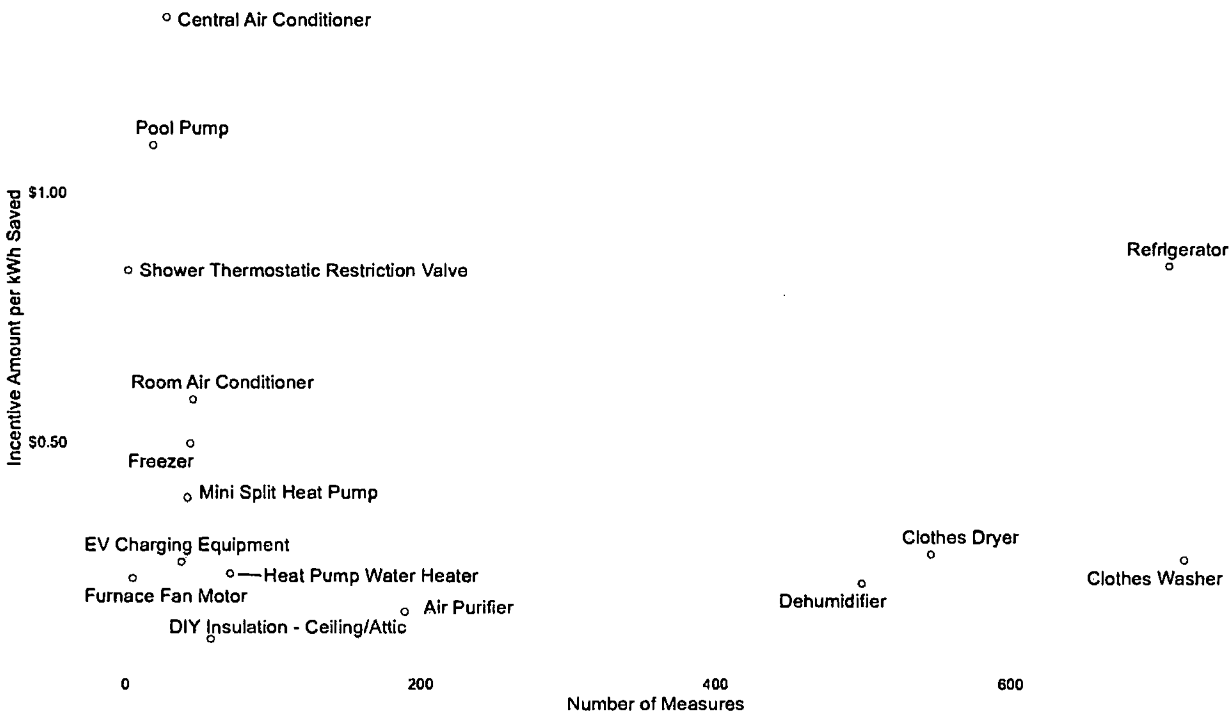
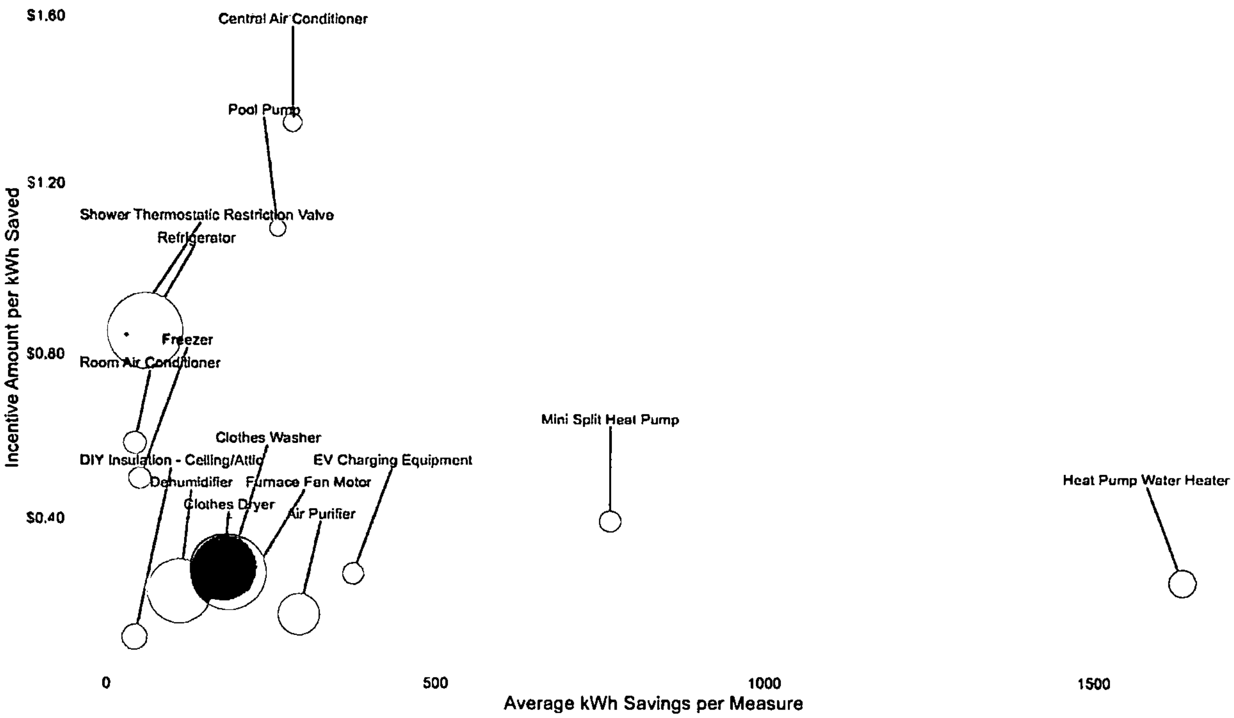


Figure 3-3 Average kWh Savings by Incentive Amount per kWh Saved (Bubble Size is Based on Number of Rebates)



3.4.2 Program Design and Operations

The Efficient Products Program provided incentives through retailers for LED light bulbs and for weatherization measures (window caulking and door sealant, spray foam insulating sealant, electrical outlet, and switch gaskets).

Customers can apply for the program using the program portal to submit for a rebate on an incentivized product. Alternatively, customers can apply for an incentive using a paper application. The paper application can be obtained from either a tear sheet at a participating retailer or by calling the program support number, or by downloading the form from the TakeCharge website, printing it, and submitting via U.S. mail. The program implementation contractor reported that about one-half of applications are submitted through the portal and the other half by paper.

Retail discounts on LED lighting and weatherization measures are available as point-of-sale price reductions at the participating retailers.

3.4.2.1 Roles and Responsibilities

The Evaluation Team conducted an in-depth interview with the program coordinator for the Efficient Products program for Virginia. The program coordinator's main responsibilities include working closely with the implementer, CLEAResult, to ensure the smooth operation of the program. This involves tasks such as checking in with CLEAResult to ensure everything is going well, processing invoices for both incentives and implementation, and maintaining a monthly tracker to monitor proposed expenditures.

The program coordinator discussed how they are considering making changes to its incentive offerings for certain measures based on input from CLEAResult. CLEAResult suggested removing refrigerators, pool pumps, computer monitors, and thermostatic restriction valves due to low rebate uptake. However, there is some disagreement about removing pool pumps as they offer a good rebate and serve a niche market. The program is also considering adding measures such as, DIY pipe insulation, and advanced power strips. These measures have been evaluated for their cost-effectiveness and market potential. Additionally, CLEAResult has proposed exploring mid- and upstream approaches by partnering with retailers like Lowe's and Home Depot to offer discounted rates from manufacturers for dehumidifiers, room air purifiers, and other measures.

3.4.2.2 Program Performance for PY2023

The Efficient Products program has seen a good uptake for certain measures such as dehumidifiers, small appliances, refrigerators, and lighting. These measures have performed well and have met or exceeded expectations. The program employs targeted marketing emails to promote specific products, which often results in increased rebates for those products. Cross-promotion, such as featuring the program in the Energy Kit program kit contents, has also shown positive effects on product sales and rebates. However, there are other measures like larger ticket appliances (e.g., air conditioners) that have not seen a significant uptake.

To prepare for the sunsetting of lighting retail discounts in mid-PY2023 due to the EISA, the program took several steps. Program staff strategically front-loaded the first half of the year with lighting and focused on retail promotion of lighting to maximize savings during that period. Additionally, the program removed point-of-purchase (POP) materials related to lighting from retailers.

Because of the gap left by the removal of lighting measures, the Company's program coordinator gathered data and worked with CLEAResult to assess the cost-effectiveness of proposed measures that could replace lighting savings. These measures include additional appliances and new midstream or upstream retail opportunities, which would be different from their historical approach. The program filed the proposal for these measures in the next program filing.

3.4.2.3 Retailers

The criteria for retailers to participate in the program have not changed this year, and there have been no changes to partnership agreements. Participating in the retail discounts program offers several benefits for retailers. First, it drives more customers to their stores, as the program encourages customers to make purchases at participating retailers through marketing emails and signage. This increased foot traffic can lead to higher sales and revenue for the retailers. Additionally, retailers that participate in the program gain visibility and recognition as being part of an energy-efficient initiative, which can enhance their brand image and attract environmentally conscious customers. Lowe's and Home Depot are currently the main retailers involved in the program and efforts are being made to expand the list to include other retailers, including smaller establishments and dollar stores. This expansion aims to provide a broader range of retail options for customers and further increase the reach and impact of the program.

CLEAResult provides training to retailers to help them increase customers' understanding of the benefits of energy efficiency. They have a field team that conducts visits to retailers and offers training sessions, often directly in the store, with salesclerks and other staff members. The team works closely with an outreach coordinator who plans and organizes these training efforts. The training sessions aim to educate retailers about energy efficient products, their advantages, and how to effectively communicate these benefits to customers.

3.4.2.4 Program Marketing and Outreach

There are several touchpoints with customers, including a three-email campaign, specifically dedicated to promoting the efficient products program, in addition to regular customer communications conducted by the Company. The primary marketing activities included streaming TV ads, digital campaigns such as Google AdWords, boosted social media posts, and email communications. A content calendar was used to track and coordinate these marketing efforts. Additionally, there were seasonal campaigns aligned with specific themes and promotions. Below are a few examples of the seasonal campaigns:

- Flip Your Fridge campaign was featured in June;
- A smart thermostat promotion was featured at the end of June:
- A "Red-Hot Summer" series focused on thermostat efficiency tips and featuring small appliances like dehumidifiers and room air conditioners in July;
- A dehumidifier feature to prepare for fall in August;
- EV chargers were highlighted during Drive Electric Week in September; and
- November included rebate promotions around Black Friday.

According to the program coordinator, the available data on demographic factors for targeting specific audiences is limited. However, efforts are underway to improve targeting capabilities. The Company is creating Power BI dashboards that will provide better segmentation based on factors such as household income and participation data. This will allow for more precise targeting of individuals who are more likely to respond to email and digital ads. According to the program coordinator, the introduction of Power BI dashboards will provide better insights into campaign performance and allow for more targeted and effective outreach and ensure that communications are relevant and well-timed for recipients.

Direct mailing used to be a significant channel but has seen a decline in effectiveness, particularly during the pandemic. Email marketing has become the primary driver of participation. Metrics for campaign effectiveness are not easily measured due to limitations in tracking between portals and systems. Assumptions are currently made based on observed response rates. Moving forward, the goal is to move away from blanket emailing to the entire territory and focus on targeting individuals with a higher propensity to participate. Program staff believe that the pandemic affected response rates, and adjustments were made to optimize timing and messaging. The program coordinator discussed how they targeted hard-to-reach customers with direct mail and then revisited the same list with an email campaign which demonstrated the evolving approach to better engage the target audience.

There are plans to explore new marketing and outreach strategies. One pilot initiative was a partnership with a company called Propel. Propel has a provider's app that allows users to access and manage their government benefits. Through this partnership, ads for the Efficient Products program were viewed on the app among the active users in Virginia's service territory. This pilot program leveraged the app's user base of more than 18,000 users to reach and engage potential customers. The effectiveness of this new marketing channel will be evaluated once all data is complete.

3.4.2.5 Quality Control and Assurance

The program coordinator discussed the QA/QC procedures. The current procedures help to monitor program progress, identify areas for improvement, and ensure that program goals are being achieved within budgetary constraints.

CLEAResult conducts periodic checks and visits to ensure that participating retailers have the correct signage and displays in place. They also work on store restructuring and shelving to enhance the program's visibility. On occasion, the Company's staff may join these visits or make observations while traveling in the Virginia territory.

QA/QC procedures also involve tracking and monitoring various metrics to help assess program progress. A tracking document is received monthly from CLEAResult, which includes key performance indicators (KPIs), invoices, and other data. Additionally, starting in January of this year, the tracking spreadsheet now includes information on the actual appliances and types of light bulbs that have been rebated. Currently, the main ways for customers to submit a rebate for the downstream rebate component are online applications and tear sheets available in stores. Online submissions are preferred and promoted in the marketing materials. The share of submissions between online and tear sheets is fairly even, but specific data on the exact distribution was not available at the time of the interview.

There have been no changes to the application review process since PY2022. However, there have been updates to the color scheme used for promotional materials, with warmer colors being adopted to create a more "inviting atmosphere" in stores.

Rebates are typically processed within 4 to 6 weeks. If customers have any issues with submitting their rebate or have inquiries about the status of their rebate, they can reach out to the designated mailbox. CLEAResult and the Company's staff are proactive in resolving such matters promptly, according to the program coordinator.

The Company is in discussions with EFI, their current marketplace vendor, to embed the rebate process within the purchase transaction. This would eliminate the need for customers to separately claim the rebate after purchasing a qualifying appliance through EFI. The goal is to make the process more streamlined for the customer by integrating the rebate application and purchase into a single transaction.

There is documentation of the QA/QC procedures for the program. CLEAResult provides an implementation plan that outlines the processes they propose to follow. The team reviews this plan to ensure that the proposed processes meet the program's requirements and standards. Another Company staff member is responsible for overseeing this aspect of the program.

3.4.3 Participant Survey Results

The Evaluation Team surveyed customers who received a rebate for an efficient product purchase. The purpose of the survey was to gather information from participants regarding how they learned about the program, satisfaction with program elements, implementation of energy efficiency recommendations, and other program-related information. Many of the questions included in the survey were used to inform the gross and net impact analyses for the program. These data are discussed in the impact results section of the report (Section 3.3), while this section summarizes participants' feedback about their experience participating in the program.

3.4.3.1 Customer Awareness

Over half of the survey respondents indicated they heard about the program from Appalachian Power, including newsletters, emails, or the Company's website. Thirty-eight percent of respondents mentioned hearing about it through a Company newsletter or email, followed by 20% who learned of the program from the website. Almost half (47%) learned of the program some other way. Other sources, such as contractors, home energy reports, friends, relatives, coworkers, neighbors, or services received at home, played a smaller role in program awareness. Table 3-20 displays Efficient Products survey respondents' sources of program awareness. The responses do not sum to 100% because respondents could select more than one source.

Table 3-20 Source of Program Awareness

Responses	*Percent of Respondents (n = 270)*
A Company newsletter or email	38%
The Company website	20%
A contractor you worked with	7%
A Company home energy report	5%
Friend, relative, coworker, or neighbor	3%
While receiving services at my home through another Company program	3%
In some other way	47%

3.4.3.2 Application and Participation Process

The program has an easy-to-follow application process that helps customers complete it independently. Ninety-five percent of the 271 respondents said they completed the rebate application themselves, followed by 4% who had someone else complete it and 1% who had a contractor complete it. Regarding the clarity of information provided to complete the application, 95% rated the instructions for the application as clear (n = 267).[6]

Though most respondents found the application process easy to navigate, feedback revealed opportunities for improvements. Common issues include difficulties with the online submission process, usability concerns with the website, unclear instructions, and problems with tracking and status updates. Approximately 20 users reported technical issues such as broken links, errors, and other various website-related issues. An additional 15 respondents identified communication problems, specifically

[6] Provided a rating of 3 or higher on a scale from 1 (no at all clear) to 5 (completely clear).

related to the acceptance of rebates and additional requests for information, were also mentioned. Another 20 respondents had issues with submission and processing challenges, citing difficulties with the application process and online submission. Ten respondents reported miscellaneous issues, including a lack of understanding of program requirements, concerns about rebate payment, and rebate denials due to ENERGY STAR® non-compliance.

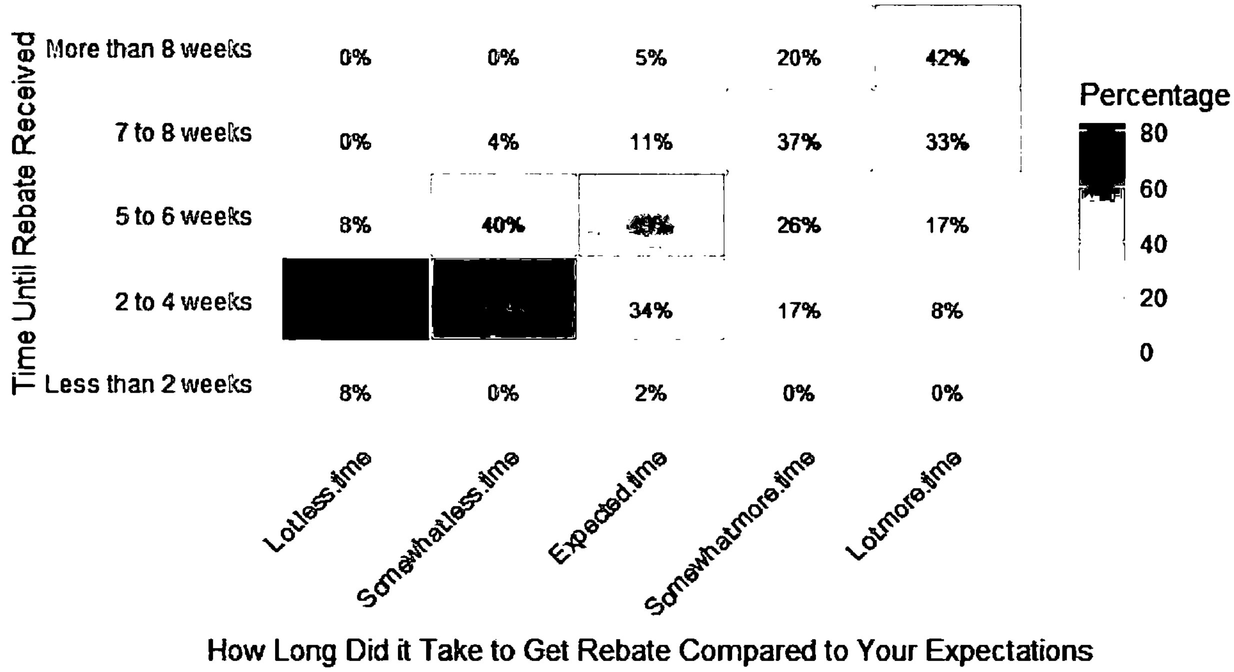
Rebate processing time mostly met customers' expectations. The majority of respondents (54%) reported that the time taken to receive the rebate was about as much as they expected (n = 253). Some respondents experienced quicker processing, with 11% stating it took somewhat less time than expected and 6% mentioning it took a lot less time. Conversely, 22% indicated that it took somewhat more time than expected, and 7% reported that it took a lot more time than anticipated. Of those that could recall how long it took to get their rebate, most indicated it took 6 weeks or less (see Table 3-21).

Table 3-21 Length of Time to Receive Rebate and Expected Wait Times

Responses	*Percent of All Respondents (n = 265)*
Less than 2 weeks	1%
2 to 4 weeks	26%
5 to 6 weeks	29%
7 to 8 weeks	12%
More than 8 weeks	8%
Don't know	24%

Generally, responses indicated that the rebates received in six or fewer weeks met or exceeded their expectations for when the checks would be received. Respondents who reported somewhat or a lot more time than expected were more inclined to experience extended wait times, noting that they received their checks between 7 – 8 weeks or 8 or more weeks (Figure 3-4). Conversely, those respondents who reported that it took either a lot less time or somewhat less time than expected to receive their checks mentioned receiving them within shorter timeframes, including less than 2 weeks and 2 – 4 weeks.

Figure 3-4 Length of Time to Receive Rebate and Expected Wait Times



3.4.3.3 Satisfaction with Program

Satisfaction with the rebated energy efficient products and the program overall was high. Ninety-five percent of respondents were somewhat or very satisfied with their new energy efficient products and 85% were satisfied with the program overall, as shown in Figure 3-5. The results indicate that respondents who received their rebates more promptly than expected were more likely to express satisfaction with the overall program compared to those who experienced delays in receiving their rebates. Further, among those dissatisfied with the program, everyone received their checks either as expected or later than expected. The findings suggest that the timeliness of receiving the rebate payment is a factor in participant satisfaction.

Program participants who received ENERGY STAR® freezers and clothes dryers were more likely to be dissatisfied compared to those who received rebates for other appliances.

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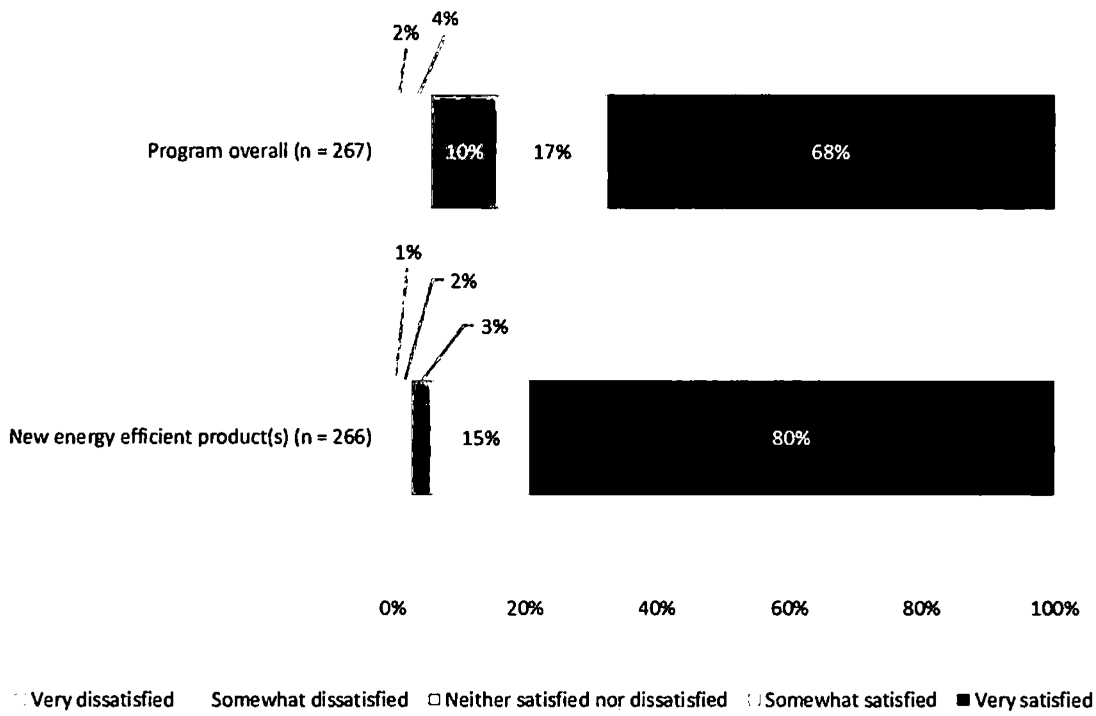
Figure 3-5 Efficient Product Participant Satisfaction



Among the 14 respondents who were dissatisfied with the program, the issues raised were issues with the online submission process, citing technical difficulties or a lack of user-friendliness. Delays in receiving rebates and challenges in tracking or obtaining status updates were also mentioned sources of frustration. Communication problems, particularly regarding the acceptance of rebates and additional requests for information, were mentioned as well. A few users had specific requests, such as offering mail-in rebate forms and expanding the program to include more products.

3.4.3.1 Home Characteristics

Nearly all survey respondents owned a single-family detached home and most indicated using electricity for home heating. Ninety-five percent of respondents said they owned their home, while the remaining respondents either rented (4%), said they rented their home (1%), or did not know (1%). Table 3-22 displays respondent home characteristics.

Table 3-22 Home Characteristics

Question	*Response*	*Percent*
Which of the following best describes your home? (n = 259)	Manufactured home	3%
	Single-family house detached	90%
	Single-family house attached	3%
	Other	3%
	Don't know	1%
What is the main fuel used to heat your home? (n = 257)	Electricity	72%
	Natural Gas	16%
	Propane	4%
	Other	8%
	Don't know	0%
When was your home built? Your best guess is fine. (n = 255)	Before 1950	13%
	1950 to 1959	4%
	1960 to 1969	9%
	1970 to 1979	15%
	1980 to 1989	10%
	1990 to 1999	14%
	2000 to 2009	21%
	2010 or later	13%
	Don't know	2%

3.5 Findings and Recommendations

LED lighting retail discounts sales accounted for most of the program savings. LED lighting discounts drove energy savings for the program in PY2023. Program staff are focused on identifying savings from for non-lighting measures due to the decreased potential for lighting savings resulting from baseline changes.

Satisfaction with the energy efficient products rebated through the program and the program overall was high. Ninety-five percent of respondents were somewhat or very satisfied with their new energy efficient products and 85% were satisfied with the program overall.

Though most respondents found the application process easy to navigate, feedback revealed opportunities for improvements. Common issues include difficulties with the online submission process, usability concerns with the website, unclear instructions, and problems with tracking and status updates.

4 Energy Efficiency Kits

4.1 Program Description

The Energy Efficient Kits Program focuses on helping homeowners improve the efficiency, health, safety, and comfort of their homes. The program mails an energy efficiency kit at no cost to residential customers when they request a kit. Depending on the fuel used to heat the home's water, the kits may include efficient lighting, water saving devices, a water temperature card, and LED nightlights.

Table 4-1 describes the content of the kits.

Table 4-1 Items Included in Efficiency Kits

Kit and Measure	*Number of Items*
Electric Water Heating Kit	
Kitchen Aerator	1
Bathroom Aerator	2
Low-flow Showerhead	1
8w LED Bulb	2
LED Nightlight	2
Hot Water Temperature Card	1
Non-electric Water Heating Kit	
8w LED Bulb	2
11w LED Bulb	2
15w LED Bulb	2
LED Nightlight	2

4.1.1 Program Eligibility Requirements

Eligible Energy Efficiency Kit recipients include active residential customers served by the Company.

4.1.2 Summary of Savings by Eligible Rate Schedule

Table 4-2 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 4-2 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	1,062,492	3,760	282.6	12,719	2.22%

4.2 Data Collection

The Evaluation Team referenced survey data collected for the PY2022 evaluation to develop in-service rates and estimate free ridership.

4.3 Impact Evaluation Approach

The M&V approach for the 2023 Energy Efficiency Kits Program is aimed at the following:

- Determining the number of measures reported as being installed through the program;
- Verifying the number of measures that are currently installed;
- Estimating annual gross and net kWh savings for measures implemented; and
- Estimating annual gross and net kW reduction for measures implemented.

4.3.1 Methodology for Estimating Gross Savings

The methodology used for estimating gross savings is described in this section.

Table 4-3 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 4-3 Data Sources for Gross Impact Parameters – Energy Efficiency Kits

Parameter	*Source*
Number of Participants	Program Tracking Data
Measures Currently Installed	Program Tracking Data/ Participant Surveys (PY2022)
Measure Characteristics	Program Tracking Data/ Mid-Atlantic TRM/ Virginia Weather Data
Home Characteristics	Program Tracking Data

4.3.1.1 Estimation of Gross Savings and Peak Demand Reductions

The methodology used for estimating gross savings impacts is dependent upon the types of measures being analyzed.

4.3.1.2 Measure Attributes Tracked

Table 4-4 presents information on the equipment specification data tracked by the program.

Table 4-4 Gross Impact Attributes Tracked by Program – Energy Efficiency Kits

Measure	*Attributes Tracked*
LED Lighting	Watts, lumens
Nightlight	Watts
Low-flow Showerhead	Gallons per minute
Low-flow Faucet Aerator	Gallons per minute, faucet type

4.3.1.3 In-Service Rates

Table 4-5 summarizes the in-service rates developed from the PY2022 survey of program participants that were used in the PY2023 evaluation.

Table 4-5 Summary of In-Service Rates

Measure	*In-Service Rate*
LED	88%
Nightlight	46%
Bathroom Aerator	62%
Kitchen Aerator	61%
Showerhead	61%
Water Temperature Card (Used it to lower water temperature)	10%

4.3.1.4 Measure Specific Calculations

Table 4-6 summarizes the equations and inputs used to estimate the savings of the program measures. The savings calculated using the approaches outlined in the table were adjusted by the verification and in-service rates developed from the survey of program participants to estimate the gross program savings.

Table 4-6 Measure Calculations and Inputs

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Measure Name: Low Flow Faucet Aerator			
Savings	*ΔkWh*		*(((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*((((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 133.
Input	*GPM_base*	2.2	Mid-Atlantic TRM V10.0, p. 133.
Input	*Throttle_base*	0.83	Mid-Atlantic TRM V10.0, p. 134.
Input	*GPM_low*	Varies	Tracking data. Varies by aerator type.

Variable Type	Variable Name	Variable Value	Variable Value Source
Input	*Throttle_low*	0.95	Mid-Atlantic TRM V10.0, p. 134.
Input	*Time_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 134.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 134.
Input	*DR*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*Hours*	Varies	Calculation: #people * Time_faucet / 60 * 365.
Input	*CF*	0.00262	Mid-Atlantic TRM V10.0, p. 135.
EUL		10	Mid-Atlantic TRM V10, p. 136.
Measure Name: LED Lamp			
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1)) * pre_enforcement_date*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF * pre_enforcement_date*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.34.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	*ηHeat*	1.74	Mid-Atlantic TRM V9.0, p.36.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	*CF*	0.058	Mid-Atlantic TRM V9.0, p. 37.
Input	*WHFd*	1.17	Mid-Atlantic TRM V9.0, p. 36.
Input	*pre_enforcement_date*	Varies	Equals 1 if ship date is before 07/01/2023; otherwise equals 0.
EUL		13.6	Mid-Atlantic TRM V10.0, p. 34.
Measure Name: LED Nightlight			
Savings	*ΔkWh*		*(WattsBase * HoursBase - WattsEE * HoursEE) * 365 / 1000*
Savings	*ΔkW*		*0*
Input	*WattsEE*	0.5	Product characteristics.
Input	*WattsBase*	7	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	*HoursEE*	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
Input	*HoursBase*	12	PA TRM V2021 Vol. 2, p. 8. Table 2-5.
EUL		8	PA TRM V2021 Vol. 2, p. 8.
Measure Name: Low Flow Showerhead			
Savings	*ΔkWh*		*((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*(((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMbase*	2.5	Mid-Atlantic TRM V10.0, p. 137.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*GPMlow*	1.5	Tracking data.
Input	*Time_shower*	7.8	Mid-Atlantic TRM V10.0, p. 137.
Input	*TEMP_sh*	105	Mid-Atlantic TRM V10.0, p. 138.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 138.
Input	*Showers_per_person*	0.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*ShowerHeads_per_home*	1.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 138.
Input	*Hours*	Varies	Calculation: (TimeShower * #people * Showers_per_person) / (ShowerHeads_per_home * 60) * 365.
Input	*CF*	0.00371	Mid-Atlantic TRM V10.0, p. 139.
EUL		10	Mid-Atlantic TRM V10, p. 140.
Measure Name: Water Temperature Card			
Savings	*ΔkWh*		*(U * A * (Tpre - Tpost) * Hours) / (3412 * RE_electric)*
Savings	*ΔkW*		*(U * A * (Tpre - Tpost)) / (3412 * RE_electric)*
Input	*U*	0.083	Mid-Atlantic TRM V10.0, p. 160.
Input	*A*	24.99	Mid-Atlantic TRM V10.0, p. 161.
Input	*Tpre*	135	Mid-Atlantic TRM V10.0, p. 161.
Input	*Tpost*	125	PUR-2020-00251 measure savings workbook. For reference, Mid-Atlantic TRM V10.0, p. 161 cites 120 as default.
Input	*Hours*	8760	Mid-Atlantic TRM V10.0, p. 161.
Input	*RE_electric*	0.98	Mid-Atlantic TRM V10.0, p. 161.
EUL		10	Mid-Atlantic TRM V10, p. 140.

4.3.2 Methodology for Estimating Net Savings

Table 4-7 summarizes the free ridership estimates developed from the survey of PY2022 participants. The spillover ratios of 4.2% (kWh) and 5.2% (kW) estimated from PY2022 survey responses were applied to estimate the program participant spillover.

Table 4-7 Summary of Free Ridership Score by Measure and Kit Type

Measure	*Average Free Ridership Score*
Bath Aerator	1%
Kitchen Aerator	1%
LED	22%
Nightlight	4%
Shower	3%

4.3.3 Impact Evaluation Results

Table 4-8 below presents the annual gross and net savings for each energy efficiency measure in the 2023 Energy Efficiency Kits Program. Table 4-9 presents results by kit type.

Table 4-8 Energy Efficiency Kits Program Realized Gross and Net Energy Savings

Measure Type	*Ex Ante Gross kWh Savings*	*Ex Post Gross kWh Savings*	*Gross Realization Rate*	*Free Ridership kWh*	*Participant Spillover kWh*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*	*Ex Post Net Lifetime kWh Savings*
Low Flow Faucet Aerator	333,953	307,059	92%	3,667	12,946	316,339	103%	3,163,388
LED Lamp	185,999	144,409	78%	32,193	6,089	118,305	82%	1,608,941
LED Nightlight	100,363	100,628	100%	4,246	4,243	100,625	100%	804,999
Low Flow Showerhead	631,887	503,569	80%	14,449	21,232	510,352	101%	5,103,519
Water Temperature Card	79,960	16,189	20%	0	683	16,872	104%	168,720
Total	1,332,164	1,071,855	80%	54,555	45,192	1,062,492	99%	10,849,568

The factors affecting realization rate that departed significantly from 100% were:

- LED light bulbs were adversely affected by the new EISA baseline that went into effect on July 1, 2023.
- Low flow showerheads had an ex ante savings estimate of 214.7 kWh per unit installed and the ex post analysis found that savings were 176.3 kWh per unit installed.
- Water temperature card savings were affected by the realization rate.

Table 4-9 Energy Efficiency Kits Program Realized Gross and Net Energy Savings by Kit Type

Kit Type	*Kit Quantity*	*Ex Ante Annual kWh Savings*	*Ex Post Annual Gross kWh Savings*	*Gross Realization Rate*	*Free Ridership kWh*	*Participant Spillover kWh*	*Ex Post Net kWh Savings*	*Net-to-Gross Ratio*	*Ex Post Net Lifetime kWh Savings*
Electric Kit	2,943	1,221,401	973,120	80%	36,715	41,029	977,433	100%	9,822,024
Gas Kit	876	110,762	98,735	89%	17,839	4,163	85,059	86%	1,027,544
Total	3,819	1,332,164	1,071,855	80%	54,555	45,192	1,062,492	99%	10,849,568

Gross and net peak ex post kW reductions are summarized below in Table 4-10 and by kit type in Table 4-11.

Table 4-10 Energy Efficiency Kits Program Peak kW Reductions Summary

Measure Type	*Ex Ante Gross kW Savings*	*Ex Post Gross kW Savings*	*Gross Realization Rate*	*Free Ridership kW*	*Participant Spillover kW*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Low Flow Faucet Aerator	12.68	26.33	208%	0.31	1.38	27.40	104%
LED Lamp	22.62	17.89	79%	3.99	0.94	14.84	83%
LED Nightlight	-	-		-	-	-	
Low Flow Showerhead	34.23	43.93	128%	1.26	2.30	44.97	102%
Water Temperature Card	9.13	1.85	20%	-	0.10	1.94	105%
Total	78.66	90.00	114%	5.56	4.72	89.15	99%

Table 4-11 Energy Efficiency Kits Program Peak kW Reductions by Kit Type

Kit Type	*Kit Quantity*	*Ex Ante Annual kW Savings*	*Ex Post Annual Gross kW Savings*	*Gross Realization Rate*	*Free Ridership kW*	*Participant Spillover kW*	*Ex Post Net kW Savings*	*Net-to-Gross Ratio*
Electric Kit	2,943	67.99	80.63	119%	3.47	4.22	81.38	101%
Gas Kit	876	10.67	9.37	88%	2.09	0.49	7.77	83%
Total	3,819	78.66	90.00	114%	5.56	4.72	89.15	99%

4.4 Process Evaluation

The following section presents key findings from the process evaluation of the Energy Efficiency Kits Program.

4.4.1 Program Design and Operations

The Evaluation Team interviewed the Company program coordinator who is responsible for the Energy Efficiency Kits program. The coordinator oversees the implementation of the kits program and manages the changes related to LED lights in the kits program.

There was a significant push in the first six months to distribute as many kits as possible due to the baseline changes affecting LED light bulbs that went into place in July 2023 (7,594 LEDs were distributed before the baseline change and 3,548 were distributed after the change).

Marketing approaches in PY2023 aimed to reach potential customers and raise awareness about the Energy Efficiency Kits Program, encouraging participation and adoption of energy-efficient practices. The marketing channels for the program included:

- Email: Sending promotional emails to potential customers and subscribers.

- Social media: Utilizing platforms such as Facebook, Instagram, and Nextdoor to reach a wide audience and promote the program.
- TakeCharge website: Displaying information about the Energy Efficiency Kits program on the program's dedicated website.
- Google AdWords: Running targeted online advertisements on the Google search engine.
- Google Video: Displaying video advertisements on the Google platform.
- YouTube: Running video advertisements on the popular video-sharing platform.
- Network ads: Placing advertisements on various online networks to reach a broader audience.
- Digital display ads: Using visual ads on websites and online platforms to increase program visibility and awareness.

A successful marketing campaign for the Kits program this year involved using email subject lines highlighting the value of the kits. For example, the subject line "Claim Your Free $25 Energy Efficiency Kit" or a similar variation was used to grab the recipients' attention and emphasize the monetary value of the kits. This approach resulted in an increase in engagement and response rates compared to sending out regular emails without mentioning the kit's value. While specific numbers were not provided at the time of the interview, the campaign's success indicated that leveraging the perceived value of the kits in the subject line was an effective strategy for generating interest in the availability of the kits.

There have not been any changes to the tracking system for the program. Additionally, there were no changes made to the QA/QC procedures (discussed below) in PY2023 or in the procedures for handling returned kits or damaged items. The process for returning kits is facilitated through the marketplace, where customers have a designated section for addressing such issues.

4.4.1.1 Quality Control and Kit Verification Process

The Company provides customer data to EFI to allow them to verify that orders are placed by eligible customers. An SFTP portal is used for biweekly data transfers of encrypted customer data that is added to the EFI system. The data provided by the company includes information on new customers and customers who left the territory. All this data is incorporated into the database that is used by EFI to validate customers who create accounts and order kits through the online marketplace. Magento, an open-source e-commerce platform, is used for kit orders and program staff can query orders by year, month. The kit program data is accessible to the Company through Tableau. Additionally, Google analytics is used to examine how customers are learning about the online marketplace.

EFI uses limit enforcement to ensure customers cannot order more than one kit per cycle. If a kit is broken or damaged, the customer can contact the EFI contact center. EFI will provide the customer with a return authorization and prepaid label to send the kit back. EFI indicated this has not yet happened for the kits program.

4.5 Findings and Recommendations

Realization rates were consistent with PY2022 evaluation results, aside from LED light bulbs. LED light bulbs had a lower realization rate due to the new baseline energy use effected by the EISA standard for lamp efficacy that went into place on July 1st, 2023. The impact of the changing baseline was mitigated by the program's successful efforts to distribute more LEDs prior to the baseline change than after.

- **Recommendation 1:** For planning purposes, revise ex ante savings estimates to align with PY2022 and PY2023 evaluation results.

5 Home Energy Reports

5.1 Program Description

The Home Energy Reports Program provides residential customers with information on their household energy use to encourage them to alter their electricity using habits. The reports compare the participants' energy usage with similar homes to motivate the customer to take action to save energy and maintain those savings. Customers may receive paper and email reports, or paper-only reports if they do not have an email in the Company's billing information system. Customers with an email address in the Company's billing information system are delivered a streamlined digital experience about their energy usage and tips on how they can be more energy conscious. Customers can also access the online web portal, which allows customers to analyze and explore their energy usage, get energy efficiency tips, and manage their home energy profile.

These reports may also direct customers to other energy efficiency programs the Company has available.

5.1.1 Program Eligibility Requirements

The Home Energy Reports are provided to approximately 300,000 randomly selected residential customers served by the Company.

5.1.2 Summary of Savings by Eligible Rate Schedule

Table 5-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 5-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	31,578,044	310,273	101.8	12,719	0.80%

5.2 Data Collection

The Evaluation Team referenced billing data, records of assignment to treatment and control groups, records of communications sent to treatment group customers, records of opt-outs, and program participation records to evaluate the Home Energy Reports Program.

5.3 Impact Evaluation Approach

To complete the evaluation of energy savings impacts, the Company and program implementation staff provided the Evaluation Team with the following data:

- Billing data that covers at least one year before the first HER is delivered, as well as all of 2023.

- Customer lists for each customer associated with an HER Program treatment or control group, when the first HER was received, and whether the customer opted out or stopped electrical service.

Table 5-2 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 5-2 Data Sources for Gross Impact Parameters – Home Energy Reports Program

Parameter	*Source*
Number of Customers in the Treatment and Control Groups, as well as opt-outs	Program Tracking Data
Monthly Energy Use	Customer Billing Records
Downstream Uplift Energy Impacts	Downstream Rebate Program Tracking Data
Midstream Uplift Energy Impacts	Treatment and Control Group Surveys (PY2023)

5.3.1 Methodology for Estimating Net kWh Savings and Peak Demand Reductions

5.3.1.1 Data Used in the Analysis

The Evaluation Team used the following data to estimate the energy savings of the HER program:

- Monthly billing data for the period January 2021 through December 2023.
- A list of customers randomly assigned to the HER treatment and control groups.
- Monthly communications reports with records of customers receiving the HER.
- Lists of customers who opted out of the program.

5.3.1.2 Data Cleaning and Preparation

This section describes the data cleaning steps the Evaluation Team performed to prepare for the billing analysis of HER impacts.

The Evaluation Team calendarized the billing data to correct the billing periods for customers, which do not fall on the same dates for all participants and do not always correspond to calendar months. For example, one customer's June bill may run from May 16th to June 17th while another's bill may run from May 20th to July 5th.

Calendarization is the process of correcting monthly billing data to match calendar dates so that the billing data is consistent between participants and to represent each month accurately. For example, if 15 days in a billing period belonged to June and 15 days belonged to July; 50% of the billed usage would be attributed to June and 50% attributed to July. The usage and number of days that fall under a given calendar month are then summed to generate a calendarized usage value and the number of billed days for that month. The following equation provides the method for calculating the monthly usage by calendar month:

$$Monthly\ usage_m = \sum_{i}^{n} \left(Energy\ usage_i \times \frac{Month\ days_i}{Billing\ days_i} \right)$$

Where:

i = First bill containing the month of interest.

n = Last bill containing the month of interest.

m = The month of interest.

Monthly usage = The calendarized monthly usage for a given month.

Month days = The number of days belonging to the month of interest in a billing period.

Billing days = The number of days in a billing period.

After calendarizing the billing data, an average daily usage value was calculated by dividing the monthly usage by the number of billed days in a month.

The Evaluation Team reviewed the data to determine if there were sufficient billing periods to include customers in the analysis and to identify any outliers in the billed energy use. Specifically, the Evaluation Team dropped customers or records from the analysis based on the following criteria:

- Months that were present after a customer's move-out date were also excluded from the analysis.
- Customer months in which average daily usage exceeded 334 kWh were excluded from the analysis.
- Pre-treatment data was limited to the 12 months before the treatment start date for each experimental cohort.
- Customers without at least 10 of the 12 months of pre-period data, as well as at least 5 of the 12 months of post-period data, were removed from the analysis.

5.3.2 Regression Model

The panel regression model used in the analysis of savings impacts was specified as follows:

$$\begin{aligned} kWh_{i,t} = {} & \beta_1 HDD65_{i,t} + \beta_2 CDD75_{i,t} + \beta_3 Post_{i,t} + \beta_4 \left(Post_{i,t} * HDD65_t\right) \\ & + \beta_5 \left(Post_{i,t} * CDD75_t\right) + \beta_6 \left(Post_{i,t} * \ Treatment_i\right) \\ & + \beta_7 \left(Post_{i,t} * \ Treatment_i * HDD65_t\right) \\ & + \beta_7 \left(Post_{i,t} * \ Treatment_i * CDD75_t\right) + \propto_i Customer_i + \varepsilon_{i,t} \end{aligned}$$

The variables included in the regression models are described in Table 5-3 below. As discussed above, the Evaluation Team weighted the data using the propensity score weights to adjust for differences in consumption between the treatment and control groups during the pre-period.

Table 5-3 Description of Variables Used in Regression Model

Variable	*Description*
Customer random intercept	Unique identifier for each customer to control for any customer specific differences.
Heating Degree Days (HDD)	Average Heating Degree Days per day within each billing period. This will be calculated by summing up the number of heating degree hours per day, and then averaging over the number of days in the billing period. 65 degrees was used as the base temperature.
Cooling Degree Days (CDD)	Average Cooling Degree Days per day within each billing period. This will be calculated by summing up the number of cooling degree hours per day, and then averaging over the number of days in the billing period. 75 degrees was used as the base temperature.
Post	Indicator if an observation is post audit (=1 if post, =0 otherwise).
kWh	The average daily kWh usage for account i during billing period t.
Post * Treatment	Indicator that adjusts for the interactive effect between whether customer i's monthly billing data in period t is in the pre or post period and whether customer i is in the treatment or control group during period t.
Customer	Fixed effects for each customer account.

The Evaluation Team used the model coefficients to estimate the difference in post-period consumption between the treatment group customers. The calculation steps are as follows:

- The model coefficients were applied to estimate the difference in average daily consumption for the treatment group.
- The average daily savings for the treatment group was used to estimate total program savings for 2023. Savings for 2023 were calculated by multiplying the number of treatment days for each customer in the treatment group by the average daily savings value. Savings were not estimated for customers who opted out.
- Peak demand reduction was estimated by assuming that percentage reduction in energy usage attributable remained constant across each hour of the year. Calendar year 2023 AMI interval energy usage data was obtained for the treatment group customer meters for which such data was available at the start and end of the year. The interval energy usage data was summed for the treatment group for each hour. The treatment group average hourly energy usage during PJM 5CP hours (kW_5cp) was determined as was the treatment group average hourly energy usage during all hours (kW_all). Peak demand reduction was then calculated as:

  kW Savings = kWh Savings * (kW_5cp / kW_all) / 8,760

- The estimated per account kWh and kW were multiplied by the number of customers in the treatment group to estimate the total savings impact for the program.

5.3.2.1 Accounting for Program Uplift

The HER Program reports may also increase the customer's propensity to participate in other programs. This additional participation induced by the HER is known as uplift. When a household participates in an efficiency program because of this encouragement, the utility might count their savings twice: once in the regression-based estimate of HER program savings and again in the estimate of savings for the other energy efficiency program. To prevent this double counting of savings, the Evaluation Team assessed if there was evidence of uplift and adjusted the HER savings accordingly.

To adjust HER savings, the estimate of double-counted savings, whether positive or negative, is subtracted from the program savings estimated using the regression analysis described above.

5.3.2.1.1 Downstream Program Uplift

The Evaluation Team referenced customer-level downstream program tracking data and the associated ex post savings estimates.

The Evaluation Team corrected for downstream program uplift that occurred after treatment began using the following equation. With this approach, the Evaluation team estimated the savings due to downstream program uplift by estimating per-household uplift savings in the treatment and control groups and extrapolating the per-household savings.

Equation 5.1

$$Uplift\ kWh = \left(\frac{OP\ kWh}{Household_{Treatment}} - \frac{OP\ kWh}{Household_{Control}}\right)\ X\ \#Accounts_{Treatment}$$

Where,

$\frac{OP\ kWh}{Household_{Treatment}}$ = Other program kWh per household in the treatment group

$\frac{OP\ kWh}{Household_{Control}}$ = Other program kWh per household in the control group

$\#Accounts_{Treatment}$ = Total accounts in the treatment group.

5.3.2.1.2 Upstream Program Uplift

Upstream programs provide incentives to retailers to discount efficient products and/or negotiate lower prices for them. Identifying HER uplift effects for these programs is more challenging because there are not any customer records of participation in the program and, by design, customers may not realize they received program benefits when they purchase the discounted products.

To address this issue, the Evaluation Team used PY2022 surveys of treatment and control group customers to estimate differences in the rates of purchase of the upstream measures. The treatment and control groups were compared to determine if the treatment group recalled purchasing more of the discounted upstream measures than the control group during the past three months. The PY2022 surveys did not identify any difference in upstream measure purchase between the treatment and control groups and no adjustment was made for upstream uplift to the PY2023 program savings.

5.3.2.2 Measure Attributes Tracked

Table 5-4 presents information on the equipment specification data tracked by the program.

Table 5-4 Gross Impact Attributes Tracked by Program – Home Energy Reports

Measure	*Attributes Tracked*
HER	Records of reports sent, account numbers in treatment and control group, accounts that opted out.

5.3.3 Impact Evaluation Results

Table 5-5 below presents the annual gross and net savings for each energy efficiency measure in the 2023 Home Energy Reports Program.

Table 5-5 Home Energy Reports Program Realized Gross and Net Energy Savings

Ex Ante kWh Savings	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
23,102,091	31,578,044	31,578,044	100%	31,578,044	100%

Peak demand reduction was estimated by assuming that the percentage reduction in energy usage attributable is constant across each hour of the year. Calendar year 2023 AMI interval energy usage data was obtained for the treatment group customer meters for which such data was available at both the start and end of the year. The interval energy usage data was summed for the treatment group for each hour. The treatment group average hourly energy usage during PJM five coincidental peaks (kW_5cp) was determined as was the treatment group average hourly energy usage across all hours (kW_all). Peak demand reduction was then calculated as:

$$kW\ Savings = kWh\ Savings * (kW\_5cp\ /\ kW\_all)\ /\ 8{,}760$$

Gross and net peak ex post kW reductions are summarized below in Table 5-6

Table 5-6 Home Energy Reports Program Peak kW Reductions Summary

Ex Ante kW Savings	*Gross Ex Post kW Savings*	*Gross Realization Rate*	*Net Ex Post kW Savings*	*Net-to-Gross Ratio*
6,690.44	6,690.44	100%	6,690.44	100%

5.4 Process Evaluation

The following section presents key findings from the process evaluation of the Home Energy Reports Program.

5.4.1 Program Design and Operations

The Evaluation Team interviewed the program coordinator at the Company who oversees the Home Energy Reports (HERs) program in Virginia. The purpose of the interview was to gain insights into the program design and operations.

There have not been significant changes to the HERs program in the past year. The program design includes a control group and customers who receive email or print reports, with no major modifications this year. The program coordinator mentioned that the only notable action taken was backfilling customers for the treatment group. This was done at the beginning of the year and staff typically aim to do it twice a year.

The HER program is performing well, but the program coordinator identified areas for improvement regarding customers who receive the reports via mail and provide feedback through letters. Many of these customers may be elderly and not have email or prefer not to call. Currently, the program coordinator forwards these letters to customer service for follow-up, but there is a need to enhance the process. One suggestion was to include a checkbox on the print report, allowing customers to indicate if they no longer wish to receive the HERs. This would streamline the feedback process and eliminate the need for lengthy letters explaining their dissatisfaction. Additionally, since these customers are more comfortable communicating by mail and phone, there may be a need to prioritize communication through those channels. The program coordinator plans to discuss this topic with the customer service team to explore better ways to follow up with these customers and address their concerns.

The HERs program has introduced a feedback tracking system to record customer inquiries and comments, to aid in future program enhancements. This system includes a smart sheet tracker for documenting details of customer interactions, including the caller's identity, nature of inquiries, and resolution methods. The program coordinator emphasized that this approach ensures attention to customer concerns and helps in identifying any persistent issues that need attention.

Through this feedback tracking system, an issue was discovered with the HERs program in 2022. The program coordinator received letters from customers regarding mailing discrepancies, particularly related to customers with PO boxes. By observing the trend in returned mail from customers with PO boxes, the program coordinator identified a flaw in the data transferred to Opower. The flaw caused reports to be sent to customers' physical addresses instead of their alternate mailing addresses. Thanks to the tracking system, this issue was recognized, and necessary adjustments were made to ensure accurate account information was provided to Opower.

Another issue identified is customer perception of the accuracy of the home energy profiles for customers who are not online and unable to update their information. To ensure accurate reports, intervention is necessary to reach out to these customers, explain the importance of updating their profiles, and address any issues they may have. The program coordinator aims to improve the timeliness of this process, as some letters may remain at the corporate office for an extended period before they are forwarded to the program coordinator.

Additionally, there have been changes to the Home Energy Assessment categories published in the HERs. Previously, the "Other" category was too broad, and based on feedback from the customer service team, it was refined to specify "Small Appliances." This change allows for a more detailed breakdown of where customers' energy usage is coming from, including specific items such as humidifiers, hair dryers, and small kitchen appliances. These changes reflect efforts to improve the accuracy and specificity of the HERs, addressing issues with bill comparisons and refining the categorization of energy usage.

To ensure the accuracy and reliability of the data used to create the HERs, there are a few steps taken. The process involves generating the data and files for the reports, followed by a sample review conducted by the team responsible for creating the reports. This sample review is intended to identify any anomalies or discrepancies in the reports before they are sent out to customers. During the sample review, the team closely examines the information in the reports to catch any issues or errors that may have occurred during the data generation process. While the exact details of what is checked and how it is done may vary, the goal is to ensure the quality and accuracy of the data before it is released. It is worth noting that the specific procedures and checks performed during the sample review process may not be known in detail by the person providing the information. However, it is acknowledged that the team responsible for generating the reports undertakes this additional step to verify the accuracy of the data before finalizing the reports for distribution. Opower or other relevant personnel are directly involved in the generation and review of the HERs.

Tracking and monitoring the success of campaigns related to HERs can be challenging due to the multi-channel marketing approach and thematic marketing strategies. While efforts are made to promote specific themes and messages through various channels like emails, social media posts, and the HERs themselves, it can be difficult to attribute program enrollments to a specific channel.

Through the uplift analysis, the Evaluation Team found that the share of customers that participated in a rebate program was higher for the treatment group than the control group, indicating the effectiveness of the HER as a tool for increasing enrollments in other programs.

Table 5-7 Program Participation by HER Group

HER Group	*Percent that Participated in a Rebate Program*
Treatment	1.25%
Control	1.08%

The Company holds regular meetings held to discuss the program and its performance. There are biweekly meetings to address ongoing matters, as well as quarterly meetings specifically focused on the Home Energy Reports (HERs). These meetings provide an opportunity to review the effectiveness of the HERs, discuss any issues or improvements, and ensure alignment with program goals.

5.5 Findings and Recommendations

Program savings increased from PY2022. The Evaluation Team found that savings increased from 26,612,523 kWh to 31,578,044 kWh, which aligns with the program planning assumption of an increase in savings during the second year.

In addition to directly driving energy savings, HER increases participation in other Company programs. The Evaluation Team found that a larger share of HER treatment group customers (1.25%) participated in a rebate program than control group customers (1.08%).

Enhancements were made to improve quality assurance and enhance the customer experience. Program staff introduced a tracking system to record customer inquiries and comments to inform future program improvements. Additionally, the program is seeking to improve customer completion of profiles to improve the perceived accuracy of the home energy report information and has refined the home assessment and HER report.

6 Bring Your Own Thermostat Program

6.1 Program Description

The Bring Your Own Thermostat (BYOT) program is a voluntary demand response program that offers customers a one-time $50 incentive to enroll a qualifying smart thermostat and a $5 a month incentive, up to $25 per year, for allowing adjustments to their thermostat to reduce air conditioner usage during peak event periods between May and September. Google Nest, Emerson Sensi, Honeywell Home and TCC, ecobee, Alarm.com, Amazon, and Lux thermostats are eligible for the program.

The program sets a maximum of 30 load management events, with 5 events reserved for emergencies during the program year. The events typically last two to three hours. During an event, a signal is sent to the enrolled thermostat to either cycle the unit on and off or raise the thermostat set point to reduce consumption during the event period. Twelve events were called during PY2023. The events were called during periods when forecasted electricity demand on the PJM regional transmission organization (RTO) was high.

6.1.1 Program Eligibility Requirements

The program is open to residential customers in the Company's Virginia service territory. To qualify, customers:

- Must have an approved Wi-Fi enabled thermostat;
- Must have central air conditioner in working order that is controlled by the smart thermostat; and
- Have a Wi-Fi network compatible with the smart thermostat and remain connected during the program.

The program is open to property owners and renters.

6.1.2 Summary of Savings by Eligible Rate Schedule

Table 6-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 6-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	90,101	6,589	13.7	12,719	0.11%

6.2 Data Collection

The Evaluation Team referenced AMI metering data for the evaluation of the BYOT Program.

6.3 Impact Evaluation

This section addresses the estimation of peak kW reductions and gross kWh savings resulting from the BYOT Program.

6.3.1 Evaluation Objectives

As part of the evaluation effort for 2023, the Evaluation Team collaborated with the Company and its implementation contractor to determine the following metrics:

- What was the maximum achieved demand reduction in summer 2023?
- What were the total energy savings per event and for the entire 2023 event season?

The following sections discuss the methodology and impacts for the 2023 BYOT Program.

6.3.2 Methodology for Estimating Gross Savings

Peak reduction and energy savings for each event were calculated using AMI energy usage data from participating customer accounts for which seasonal interval data were available.

6.3.2.1 Measure Attributes Tracked

Table 6-2 presents information on the equipment specification data tracked by the program.

Table 6-2 Gross Impact Attributes Tracked by Program – BYOT Program

Attributes Tracked
Thermostat Location (Zip Code)
HVAC Unit Serial Number
HVAC Unit Hourly Cooling Run-Time

6.3.2.2 Analysis of Peak Event Reductions and Energy Savings

To estimate the program ex post energy and demand savings, the Evaluation Team used AMI data from a census of participants to estimate the program ex post energy and demand savings.

To perform the season-level analysis of event peak demand reductions and energy savings, hourly baseline energy usage, the Evaluation Team used a propensity score matching approach to develop a control group of non-participant customers for baseline development. Using Euclidean distance matching, we selected a set of match days to serve as proxies for each event day in each state. Match days, chosen from non-holiday, summer weekdays during the program year, were based on weather and energy usage of non-participant residential customers. For each event date, the Evaluation Team selected the three days with the closest average usage and weather as match days. Through this process, a match day may have been chosen multiple times for different events, but an event day cannot serve as a match day for another event.

After determining the match days for each event, we compared the energy usage of participants on non-event days with that of non-participants on non-event days to identify a control group match for each participant.

To facilitate control group creation, we constructed the following variables:

- kWh_12_14 = mean hourly kWh during 12:00 PM - 3:00 PM
- kWh_15_17 = mean hourly kWh during 3:00 PM - 6:00 PM
- kWh_18_20 = mean hourly kWh during 6:00 PM - 9:00 PM
- kWh = mean hourly kWh during all hours

We then calculated a distance variable for each potential control match account for each treatment account:

Equation 6-1 Euclidean Distance Calculation

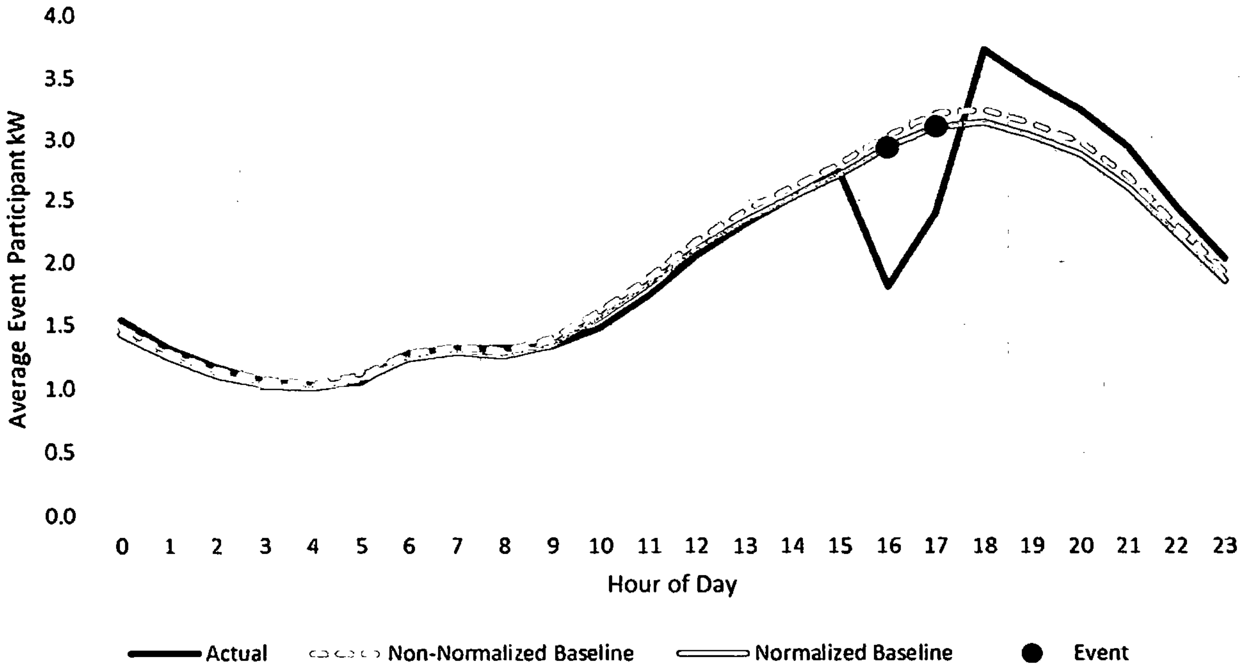
$$\text{Distance} = ((kWh\_12\_14_{treatment} - kWh\_12\_14_{i})^{\wedge}2 + (kWh\_15\_17_{treatment} - kWh\_15\_17_{i})^{\wedge}2 + (kWh\_18\_20_{treatment} - kWh\_18\_20_{i})^{\wedge}2 + (kWh_{treatment} - kWh_{i})^{\wedge}2)^{\wedge}.5$$

For each treatment account, the potential control account with the minimum distance was selected as the match account, applying a tie-breaking procedure if needed.

With the control group selected, we determined the average hourly event day usage. The control group's average usage served as a preliminary baseline. This baseline was adjusted by a normalization factor equal to (kWhtreatment / kWhcontrol), based on usage values two hours prior to the first event hour. As the average non-event hour usage of treatment and control groups on event days was very similar, the adjustment factor generally varied little from 1.0.

An example of the plotted normalized baselines and actual energy usage for the 8/21/2023 event is shown below.

Figure 6-1 Event Plot Example



6.3.2.3 Analysis of Peak Event Reductions and Energy Savings

Demand reduction during events, precooling periods, and snapback periods were referenced to calculate average annual energy savings. The equation for this shown below (Equation 6-2) is based on reference to hourly data. The summation will occur for all periods during the event and for two hours before and after the event (to cover precooling/load shifting and snapback periods).

Equation 6-2 Estimation of Energy Savings

$$kWh_{saved} = \sum_{t} kW_t^{reduction}$$

6.3.3 Methodology for Estimating Net Savings

The methodology for developing savings resulting from demand reduction events are net savings estimated. In addition to these savings, the program may influence the installation of smart thermostats that generate savings during non-peak periods.

The Evaluation Team referenced PY2022 participant survey data to estimate thermostat spillover. The research found that spillover thermostat savings were 42.5 kWh per newly enrolled participant and this value was used to estimate spillover savings for PY2023.

6.3.4 Energy Savings and Demand Reduction Results

The Company initiated 12 load management events during the summer of 2023. As shown in Table 6-3 below, the Company was successful in initiating events that coincided with all five PJM coincident peak (CP) hours.

Table 6-3 Demand Response Event Times

Date	*Event Start Time*	*Event Stop Time*	*Event Coincident with 5CP*	*PJM Coincident Peak Occurred During Hour Ending*
6/2/2023	4:00 PM	6:00 PM	No	
7/5/2023	4:00 PM	6:00 PM	Yes	6:00 PM
7/13/2023	4:00 PM	6:00 PM	No	
7/14/2023	4:00 PM	6:00 PM	No	
7/26/2023	4:00 PM	6:00 PM	No	
7/27/2023	3:00 PM	6:00 PM	Yes	6:00 PM
7/28/2023	3:00 PM	6:00 PM	Yes	6:00 PM
8/21/2023	4:00 PM	6:00 PM	No	
9/5/2023	3:00 PM	6:00 PM	Yes	5:00 PM
9/6/2023	3:00 PM	6:00 PM	Yes	5:00 PM
9/21/2023	4:00 PM	5:00 PM	No	
9/22/2023	4:00 PM	6:00 PM	No	

The demand reductions were calculated for each event hour. Hourly results are provided below in Table 6-4 for both the demand response events, as well as the one-hour precooling and one-hour snapback period following the event. Event pre and post hours are represented with gray fill. Table 6-5 presents the average per participant reductions.

Table 6-4 kW Reductions for Event Days by Hour

Date	*2:00 PM – 3:00 PM*	*3:00 PM – 4:00 PM*	*4:00 PM – 5:00 PM*	*5:00 PM – 6:00 PM*	*6:00 PM – 7:00 PM*	*Event-Level Mean Hourly kW Reduction*	*Maximum Event Hour kW Reduction*
6/2/2023		-39.80	4,585.96	3,173.67	-2,677.97	3,879.81	4,585.96
7/5/2023		80.36	6,561.98	4,400.75	-2,998.22	5,481.37	6,561.98
7/13/2023		200.83	6,787.34	4,407.61	-2,957.26	5,597.47	6,787.34
7/14/2023		-255.36	6,425.26	4,145.56	-3,191.68	5,285.41	6,425.26
7/26/2023		-1,086.89	6,806.37	4,451.80	-2,991.12	5,629.08	6,806.37
7/27/2023	-1,056.75	7,572.53	4,991.84	2,576.83	-3,060.73	5,047.06	7,572.53
7/28/2023	-898.99	8,123.23	4,868.97	2,647.39	-2,556.79	5,213.20	8,123.23
8/21/2023		-148.30	7,084.74	4,496.32	-3,615.85	5,790.53	7,084.74
9/5/2023	-1,211.22	7,519.58	4,877.29	2,580.01	-3,778.04	4,992.29	7,519.58

9/6/2023	-954.71	7,805.89	4,835.64	2,619.90	-3,196.94	5,087.14	7,805.89
9/21/2023		-36.83	3,216.39	-1,841.14		3,216.39	3,216.39
9/22/2023		-158.16	1,886.63	1,407.76	-2,324.51	1,647.19	1,886.63

Table 6-5 Average per Participant kW Reduction

Date	*2:00 PM - 3:00 PM*	*3:00 PM - 4:00 PM*	*4:00 PM - 5:00 PM*	*5:00 PM - 6:00 PM*	*6:00 PM - 7:00 PM*	*Event-Level Mean Hourly kW Reduction*	*Maximum Event Hour kW Reduction*
6/2/2023		-0.01	0.77	0.54	-0.45	0.66	0.77
7/5/2023		0.01	1.09	0.73	-0.50	0.91	1.09
7/13/2023		0.03	1.13	0.73	-0.49	0.93	1.13
7/14/2023		-0.04	1.06	0.69	-0.53	0.88	1.06
7/26/2023		-0.18	1.12	0.73	-0.49	0.92	1.12
7/27/2023	-0.17	1.24	0.82	0.42	-0.50	0.83	1.24
7/28/2023	-0.15	1.33	0.80	0.43	-0.42	0.85	1.33
8/21/2023		-0.02	1.13	0.72	-0.58	0.93	1.13
9/5/2023	-0.19	1.19	0.77	0.41	-0.60	0.79	1.19
9/6/2023	-0.15	1.24	0.77	0.41	-0.51	0.81	1.24
9/21/2023		-0.01	0.51	-0.29		0.51	0.51
9/22/2023		-0.02	0.30	0.22	-0.37	0.26	0.30

The energy savings associated with each event day are presented in Table 6-6. Summing the energy savings across all events results in overall kWh savings of 90,101 kWh.

Table 6-6 kWh Savings During Event Days

Event	*Participants*	*Event kWh Savings*	*Shoulder Hour kWh*	*kWh Savings*
6/2/2023	5,923	7,760	(2,718)	5,042
7/5/2023	5,997	10,963	(2,918)	8,045
7/13/2023	6,033	11,195	(2,756)	8,439
7/14/2023	6,037	10,571	(3,447)	7,124
7/26/2023	6,097	11,258	(4,078)	7,180
7/27/2023	6,101	15,141	(4,117)	11,024
7/28/2023	6,123	15,640	(3,456)	12,184
8/21/2023	6,246	11,581	(3,764)	7,817
9/5/2023	6,312	14,977	(4,989)	9,988
9/6/2023	6,316	15,261	(4,152)	11,110
9/21/2023	6,357	3,216	(1,878)	1,338

Event	*Participants*	*Event kWh Savings*	*Shoulder Hour kWh*	*kWh Savings*
9/22/2023	6,355	3,294	(2,483)	812
Total		130,857	(40,756)	90,101

Using data collected through the PY2022 survey of participants, the Evaluation Team estimated that the spillover savings resulted from program induced and newly installed thermostats was 71,211.

Table 6-7 presents the total energy savings and peak demand reductions attributable to the Bring Your Own Thermostat Program for PY2023.

Table 6-7 Realized kWh Savings and kW Reduction

Expected kWh Savings	*Expected Peak kW Reduction*	*Realized kWh Savings*	*Realized kW Reduction*	*kWh Gross Realization Rate*	*kW Gross Realization Rate*	*Spillover kWh Savings*	*Net kWh Savings*
90,101	5,790.53	90,101	5,790.53	100%	100%	71,211	161,312

6.4 Process Evaluation

A process evaluation was not completed for the BYOT Program. The program quality control process is summarized below.

6.4.1 Quality Control

There are multiple quality control steps integrated into the customer enrollment process. The customer's status as an active customer is verified by cross-checking their account number with the list of active accounts. When enrolling the thermostat, the registration system will provide an error message if they do not have an approved device that the system cannot communicate with. Staff also review the thermostat information entered and, if an issue is discovered, contact the customer to resolve it.

When processing incentive payments staff verifies that listed devices are enrolled and that no device is enrolled more than once.

At the time of an event, staff has access to information on the number of devices online that responded to the event. Additionally, the program receives data on the set point and customer adjustments to the set point during the event.

6.5 Findings and Recommendations

Events were timed with all 5 PJM coincident peak hours. Twelve events were called during the year and events overlapped with each of the PJM coincident peak hours. The program realized kW reductions of 5,790.53 kW.

7 Low-Income Single-Family Program

7.1 Program Description

The LISF Program is designed to provide home energy services to the Company's Virginia customers with limited income to assist them in reducing their electric energy usage and managing their utility costs. The LISF Program helps facilitate the implementation of electric energy-saving measures in residential low-income single-family households.

The program reduces energy consumption by educating residential customers about the energy and money-saving benefits associated with energy efficiency in the home. All customers participating in this program receive educational materials and an opportunity to discuss ways that they can continue to conserve and maintain the energy efficiency of their homes after the weatherization process has been completed.

The LISF Program targets measures that have been proven to save energy, reduce consumption, and protect the health and safety of occupants while helping to lower their electric bills. Eligible measures include, but are not limited to, those listed below.

- Energy efficient lighting
- Water saving devices (for homes with electric water heaters)
- Water heater pipe wrap insulation (for homes with electric water heaters)
- HVAC replacement and maintenance
- ENERGY STAR® appliance upgrades
- Insulation and air sealing measures
- Electrical system upgrades and maintenance
- Home ventilation measures
- Programmable thermostat upgrades
- General health and safety measures

Equipment and installation costs for all measures are provided at no cost to eligible customers and properties.

7.1.1 Program Eligibility Requirements

To qualify for the program, a household's income cannot exceed 60% of the State Median Income and must have electric heating. The Company does not offer this Program directly; it is managed by Community Housing Partners (CHP) in conjunction with the Weatherization Service Providers. When customers apply for an energy assistance program through an agency, they are also applying for this program.

7.1.2 Summary of Savings by Eligible Rate Schedule

Table 7-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 7-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	1,458,953	515	2,832.9	12,719	22.27%

7.2 Data Collection

7.2.1 Participant Survey

Data collection from a participant survey was used to:

- Verify measures to estimate gross savings impacts; and
- Collect data on participants' experience with the program to inform the process evaluation.

To estimate the sufficiency of the sample size, the Evaluation Team calculated the sample size needed to meet the 90/10 precision and confidence level. The sample size to meet 90/10 requirements is calculated using the coefficient of variation defined as:

$$CV(x) = \frac{Standard\ Deviation\ (x)}{Mean(x)}$$

Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated by the following equation:

$$n = \left(\frac{1.645\ cv}{D}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

D = Desired Precision, 10% in this evaluation

To account for the number of participants in the program, a finite population correction is applied with the following formula in order to calculate an adjusted sample size:

$$n = \frac{n_0}{1 + n_0/N}$$

Where,

n_0 = Sample size calculated prior to application of finite population correction.

N = Population size (number of program participants)

With the application of the finite population correction factor for the program participant population size of 431, the sample size required to meet 90% confidence and 10% precision is 59. The 79 responses obtained exceeded this threshold. Table 7-2 summarizes the survey data collection effort.

Table 7-2 Survey Response Summary

Mode	*Time Frame*	*Number of Contacts*	*Number of Completions*
Phone	December 2023	431	79

7.3 Impact Evaluation

This chapter addresses the impacts of energy savings and peak demand reductions resulting from measures installed in facilities of customers that obtained incentives under the Residential Low-Income Single-Family Program during the period January 2023 through December 2023.

The M&V approach for the 2023 Low-Income Single-Family Program is aimed at the following:

- Determining the number of weatherization measures reported as being installed through the program;
- Verifying the extent to which the reported weatherization measures are currently installed;
- Estimating annual kWh savings for measures implemented; and
- Estimating annual kW reduction for measures implemented.

7.3.1 Methodology for Estimating Gross Savings

Table 7-3 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 7-3 Data Sources for Gross Impact Parameters – Low-Income Single Family Program

Parameter	*Source*
Number of Participants	Program Tracking Data
Measures Installed	Program Tracking Data/ Telephone Surveys
Measures Still In Use	Participant Surveying/ Telephone Surveys
Home characteristics	Program Tracking Data / Telephone Surveys

7.3.1.1 Measure Attributes Tracked

Under this program, energy auditors collect details on home and equipment characteristics, documenting this through use of Excel-based project tracking workbooks. The workbooks facilitate tracking of information on baseline home and equipment characteristics as well as information regarding specific recommended improvements that are subsequently implemented under the program.

Table 7-4 presents information on the equipment specification data tracked by the program.

Table 7-4 Gross Impact Attributes Tracked by Program – Low-Income Single Family Program

Measure	*Attributes Tracked*
HVAC Measures	Heating and Cooling System Types and Efficiency Levels
Lighting Measures	Light Level (Lumens)
	Wattage
	Installation Location (Room)
Water Heating Measures	Water Heating Type, Installation Location (Room) for Aerators
Envelope Measures	Existing and New Insulation Levels, Heating and Cooling System Types

7.3.1.2 Verification of Measure Installation

The initial step in conducting measurements of program activity is to verify the number of weatherization measures installed. The Evaluation Team took several steps in verifying the number of weatherization measures installed which consists of the following:

- Validating Program tracking data provided by CHP by checking for duplicate or erroneous entries;
- Verifying that participants were part of the program according to the agreed-upon process between CHP and the Company; and
- Conducting verification surveys with a sample of program participants (the focus of these verification surveys is to confirm that customers listed in the program tracking database did indeed participate and that the number of measures installed was accurate).

Table 7-5 summarizes the in-service and verification rates for the Residential Low-Income Single-Family Program.

Table 7-5 Installation Rates by Measure Type – Low-Income Single-Family Program

Measure	*Number of Respondents*	*In-Service/ Verification Rate*
Air Sealing	44	98%
Water Heater Tank Wrap	29	100%
Low Flow Showerhead	6	100%
Air Source Heat Pump	51	100%
Ceiling Fan	4	100%
Attic Insulation	34	100%
Mobile Home Attic Insulation	34	100%
Mobile Home Floor Insulation	34	100%
Water Heater Pipe Insulation	27	100%

Measure	*Number of Respondents*	*In-Service/ Verification Rate*
Direct Install Lighting	22	96%
Refrigerator	5	100%
Low Flow Faucet Aerator	13	84%
Heat Pump Clean & Tune	2	100%
Duct Insulation	2	100%
Duct Sealing	2	100%
Smart Thermostat	1	100%

7.3.1.3 Weather Dependent Inputs

Many measures utilize common weather-dependent factors, such as effective full-load heating hours and cooling hours (EFLH), cooling degree hours (CDH), heating degree days (HDD) and cooling degree days (CDD).

The method utilized by the Mid-Atlantic TRM to estimate full load hours (EFLH) from the EmPower metering study multiplied by the ratio of the Energy Star full load hours of the analyzed city to the study city, was developed for the eight Virginia and West Virginia cities referenced in the Energy Star full load data.

The heating degree days were developed for 932 zip codes in Virginia from TMY3 weather data and the Mid-Atlantic TRM method with the referenced base balance point outdoor air temperature. The data from 11 weather stations with TMY3 data were obtained along with the TRM heating balance point of 60F and a TRM cooling balance point of 65F to develop CDD and HDD. From these 11 weather stations, the HDD and CDD values were assigned by the nearest radial distance to 932 zip codes. The CDH was determined for each zip code by a similar Mid-Atlantic TRM method, with the referenced balance point of 75F.

7.3.1.4 Measure Specific Calculations

Table 7-6 summarizes the equations and inputs used to estimate the savings of the program measures. The savings calculated using the approaches outlined in the table were adjusted by the verification and in-service rates developed from the survey of program participants to estimate the gross program savings.

Table 7-6 Measure Specific Calculations

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Measure Name: Low Flow Faucet Aerator			
Savings	ΔkWh		(((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412
Savings	ΔkW		((((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412) / Hours * CF
Input	#people	2.39	Mid-Atlantic TRM V10.0, p. 133.
Input	GPM_base	2.2	Mid-Atlantic TRM V10.0, p. 133.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*Throttle_base*	0.83	Mid-Atlantic TRM V10.0, p. 134.
Input	*GPM_low*	Varies	Tracking data.
Input	*Throttle_low*	0.95	Mid-Atlantic TRM V10.0, p. 134.
Input	*Time_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 134.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 134.
Input	*DR*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*Hours*	Varies	Calculation: #people * Time_faucet / 60 * 365.
Input	*CF*	0.00262	Mid-Atlantic TRM V10.0, p. 135.
EUL		10	Mid-Atlantic TRM V10, p. 136.
Measure Name: Low Flow Showerhead			
Savings	ΔkWh		((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412
Savings	ΔkW		(((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412) / Hours * CF
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMbase*	2.5	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMlow*	Varies	Tracking data.
Input	*Time_shower*	7.8	Mid-Atlantic TRM V10.0, p. 137.
Input	*TEMP_sh*	105	Mid-Atlantic TRM V10.0, p. 138.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 138.
Input	*Showers_per_person*	0.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*ShowerHeads_per_home*	1.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 138.
Input	*Hours*	Varies	Calculation: (TimeShower * #people * Showers_per_person) / (ShowerHeads_per_home * 60) * 365.
Input	*CF*	0.00371	Mid-Atlantic TRM V10.0, p. 139.
EUL		10	Mid-Atlantic TRM V10, p. 140.
Measure Name: Water Heater Tank Wrap			
Savings	ΔkWh		(((U_base * A_base) - (U_insul * A_insul)) * ΔT * Hours) / (3412 * ηDHW)
Savings	ΔkW		((((U_base * A_base) - (U_insul * A_insul)) * ΔT * Hours) / (3412 * ηDHW)) / 8760
Input	*U_base*	Varies	Mid-Atlantic TRM V10.0, p. 141.
Input	*A_base*	Varies	Mid-Atlantic TRM V10.0, p. 142, based on WH capacity
Input	*U_insul*	Varies	Mid-Atlantic TRM V10.0, p. 142.
Input	*A_insul*	Varies	Mid-Atlantic TRM V10.0, p. 142.
Input	ΔT	60	Mid-Atlantic TRM V10.0, p. 142.
Input	*Hours*	8760	Mid-Atlantic TRM V10.0, p. 142.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*ηDHW*	0.98	Mid-Atlantic TRM V10.0, p. 142.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
			Measure Name: Water Heater Pipe Insulation
Savings	*ΔkWh*		*(((1 / Rexist) - (1 / Rnew)) * L * C * ΔT * 8760) / n_DHW / 3413*
Savings	*ΔkW*		*(((1 / Rexist) - (1 / Rnew)) * L * C * ΔT) / n_DHW / 3413*
Input	*Rexist*	Varies	Mid-Atlantic TRM V9.0, p. 186.
Input	*Rnew*	Varies	Tracking data.
Input	*L*	Varies	Tracking data.
Input	*C*	Varies	Tracking data.
Input	*ΔT*	65	Mid-Atlantic TRM V9.0, p. 187.
Input	*n_DHW*	0.98	Mid-Atlantic TRM V9.0, p. 187.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
			Measure Name: Air Sealing
Savings	*ΔkWh*		*(((((CFM50_Exist - CFM50_New) / N - cool) * 60 * CDH * DUA * 0.018) / 1000 / ηCool) * LM) + (((((CFM50_Exist - CFM50_New) / N - heat) * 60 * 24 * HDD * 0.018) / 1000000 / ηHeat) * 293.1)*
Savings	*ΔkW*		*(((((CFM50_Exist - CFM50_New) / N - cool) * 60 * CDH * DUA * 0.018) / 1000 / ηCool) * LM) / EFLH_cool * CF*
Input	*CFM50_Exist*	Varies	Tracking data.
Input	*CFM50_New*	Varies	Tracking data.
Input	*CDH*	Varies	Applicable weather data.
Input	*DUA*	0.75	Mid-Atlantic TRM V9.0, p. 253.
Input	*ηCool*	Varies	Tracking data.
Input	*LM*	Varies	Based on location: Mid-Atlantic TRM method.
Input	*HDD*	Varies	Applicable weather data.
Input	*ηHeat*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 257.
EUL		15	PA TRM V2021 Vol. 2, p. 147.
			Measure Name: Direct Install Lighting
Savings	*ΔkWh*		*((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))*
Savings	*ΔkW*		*((WattsBase - WattsEE) / 1000) * WHFd * CF*
Input	*WattsEE*	Varies	Product characteristics.
Input	*WattsBase*	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	*Hours*	679	Mid-Atlantic TRM V9.0, p.34.
Input	*HF*	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	*ηHeat*	Varies	Tracking data.
Input	*%ElecHeat*	Varies	Tracking data.
Input	*WHFeCool*	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	*CF*	0.06	Mid-Atlantic TRM V9.0, p. 37.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*WHFd*	1.19	Mid-Atlantic TRM V9.0, p. 36.
EUL		Varies	For direct installations occurring before July 1, 2023, the duration is 18 year (Mid-Atlantic TRM V10.0, p. 34); for direct installations on or after July 1, 2023, the duration is 1.8 years.
		Measure Name: Duct Insulation	
Savings	*ΔkWh*		*(DI_heat_supply_basement * A_supply_basement + DI_heat_return_basement * A_return_basement + DI_heat_supply_attic * A_supply_attic + DI_heat_return_attic * A_return_attic + DI_cool_supply_basement * A_supply_basement + DI_cool_return_basement * A_return_basement + DI_cool_supply_attic * A_supply_attic + DI_cool_return_attic * A_return_attic) * Adjustment_Factor*
Savings	*ΔkW*		*(DI_cool_supply_basement * A_supply_basement + DI_cool_return_basement * A_return_basement + DI_cool_supply_attic * A_supply_attic + DI_cool_return_attic * A_return_attic) * Adjustment_Factor / EFLH_cool * CF*
Input	*DI_heat_supply_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_return_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_supply_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_heat_return_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_supply_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_return_basement*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_supply_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*DI_cool_return_attic*	Varies	Connecticut's 2020 Program Savings Document, p. 178.
Input	*A_supply_basement*	Varies	Surface area of ducts (ft2) insulated - basement supply ducts.
Input	*A_return_basement*	Varies	Surface area of ducts (ft2) insulated - basement return ducts.
Input	*A_supply_attic*	Varies	Surface area of ducts (ft2) insulated - attic supply ducts.
Input	*A_return_attic*	Varies	Surface area of ducts (ft2) insulated - attic return ducts.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 263.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*Adjustment_Factor*	Varies	ADM. Factor to adjust savings estimate to account for diminishing marginal benefits. Value between 0 and 1.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
		Measure Name: Smart Thermostat	
Savings	*ΔkWh*		*(Capacity_cool / SEER * EFLH_cool * SF_cool / 1000) + (Capacity_heat / HSPF * EFLH_heat * SF_heat / 1000)*
Savings	*ΔkW*		*0*
Input	*Capacity_cool*	Varies	Tracking data.
Input	*SEER*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*Capacity_heat*	Varies	Tracking data.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*HSPF*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*SF_cool*	0.06	Mid-Atlantic TRM V10.0, p. 104.
Input	*SF_heat*	0.07	Mid-Atlantic TRM V10.0, p. 104.
EUL		7.5	Mid-Atlantic TRM V10.0, p. 106.
Measure Name: Attic Insulation			
Savings	*ΔkWh*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool * ADJcool) + ((1 / Rexist - 1 / Rnew) * HDD * 24 * Area / 1000000 / ηHeat * 293.1 * ADJheat)*
Savings	*ΔkW*		*((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool) / EFLH_cool * CF*
Input	*Rexist*	Varies	Tracking data.
Input	*Rnew*	Varies	Tracking data.
Input	*CDH*	Varies	Applicable weather data.
Input	*DUA*	0.75	Mid-Atlantic TRM V9.0, p. 261.
Input	*Area*	Varies	Tracking data.
Input	*ηCool*	Varies	Tracking data.
Input	*ADJcool*	0.8	Mid-Atlantic TRM V9.0, p. 261.
Input	*HDD*	Varies	Applicable weather data.
Input	*ηHeat*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*ADJheat*	0.6	Mid-Atlantic TRM V9.0, p. 263.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 263.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Measure Name: Duct Sealing			
Savings	*ΔkWh*		*((((Pre_CFM25 - Post_CFM25) / (Cool_Capacity * 400)) * EFLH_cool * BTUH_cool) / 1000 / ηCool) + ((((Pre_CFM25 - Post_CFM25) / (Heat_Capacity * 400)) * EFLH_heat * BTUH_heat) / 1000000 / ηHeat * 293.1)*
Savings	*ΔkW*		*((((Pre_CFM25 - Post_CFM25) / (Cool_Capacity * 400)) * EFLH_cool * BTUH_cool) / 1000 / ηCool) / EFLH_cool * CF*
Input	*Pre_CFM25*	Varies	Tracking data.
Input	*Post_CFM25*	Varies	Tracking data.
Input	*Cool_Capacity*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*BTUH_cool*	Varies	Tracking data.
Input	*ηCool*	Varies	Tracking data.
Input	*Heat_Capacity*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*BTUH_heat*	Varies	Tracking data.
Input	*ηHeat*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 257.

Variable Type	Variable Name	Variable Value	Variable Value Source
EUL		15	PA TRM V2021 Vol. 2, p. 42.
Measure Name: Heat Pump Clean & Tune			
Savings	ΔkWh		(((EFLH_cool * Capacity_cool * (1 / SEER)) / 1000 * Mfe) + (EFLH_heat * Capacity_heat * (1 / HSPF)) / 1000 * Mfe)
Savings	ΔkW		Capacity_cool * (1 / EER) / 1000 * MFd * CF
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	EFLH_heat	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	Capacity_cool	Varies	Tracking data.
Input	Mfe	0.05	Illinois TRM V11.0 Vol. 3, p. 167.
Input	SEER	Varies	Tracking data.
Input	Capacity_heat	Varies	Tracking data.
Input	HSPF	Varies	Tracking data.
Input	EER	Varies	Calculation: (-0.02 * SEER * SEER) + (1.12 * SEER).
Input	MFd	0.02	Illinois TRM V11.0 Vol. 3, p. 168.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 124.
EUL		3	Illinois TRM V11.0 Vol. 3, p. 165.
Measure Name: Air Source Heat Pump			
Savings - 1	ΔkWh Baseline 1		(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Heating_kwh_exist - ((Capacity_heat_ee / HSPF_base) / 1000 * EFLH_heat)) * ER_Factor) + (((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * ER_Factor * EFLH_cool)
Savings - 2	ΔkW Baseline 1		((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF + ((Capacity_cool_exist / EER_exist) - (Capacity_cool_exist / EER_base)) / 1000 * CF * ER_Factor
Savings - 2	ΔkWh (Baseline 2)		(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool)
Savings - 2	ΔkW (Baseline 2)		((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF
Input	Capacity_cool_exist	Varies	Tracking data.
Input	Capacity_cool_ee	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	SEER_exist	Varies	Tracking data.
Input	SEER_base	14	Mid-Atlantic TRM V10.0, p. 80.
Input	SEER_ee	Varies	Tracking data.
Input	EER_exist	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	EER_base	11.8	Mid-Atlantic TRM V10.0, p. 80.
Input	EER_ee	Varies	Tracking data.
Input	Capacity_heat_ee	Varies	Tracking data.
Input	EFLH_heat	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	HSPF_base	8.2	Mid-Atlantic TRM V10.0, p. 80.

Variable Type	Variable Name	Variable Value	Variable Value Source
Input	HSPF_ee	Varies	Tracking data.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 95.
Input	Heating_kwh_exist	Varies	Pre-project annual electric energy usage. Based on econometric analysis of interval meter data and capped at estimate of electric resistance baseline usage.
Input	ER_Factor	1	Assume early replacement for income qualified program.
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 87.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 87.
Measure Name: Mini Split Heat Pump			
Savings - 1	ΔkWh Baseline 1		(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Heating_kwh_exist - ((Capacity_heat_ee / HSPF_base) / 1000 * EFLH_heat)) * ER_Factor) + (((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * ER_Factor * EFLH_cool)
Savings - 2	ΔkW Baseline 1		((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF + ((Capacity_cool_exist / EER_exist) - (Capacity_cool_exist / EER_base)) / 1000 * CF * ER_Factor
Savings - 2	ΔkWh (Baseline 2)		(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool)
Savings - 2	ΔkW (Baseline 2)		((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF
Input	Capacity_cool_exist	Varies	Tracking data.
Input	Capacity_cool_ee	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	SEER_exist	Varies	Tracking data.
Input	SEER_base	14	Mid-Atlantic TRM V10.0, p. 88.
Input	SEER_ee	Varies	Tracking data.
Input	EER_exist	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	EER_base	11.8	Mid-Atlantic TRM V10.0, p. 88.
Input	EER_ee	Varies	Tracking data.
Input	Capacity_heat_ee	Varies	Tracking data.
Input	EFLH_heat	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	HSPF_base	8.2	Mid-Atlantic TRM V10.0, p. 88.
Input	HSPF_ee	Varies	Tracking data.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 124.
Input	Heating_kwh_exist	Varies	Pre-project annual electric energy usage. Based on econometric analysis of interval meter data and capped at estimate of electric resistance baseline usage.
Input	ER_Factor	1	Assume early replacement for income qualified program.
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 94.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 94.
Measure Name: Mobile Home Attic Insulation			

Variable Type	Variable Name	Variable Value	Variable Value Source
Savings	ΔkWh		((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool * ADJcool) + ((1 / Rexist - 1 / Rnew) * HDD * 24 * Area / 1000000 / ηHeat * 293.1 * ADJheat)
Savings	ΔkW		((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool) / EFLH_cool * CF
Input	Rexist	Varies	Tracking data.
Input	Rnew	Varies	Tracking data.
Input	CDH	Varies	Applicable weather data.
Input	DUA	0.75	Mid-Atlantic TRM V9.0, p. 261.
Input	Area	Varies	Tracking data.
Input	ηCool	Varies	Tracking data.
Input	ADJcool	0.8	Mid-Atlantic TRM V9.0, p. 261.
Input	HDD	Varies	Applicable weather data.
Input	ηHeat	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	ADJheat	0.6	Mid-Atlantic TRM V9.0, p. 263.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 263.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Measure Name: Mobile Home Floor Insulation			
Savings	ΔkWh		((1 / (0.55 * RVALPRE + 3.9) - 1 / (1 * RVALPOST + 3.9)) * HDD * 24 * FADJ * SQFT * GF / ηHeat) / 1000000 / 0.003412
Savings	ΔkW		0
Input	RVALPRE	Varies	Tracking data.
Input	RVALPOST	Varies	Tracking data.
Input	HDD	Varies	Applicable weather data.
Input	FADJ	0.64	Efficiency Maine Residential TRM V2018.1, p. 76.
Input	SQFT	Varies	Tracking data.
Input	GF	1	Percent of unconditioned space walls above grade.
Input	ηHeat	Varies	Tracking data.
EUL		15	PA TRM V2021 Vol. 2, p. 163.
Measure Name: Ceiling Fan			
Savings	ΔkWh		(Days * FanHours * ((%Lowbase * WattsLowbase) + (%Medbase * WattsMedbase) + (%Highbase * WattsHighbase)) / 1000) - (Days * FanHours * ((%LowES * WattsLowES) + (%MedES * WattsMedES) + (%HighES * WattsHighES)) / 1000)
Savings	ΔkW		((WattsHighbase - WattsHighES) / 1000) * CF
Input	Days	365.25	Mid-Atlantic TRM V10.0, p.125.
Input	FanHours	3	Mid-Atlantic TRM V10.0, p.125.
Input	%Lowbase	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsLowbase	15	Mid-Atlantic TRM V10.0, p.125.
Input	%Medbase	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsMedbase	34	Mid-Atlantic TRM V10.0, p.125.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*%Highbase*	0.2	Mid-Atlantic TRM V10.0, p.125.
Input	*WattsHighbase*	67	Mid-Atlantic TRM V10.0, p.125.
Input	*%LowES*	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	*WattsLowES*	6	Mid-Atlantic TRM V10.0, p.125.
Input	*%MedES*	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	*WattsMedES*	23	Mid-Atlantic TRM V10.0, p.125.
Input	*%HighES*	0.2	Mid-Atlantic TRM V10.0, p.125.
Input	*WattsHighES*	56	Mid-Atlantic TRM V10.0, p.125.
Input	*CF*	0.3	Mid-Atlantic TRM V10.0, p.126.
EUL		15	Mid-Atlantic TRM V10.0, p. 128.
Measure Name: Smart Powerstrip			
Savings	*ΔkWh*		*Annual_kWh * ERPenergy*
Savings	*ΔkW*		*Load * ERP_peak*
Input	*Annual_kWh*	449	Mid-Atlantic TRM V10.0, p. 200.
Input	*ERPenergy*	0.25	Mid-Atlantic TRM V10.0, p. 200.
Input	*Load*	0.052	Mid-Atlantic TRM V10.0, p. 200.
Input	*ERP_peak*	0.18	Mid-Atlantic TRM V10.0, p. 200.
EUL		5	Mid-Atlantic TRM V10.0, p. 201.
Measure Name: Refrigerator			
Savings - 1	*ΔkWh Baseline 1*		*kWhExist - kWhEE*
Savings - 2	*ΔkW Baseline 1*		*(kWhExist - kWhEE) / 8760 * TAF * LSAF*
Savings - 2	*ΔkWh* (Baseline 2)		*kWhBASE - kWhEE*
Savings - 2	*ΔkW* (Baseline 2)		*(kWhBASE - kWhEE) / 8760 * TAF * LSAF*
Input	*kWhExist*	Varies	Annual energy usage of pre-existing unit.
Input	*kWhBASE*	Varies	ENERGY STAR database for applicable product ID.
Input	*kWhEE*	Varies	ENERGY STAR database for applicable product ID.
Input	*TAF*	1.23	Mid-Atlantic TRM V10.0, p. 63.
Input	*LSAF*	1.15	Mid-Atlantic TRM V10.0, p. 63.
EUL - 1		4	Mid-Atlantic TRM V10.0, p. 62.
EUL - 2		8	Mid-Atlantic TRM V10.0, p. 62.
Measure Name: Room Air Conditioner			
Savings	*ΔkWh*		*(Hours_cool * Capacity_cool_ee * (1 / CEER_base - 1 / CEER_ee)) / 1000*
Savings	*ΔkW*		*(Capacity_cool_ee * (1 / CEER_base - 1 / CEER_ee)) / 1000 * CF*
Input	*Capacity_cool_ee*	12000	Tracking data.
Input	*Hours_cool*	325	Mid-Atlantic TRM V10.0, p. 70-71.
Input	*CEER_base*	Varies	Mid-Atlantic TRM V10.0, p. 70.
Input	*CEER_ee*	Varies	Tracking data.
Input	*CF*	0.3	Mid-Atlantic TRM V10.0, p. 71.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
EUL		12	Mid-Atlantic TRM V10.0, p. 72.

7.3.2 Methodology for Estimating Net Savings

The purpose of the Residential Low-Income Single-Family Program is to assist income-qualified customers who would benefit from higher level standard home weatherization measures such as ceiling insulation, home infiltration reduction, and duct sealing. The NTG ratio for the LISFP was assumed to be 1.0 in line with common practice for estimation of low-income program net savings.[7]

7.3.3 Impact Evaluation Results

The following subsections summarize the results of the impact evaluation conducted for the 2023 Low-Income Single-Family Program.

7.3.3.1 Results of Database Review

The Evaluation Team first examined the tracking database for systemic entry errors for each channel, i.e., duplicate entries and/or erroneous entries (such as data entered into improper columns). Upon receiving final program tracking databases, the Evaluation Team found quantities and unit specifications to match the implementer's records.

7.3.3.2 Annual kWh Savings and Peak kW Reduction

The program-level PY2023 realized net energy savings are presented below in Table 7-7. The net-to-gross ratio for the program is assumed to be 1.0 in line with common practice for estimation of net energy savings for low-income programs.[8]

Table 7-7 Low-Income Single-Family Program Realized Net Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
Air Sealing	120,482	101,735	84%	101,735	100%	1,526,022
Attic Insulation	40,976	23,215	57%	23,215	100%	348,232
Duct Insulation	2,976	4,561	153%	4,561	100%	68,419
Duct Sealing	182,173	222,403	122%	222,403	100%	3,336,050
Mobile Home Attic Insulation	27,446	15,079	55%	15,079	100%	226,186
Mobile Home Floor Insulation	127,627	50,581	40%	50,581	100%	758,714

[7] See Violette and Rathbun, Chapter 21: Estimating Net Savings: Common Practices. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, available electronically at https://www.nrel.gov/docs/fy17osti/68578.pdf, p. 45

[8] Ibid.

Air Source Heat Pump	839,240	640,171	76%	640,171	100%	4,369,679
Mini Split Heat Pump	287,394	203,763	71%	203,763	100%	1,925,651
Smart Thermostat	5,460	4,848	89%	4,848	100%	36,357
Heat Pump Clean & Tune	4,839	4,808	99%	4,808	100%	14,425
Direct Install Lighting	37,668	30,439	81%	30,439	100%	319,831
Ceiling Fan	3,384	557	16%	557	100%	8,355
Refrigerator	1,073	15,200	1416%	15,200	100%	67,992
Smart Powerstrip	1,167	2,572	220%	2,572	100%	12,861
Low Flow Faucet Aerator	7,940	5,597	70%	5,597	100%	55,970
Low Flow Showerhead	20,111	20,111	100%	20,111	100%	201,109
Water Heater Tank Wrap	54,424	53,312	98%	53,312	100%	799,674
Water Heater Pipe Insulation	60,000	60,000	100%	60,000	100%	900,007
Room Air Conditioner	173	173	100%	173	100%	2,073
Total	1,824,555	1,459,126	80%	1,459,126	100%	14,977,607

Table 7-8 shows the realized net peak kW reduction attributable to the Low-Income Single-Family Program for PY2023.

Table 7-8 Low-Income Single-Family Program Realized Peak kW Reductions

Measure Name	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*	*Net Ex Post kW Savings*	*Net-to-Gross Ratio*
Air Sealing	126.12	6.94	6%	6.94	100%
Attic Insulation	41.74	1.24	3%	1.24	100%
Duct Insulation	6.22	0.30	5%	0.30	100%
Duct Sealing	51.05	66.74	131%	66.74	100%
Mobile Home Attic Insulation	29.25	0.64	2%	0.64	100%
Mobile Home Floor Insulation	-	-	N/A	-	N/A
Air Source Heat Pump	228.79	128.73	56%	128.73	100%
Mini Split Heat Pump	(8.97)	32.51	-362%	32.51	100%
Smart Thermostat	-	-	N/A	-	N/A
Heat Pump Clean & Tune	0.49	0.70	141%	0.70	100%
Direct Install Lighting	9.13	3.68	40%	3.68	100%
Ceiling Fan	0.59	0.16	28%	0.16	100%
Refrigerator	0.17	2.45	1416%	2.45	100%
Smart Powerstrip	0.15	0.21	146%	0.21	100%
Low Flow Faucet Aerator	3.77	0.41	11%	0.41	100%
Low Flow Showerhead	12.82	1.75	14%	1.75	100%
Water Heater Tank Wrap	6.21	6.09	98%	6.09	100%
Water Heater Pipe Insulation	6.85	6.85	100%	6.85	100%
Room Air Conditioner	0.16	0.16	100%	0.16	100%
Total	514.55	259.58	50%	259.58	100%

7.3.3.3 Supplementary Econometric Analysis

To supplement the impact evaluation, the Evaluation Team utilized IPMVP Option C by performing regression analysis to assess the presence of energy savings during the period subsequent to implementation of program measures. The Evaluation Team obtained energy usage data of program participants from the Company. The analysis was performed using data associated with customers with energy usage data available for at least 11 months after implementation of program measures. For the Low-Income Single-Family Program, such data was available for a total of 67 PY2022 program participants. The variables described in Table 7-9 were included in the analysis.

Table 7-9 Analysis Model Variables

Variable Name	*Variable Description*
kWh	Dependent variable; participant daily energy use.
CDH	MAX (Outdoor Temperature - 75°F, 0) calculated hourly and averaged across month.
HDH	MAX (55°F - Outdoor Temperature, 0) calculated hourly and averaged across month.
Post	1 during post-implementation period; otherwise 0.

A mixed effects regression model was employed to estimate the incremental impact of implementation of program measures on participant energy use. The following equation was modeled:

Equation 7.1

$$kWh_{it} = \beta_0 + \beta_1 Post_{it} + \beta_2 CDH_{it} + \beta_3 HDH_{it} + e_{it}$$

Table 7-10 presents the results of the regression analysis.

Table 7-10 Parameter Estimates for Regression Model

Variable Name	*Estimate*	*Standard Error*	*Z score*	*p value*	*90% Confidence Interval*	
					Lower Bound	*Upper Bound*
CDH	0.004	0	10.65	0	0.003	0.004
HDH	0.002	0	33.13	0	0.002	0.002
Post	-5.082	1.038	-4.9	0	-6.789	-3.376
Intercept	21.69	1.849	11.73	0	18.648	24.732
Number of Observations						1,563
Number of Groups						67

Intuitively, the weather variables (*CDH* and *HDH*) have positive coefficients indicating the presence of weather-sensitive energy usage and the *Post* variable has a negative coefficient indicating lower energy use during the post-implementation period. The coefficient of *Post* indicates that average daily energy use of Low-Income Single-Family participants included in the analysis during the period after implementation of program measures is about 5.08 kWh lower, controlling for weather-related effects.

The energy savings estimate of 5.08 kWh associated with the Low-Income Single Family Program mixed effects regression model is equal to 71% of the average daily ex post gross kWh savings value of 7.13 kWh per account included in the econometric analysis. The average daily ex post gross kWh savings estimate is above the confidence interval of the savings estimate associated with the model *Post* variable.

7.4 Process Evaluation

This chapter presents key findings from the process evaluation of the Low-Income Single-Family Program.

7.4.1 Program Design and Operations

The Evaluation Team conducted an in-depth interview with a program coordinator from the Company and to gain insight into any changes to the design and operations of the Low-Income Single-Family program.

7.4.1.1 Program Operations and Changes

The Evaluation Team conducted an in-depth interview with the program coordinator for the LISF Program in Virginia. The purpose of the interview was to gain insight into program design and operations for PY2023.

There were no major changes in PY2023 for the LISF Program, including no changes made for income verification procedures.

The program coordinator noted high demand for the program, as evidenced by a waitlist of potential participants. To alleviate this backlog, proactive measures were implemented in PY2023. A primary strategy involved increasing the team's size by enlisting more contractors, especially those possessing larger workforce capabilities. This augmentation of staffing resources was intended to expedite the processing of the pending work. However, the coordinator underscored that this remediation process is ongoing, with continued efforts directed towards hiring additional contractors.

The coordinator identified labor shortages and workforce development as impediments to the program's progress. The scarcity of available workers could potentially stall the program's progress and impede timely implementation of the weatherization measures. A related factor is the time investment needed for training and certification of individuals for specific program tasks. The coordinator noted that some individuals might be reluctant to acquire the necessary certifications for tasks such as home or unit inspections, thereby exacerbating the labor shortage. It remains ambiguous whether this reluctance stems from the time-intensive certification process, inadequate remuneration, or other undisclosed reasons.

Because there is a waitlist, the program's promotional activities remain low-key, according to the staff. The primary marketing strategy has been the inclusion of an informative banner in emails sent to low-income households. This banner guides recipients to the program's website where they can explore available programs such as the Single-Family and Multifamily programs and fill out an application. Although these promotional efforts are not designed to drive a large influx of applicants, they have sparked inquiries from interested customers.

The various low-income programs are tracked using Excel, with data on incentives, administrative fees, implemented measures, and savings.

7.4.1.2 Project Process and Quality Control

Low-income residents have three ways to apply for the program: directly with the service provider, through the Company website, or through CHP. They can reach out directly to a local weatherization service provider to enroll and participate in the program. The program application process requires submission of documentation to substantiate income eligibility. Once the application is reviewed and approved, a contractor is assigned to the customer, or the customer is placed on a waitlist. The contractor will contact the customer to schedule an energy audit (door blower, duct test, etc.) in their home. After the energy audit, the service provider will develop a scope of work. Once the scope of work has been developed, the provider will decide to assign the projects to assign another subcontractor or to the in-house crew.

After completion, projects undergo inspection, and the work crew submits the required documentation to CHP. The field inspection policy directs participating Weatherization Service Providers (WSP), who are Building Performance Institute (BPI) Quality Control Inspector (QCI) certified, to inspect 100% of projects after the measures have been installed. The QCI performs diagnostic testing, which is a requirement for other state funding. Measures are inspected to verify that they were installed in accordance with the Virginia SWS Field Guide and the State Plan of Virginia. The WSP is to maintain a copy of the inspection results and provide them as requested by CHP. Additional information that CHP may request and the WSP must provide include:

- QCI report
- Data collection forms;
- Pre and post photos;
- Energy models, if applicable;
- Subcontractor invoices, if applicable; and
- Manual J calculations, if applicable.

As an additional quality control step, 10% of projects completed by participating contractors are randomly selected and inspected by CHP staff for quality assurance. Standard work specification (SWS) weatherization standards are used for quality assurance and control field inspections.

After quality control activities are complete, CHP sends an invoice to the Company and the project might be selected for an additional inspection. Inspectors complete a client satisfaction survey with program participants to collect feedback. There is an additional survey that is fielded over the phone to gather feedback from clients about their experiences with the LISF program. CHP staff provided the Evaluation Team with the client satisfaction survey. The survey includes questions about program awareness, why clients apply for the program, challenges, scheduling difficulties, contractor questions, and equipment satisfaction. Additionally, the survey solicits feedback from participants about energy savings in their home.

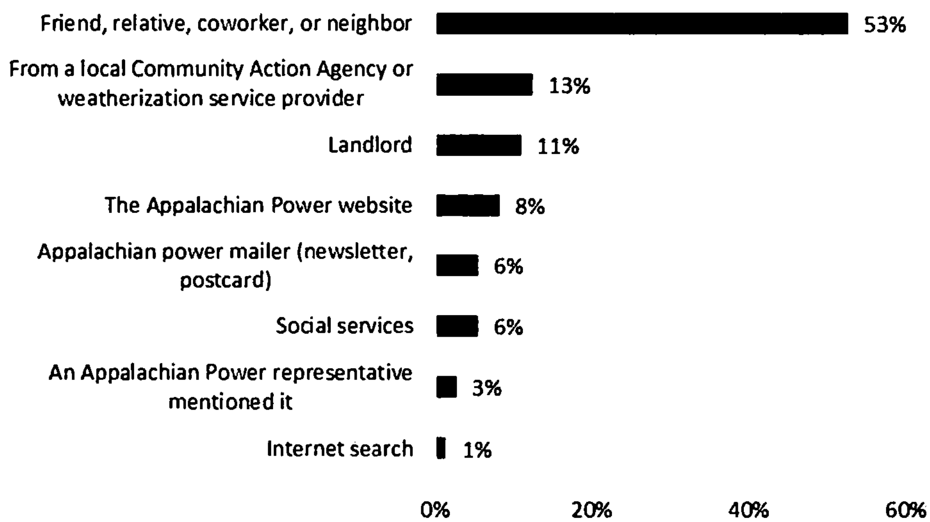
7.4.2 Participant Survey Results

The Evaluation Team conducted surveys with program participants as part of the evaluation effort. These surveys were designed to gather information related to both the impact and process components of the program evaluation. This section summarizes participant feedback on sources of program awareness, the participation experience and overall satisfaction with the program.

7.4.2.1 Customer Awareness of Program

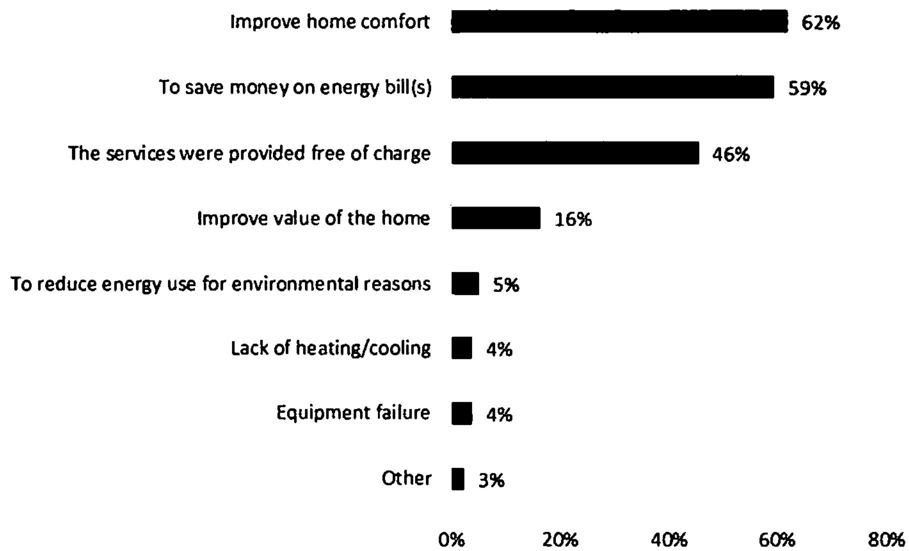
Participant awareness is driven by community action agencies/weatherization service providers and through word-of-mouth. As shown in Figure 7-1 respondents most commonly (53%) learned of the program from a friend, relative, coworker, or neighbor (word-of-mouth), followed by from a community action agency or weatherization service provider (13%). Though not the primary source, landlords contributed to program awareness, with 11% finding information through them. Other sources varied and included social service programs, the Company mailings or newsletters, program representatives, and internet searches.

Figure 7-1 How Customers Learned about the Program (n = 72)



Enhancing home comfort and saving money were the two primary motivations for participating. The most common motivations were to improve home comfort (62%), save money on energy bills (59%), and benefit from free services (46%). Additionally, 16% of respondents participated to enhance the value of their homes. Other reasons, such as reducing energy use for environmental reasons, experiencing equipment failure, and facing a lack of heating or cooling, also contributed to participants' decision to join the program. Figure 7-2 summarizes all the participants' reasons for participating.

Figure 7-2 Why Customers Participated in the Program (n = 79)[9]



7.4.2.2 Experience with Home Energy Assessment

All participants found the process of scheduling the audit to be easy, and the majority expressed satisfaction with both the home energy assessment and the information provided. The majority of households (59%) engaged in discussions about energy-saving strategies and the installation of energy-efficient equipment. Eighty-nine percent of survey respondents indicated that they scheduled the appointment, and all indicated they were home at the time of the visit. Sixty-nine percent thought scheduling the home visit was very easy and another 24% thought it was somewhat easy. No respondents said it was difficult to schedule.

Most respondents (89%) who recalled the home visit reported that their appliances or building structure were examined for energy efficiency. A majority of participants (72%) stated the program representative engaged in discussion with them about how to save energy in their home or offered recommendations on how to use their appliances and equipment in an energy efficient way.

A majority of survey respondents either somewhat or completely agreed that the work was completed in a timely and efficient manner, the work crew demonstrated courtesy and professionalism, and the information about their home's energy use was both useful and easy to understand (see Figure 7-3).

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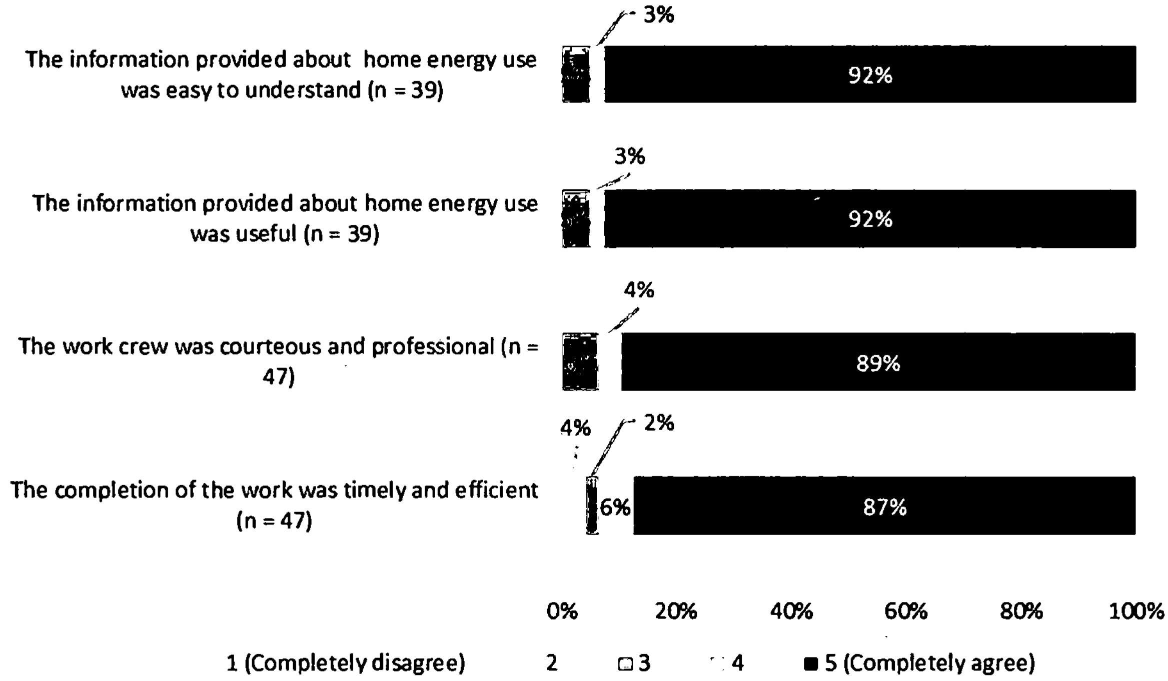
[9] Respondents were able to select more than one response and the sum of percentages shown in the figure exceeds 100%.

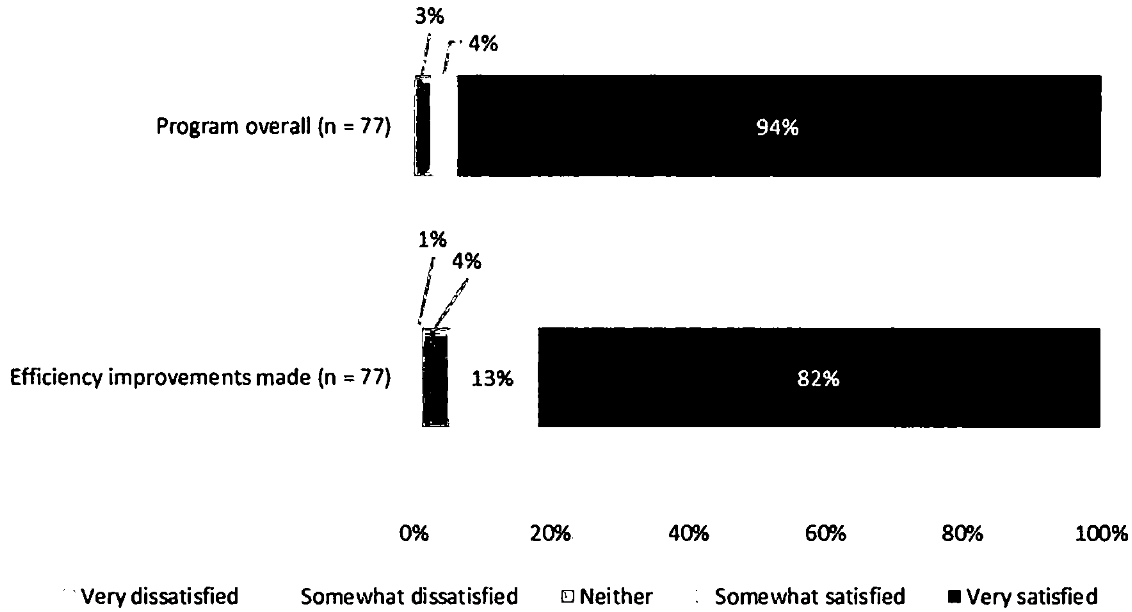
Figure 7-3 Customer Feedback on Work Performed



7.4.2.3 Customer Satisfaction

Participants were satisfied with the program and the improvements made. Ninety-four percent of respondents were very satisfied with the program overall and 82% were very satisfied with the efficiency improvements made to their homes (see Figure 7-4). One participant was dissatisfied with the efficiency improvements made and expressed disappointment because not all of their pipes were wrapped, only a small section received wrapping, and the installed wrapping came off the next day, requiring the individual to redo the work independently.

Figure 7-4 Program Satisfaction



Respondents provided varied feedback on the LISF Program, with some expressing overall satisfaction and others offering specific suggestions for improvement. Positive comments included satisfaction with the program, efficient work, and gratitude for the assistance provided. Some respondents wished for additional coverage, such as window replacement or improved communication between program representatives and contractors. Others mentioned delays in receiving services or encountered issues with the contractors' professionalism and responsiveness. Suggestions for improvement included better communication, clearer program expectations, prioritizing urgent cases, and ensuring tools are available for the proposed work. Despite a range of experiences, many participants expressed appreciation for the program's positive impact on their homes and well-being.

7.5 Findings and Recommendations

The Low-Income Single-Family program faced high demand with waitlists, requiring staffing expansion to address processing delays. Challenges stemming from labor shortages and extensive training requirements have limited participation, prompting a balanced, low-key promotion strategy to manage intake while sustaining customer interest. Ongoing proactive measures, such as team expansion and improved promotional activities, are directed at mitigating the waitlist backlog and addressing potential obstacles, including labor shortages and certification reluctance. The program remains dedicated to ensuring accessibility for all low-income participants.

The program staff has identified certain barriers to participation, with a specific focus on the challenges associated with the application process. In response, the program is actively working to enhance application accessibility. This initiative aligns with the program's broader commitment to support inclusivity and ensure that all participants can navigate the application process effectively.

Participant awareness is primarily driven by word-of-mouth, as the program is not actively marketing due to the existing waitlist. Most survey respondents learned of the program through friends, family, coworkers, or neighbors. Additionally, community action agencies or weatherization service providers contribute to program awareness, while landlords also play a role. Other sources of awareness include social service programs, the Company mailings or newsletters, program representatives, and internet searches. The two main motivations for participation are to improve home comfort and save money on energy bills. Because there is a waitlist, program staff indicate that there is no active need for additional promotional efforts to attract more applicants. The main marketing activity involves the inclusion of a banner in emails, serving as a notification to customers and directing them to the program's website for applications and program details. While the marketing focus isn't on generating a significant influx of applicants, there have been inquiries from customers seeking information about the application process.

Participants universally found scheduling the energy audit easy, with none finding it difficult. Additionally, the majority engaged in discussions about energy-saving strategies during the home visit, and all participants were present during the visit. Survey respondents generally agreed that the work was completed in a timely and efficient manner, the work crew demonstrated courtesy and professionalism, and the information about their home's energy use was both useful and easy to understand.

Survey respondents showed high satisfaction with the Low Income Single Family Program, with 94% very satisfied overall and 82% very satisfied with home improvements. Varied open-ended feedback included positive comments on program satisfaction and efficient work, along with suggestions for improvement such as coverage of additional measures, better communication, and addressing delays or contractor-related issues. Despite some suggestions for improvement, nearly all participants were satisfied with the program and the work performed.

8 Low-Income Multifamily Family Program

8.1 Program Description

The LIMF Program aims to reduce energy consumption by installing energy efficiency measures in multifamily properties and educating residential customers about the energy and money saving benefits associated with energy efficiency in the home. The program works with property managers and owners to implement energy efficiency measures at the property and tenants receive educational materials and an opportunity to discuss ways that they can continue to conserve and maintain the efficiency of their home after the services have been performed.

The LIMF Program targets measures that have been proven to save energy, reduce consumption, and protect the health and safety of occupants while helping to lower their electric bills. Eligible measures include, but are not limited to, those listed below.

Electric Baseload Reduction

- Energy efficient lighting
- Electric water heating measures (aerators, pipe wrap, showerheads, etc.)
- ENERGY STAR® appliance upgrades

Electric Weatherization Measures

- HVAC replacement and maintenance
- Insulation and air sealing measures
- Duct system sealing and replacement

Health and Safety

- Electrical system upgrades and maintenance
- Home ventilation

In general, equipment and installation costs for all measures are provided at no cost to eligible customers and properties.

8.1.1 Program Eligibility Requirements

Multifamily properties that are individually metered and within the Company's service area and meet one of the two following requirements are eligible to receive services through the program.

- A minimum of 66% (50% for any buildings under 5 units) of the dwelling units in the building are occupied by a family unit whose household annual income does not exceed 80% of the Virginia State Median Income.
- The building is listed on the HUD-DOE approved multifamily list.

8.1.2 Summary of Savings by Eligible Rate Schedule

Table 8-1 compares average participant ex post net energy savings with the average energy usage of accounts for the applicable eligible rate schedule.

Table 8-1 Summary of Savings by Eligible Rate Schedule

Rate Schedule	*Total Net Ex Post kWh Savings*	*Number of Participating Accounts*	*Average Participant Account-Level Net Ex Post kWh Savings*	*Average Rate Schedule Account-Level kWh Usage*	*Average Participant Account-Level Net Ex Post kWh Savings as Percentage of Average Rate Schedule Account-Level kWh Usage*
RS	320,034	517	619.0	12,719	4.87%

8.2 Data Collection

8.2.1 Participant Survey

Data collection from tenant and property manager surveys was used to verify measure installation and develop in-service rates for measures that may have been removed by tenants.

To estimate the sufficiency of the sample size, the Evaluation Team calculated the sample size needed to meet the 90/10 precision and confidence level. The sample size to meet 90/10 requirements is calculated using the coefficient of variation defined as:

$$CV(x) = \frac{Standard\ Deviation\ (x)}{Mean(x)}$$

Without data to use as a basis for a higher value, it is typical to apply a CV of .5 in residential program evaluations. The resulting sample size is estimated by the following equation:

$$n = \left(\frac{1.645\ cv}{D}\right)^2$$

Where,

1.645 = Z Score for 90% confidence interval in a normal distribution

CV = Coefficient of Variation

D = Desired Precision, 10% in this evaluation

To account for the number of participants in the program, a finite population correction is applied with the following formula in order to calculate an adjusted sample size:

$$n = \frac{n_0}{1 + n_0/N}$$

Where,

n_0 = Sample size calculated prior to application of finite population correction.

N = Population size (number of program participants)

The tenant survey focused on those tenants that received measures that could be removed by them such as LED light bulbs. The Evaluation Team attempted to contact 63 tenants that received removable measures to calculate the in-service rates. The sample size required to meet 90% confidence and 10% precision is 33 for a population of 63. For the property manager survey, with a population of six contacts listed as the contact for nine properties, a census would be required due to the small sample size. Neither target was met for the evaluation.

Table 8-2 summarizes the data collection. For the tenant survey, the Evaluation Team attempted to complete a survey with a census of tenants with contact information available and was able to complete 4 surveys through an online survey. All tenant contacts were offered a $10 gift card to if they completed the survey. The Evaluation Team also emailed each property manager to ask them to confirm the accuracy of the project description. In total, we received five responses from the six contacts.

Table 8-2 Tenant Survey Response Summary

Survey	*Mode*	*Time Frame*	*Number of Contacts*	*Number of Completions*
Low Income Multi Family -- Property Manager Email Communication to Verify Project	Email	December 2023	6	5
Low Income Multi Family -- Tenant	Email	December 2023	63	5

8.3 Impact Evaluation

This chapter addresses the impacts of energy savings and peak demand reductions resulting from measures installed in facilities of customers that obtained incentives under the Low-Income Multifamily Program during the period January 2023 through December 2023.

The M&V approach for the 2023 Low-Income Multifamily Program is aimed at the following:

- Determining the number of weatherization measures reported as being installed through the program;
- Verifying the extent to which the reported weatherization measures are currently installed;
- Estimating annual kWh savings for measures implemented; and
- Estimating annual kW reduction for measures implemented.

8.3.1 Methodology for Estimating Gross Savings

Table 8-3 below summarizes the inputs needed for gross savings calculations and the source of each input.

Table 8-3 Data Sources for Gross Impact Parameters – Low-Income Multifamily Program

Parameter	*Source*
Number of Participants	Program Tracking Data
Measures Installed	Program Tracking Data/ Email Communication with Property Manager
Measures Still In Use	Participant Surveying/ Tenant Email Surveys
Home characteristics	Program Tracking Data

8.3.1.1 Measure Attributes Tracked

Under this program, energy auditors collect details on home and equipment characteristics, documenting this through use of Excel-based project tracking workbooks. The workbooks facilitate tracking of information on baseline home and equipment characteristics as well as information regarding specific recommended improvements that are subsequently implemented under the program.

Table 8-4 presents information on the equipment specification data tracked by the program.

Table 8-4 Gross Impact Attributes Tracked by Program – Low-Income Multifamily Program

Measure	*Attributes Tracked*
HVAC Measures	Heating and Cooling System Types and Efficiency Levels
Lighting Measures	Light Level (Lumens)
	Wattage
	Installation Location (Room)
Water Heating Measures	Water Heating Type, Installation Location (Room) for Aerators
Envelope Measures	Existing and New Insulation Levels, Heating and Cooling System Types

8.3.1.2 Verification of Measure Installation

The initial step in conducting measurements of program activity is to verify the number of weatherization measures installed. The Evaluation Team took several steps in verifying the number of weatherization measures installed which consists of the following:

- Validating Program tracking data provided by CHP by checking for duplicate or erroneous entries;
- Verifying that participants were part of the program according to the agreed-upon process between CHP and the Company; and

- Verifying that the work recorded in the program data was accurate through email communications with the participating property managers; and
- Conducting a survey of tenants to understand if any of the installed items were removed. Because few responses were obtained, the Evaluation Team combined responses from PY2021 – PY2023.

The verification and in-service findings are summarized below:

- The five responding project managers verified the description of the work done at eight properties.
- Most measures were assessed to have remained in use. The lowest in-service rate was for low-flow showerheads at 77%.

Table 8-5 summarizes the in-service and verification rates for the measures installed through the LIMF program.

Table 8-5 Installation Rates by Measure Type – Low Income Multifamily Program

Measure	*In-Service/ Verification Rate*
Pipe insulation	100%
Tank wrap	100%
Faucet aerator	92%
Showerhead	77%
Air source heat pump / Mini split	100%
Insulation	100%
Air sealing	100%
Smart thermostat	100%
LED	100%

8.3.1.3 Weather Dependent Inputs

Many measures utilize common weather-dependent factors, such as effective full load heating hours and cooling hours (EFLH), cooling degree hours (CDH), heating degree days (HDD) and cooling degree days (CDD).

The method utilized by the Mid-Atlantic TRM to estimate full load hours (EFLH) from the EmPower metering study multiplied by the ratio of the ENERGY STAR full load hours of the analyzed city to the study city, was developed for the eight Virginia and West Virginia cities referenced in the ENERGY STAR full load data.

The heating degree days were developed for 932 zip codes in Virginia from TMY3 weather data and the Mid-Atlantic TRM method with the referenced base balance point outdoor air temperature. The data from 11 weather stations with TMY3 data were obtained along with the TRM heating balance point of 60F and a TRM cooling balance point of 65F to develop CDD and HDD. From these 11 weather stations, the HDD and CDD values were assigned by the nearest radial distance to 932 zip codes. The CDH was determined for each zip code by a similar Mid-Atlantic TRM method, with the referenced balance point of 75F.

8.3.1.4 Measure Specific Calculations

Table 8-6 summarizes the equations and inputs used to estimate the savings of the program measures. The savings calculated using the approaches outlined in the table were adjusted by the verification and in-service rates developed from the survey of program participants to estimate the gross program savings.

Table 8-6 Measure Specific Calculations

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
		Measure Name: Low Flow Faucet Aerator	
Savings	*ΔkWh*		*(((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*((((GPM_base * Throttle_base) - (GPM_low * Throttle_low)) * Time_faucet * #people * 365 * DR) * 8.3 * (TEMP_faucet - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 133.
Input	*GPM_base*	2.2	Mid-Atlantic TRM V10.0, p. 133.
Input	*Throttle_base*	0.83	Mid-Atlantic TRM V10.0, p. 134.
Input	*GPM_low*	Varies	Tracking data.
Input	*Throttle_low*	0.95	Mid-Atlantic TRM V10.0, p. 134.
Input	*Time_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_faucet*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 134.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 134.
Input	*DR*	Varies	Mid-Atlantic TRM V10.0, p. 134.
Input	*Hours*	Varies	Calculation: #people * Time_faucet / 60 * 365.
Input	*CF*	0.00262	Mid-Atlantic TRM V10.0, p. 135.
EUL		10	Mid-Atlantic TRM V10, p. 136.
		Measure Name: Low Flow Showerhead	
Savings	*ΔkWh*		*((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412*
Savings	*ΔkW*		*(((GPMbase - GPMlow) * Time_shower * #people * Showers_per_person * 365 / ShowerHeads_per_home) * 8.3 * 1 * (TEMP_sh - TEMP_in) / DHW_RE / 3412) / Hours * CF*
Input	*#people*	2.39	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMbase*	2.5	Mid-Atlantic TRM V10.0, p. 137.
Input	*GPMlow*	Varies	Tracking data.
Input	*Time_shower*	7.8	Mid-Atlantic TRM V10.0, p. 137.
Input	*TEMP_sh*	105	Mid-Atlantic TRM V10.0, p. 138.
Input	*TEMP_in*	60.9	Mid-Atlantic TRM V10.0, p. 138.
Input	*Showers_per_person*	0.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*ShowerHeads_per_home*	1.6	Mid-Atlantic TRM V10.0, p. 138.
Input	*DHW_RE*	0.98	Mid-Atlantic TRM V10.0, p. 138.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*Hours*	Varies	Calculation: (TimeShower * #people * Showers_per_person) / (ShowerHeads_per_home * 60) * 365.
Input	*CF*	0.00371	Mid-Atlantic TRM V10.0, p. 139.
EUL		10	Mid-Atlantic TRM V10, p. 140.
			Measure Name: Water Heater Pipe Insulation
Savings	ΔkWh		$(((1 / Rexist) - (1 / Rnew)) * L * C * \Delta T * 8760) / n\_DHW / 3413$
Savings	ΔkW		$(((1 / Rexist) - (1 / Rnew)) * L * C * \Delta T) / n\_DHW / 3413$
Input	*Rexist*	Varies	Mid-Atlantic TRM V9.0, p. 186.
Input	*Rnew*	Varies	Tracking data.
Input	*L*	Varies	Tracking data.
Input	*C*	Varies	Tracking data.
Input	ΔT	65	Mid-Atlantic TRM V9.0, p. 187.
Input	*n_DHW*	0.98	Mid-Atlantic TRM V9.0, p. 187.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
			Measure Name: Water Heater Tank Wrap
Savings	ΔkWh		$(((U\_base * A\_base) - (U\_insul * A\_insul)) * \Delta T * Hours) / (3412 * \eta DHW)$
Savings	ΔkW		$((((U\_base * A\_base) - (U\_insul * A\_insul)) * \Delta T * Hours) / (3412 * \eta DHW)) / 8760$
Input	*U_base*	Varies	Mid-Atlantic TRM V10.0, p. 141.
Input	*A_base*	Varies	Mid-Atlantic TRM V10.0, p. 142, based on WH capacity
Input	*U_insul*	Varies	Mid-Atlantic TRM V10.0, p. 142.
Input	*A_insul*	Varies	Mid-Atlantic TRM V10.0, p. 142.
Input	ΔT	60	Mid-Atlantic TRM V10.0, p. 142.
Input	*Hours*	8760	Mid-Atlantic TRM V10.0, p. 142.
Input	ηDHW	0.98	Mid-Atlantic TRM V10.0, p. 142.
EUL		15	Mid-Atlantic TRM V9.0, p. 188.
			Measure Name: Air Sealing
Savings	ΔkWh		$(((((CFM50\_Exist - CFM50\_New) / N\text{-}cool) * 60 * CDH * DUA * 0.018) / 1000 / \eta Cool) * LM) + (((((CFM50\_Exist - CFM50\_New) / N\text{-}heat) * 60 * 24 * HDD * 0.018) / 1000000 / \eta Heat) * 293.1)$
Savings	ΔkW		$(((((CFM50\_Exist - CFM50\_New) / N\text{-}cool) * 60 * CDH * DUA * 0.018) / 1000 / \eta Cool) * LM) / EFLH\_cool * CF$
Input	*CFM50_Exist*	Varies	Tracking data.
Input	*CFM50_New*	Varies	Tracking data.
Input	*CDH*	Varies	Applicable weather data.
Input	*DUA*	0.75	Mid-Atlantic TRM V9.0, p. 253.
Input	$\eta Cool$	Varies	Tracking data.
Input	*LM*	Varies	Based on location: Mid-Atlantic TRM method.
Input	*HDD*	Varies	Applicable weather data.
Input	$\eta Heat$	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.

Variable Type	Variable Name	Variable Value	Variable Value Source
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 257.
EUL		15	PA TRM V2021 Vol. 2, p. 147.
Measure Name: Direct Install Lighting			
Savings	ΔkWh		((WattsBase - WattsEE) / 1000) * Hours * ((1 - ((HF / ηHeat) * %ElecHeat)) + (WHFeCool - 1))
Savings	ΔkW		((WattsBase - WattsEE) / 1000) * WHFd * CF
Input	WattsEE	Varies	Product characteristics.
Input	WattsBase	Varies	Mid-Atlantic TRM V10.0, p.27-29.
Input	Hours	679	Mid-Atlantic TRM V9.0, p.34.
Input	HF	0.47	Mid-Atlantic TRM V10.0, p.42.
Input	ηHeat	Varies	Tracking data.
Input	%ElecHeat	Varies	Tracking data.
Input	WHFeCool	1.077	Mid-Atlantic TRM V9.0, p. 35.
Input	CF	0.058	Mid-Atlantic TRM V9.0, p. 37.
Input	WHFd	1.19	Mid-Atlantic TRM V9.0, p. 36.
EUL		Varies	For direct installations occurring before July 1, 2023, the duration is 18 year (Mid-Atlantic TRM V10.0, p. 34); for direct installations on or after July 1, 2023, the duration is 1.8 years.
Measure Name: Ceiling Fan			
Savings	ΔkWh		(Days * FanHours * ((%Lowbase * WattsLowbase) + (%Medbase * WattsMedbase) + (%Highbase * WattsHighbase)) / 1000) - (Days * FanHours * ((%LowES * WattsLowES) + (%MedES * WattsMedES) + (%HighES * WattsHighES)) / 1000)
Savings	ΔkW		((WattsHighbase - WattsHighES) / 1000) * CF
Input	Days	365.25	Mid-Atlantic TRM V10.0, p.125.
Input	FanHours	3	Mid-Atlantic TRM V10.0, p.125.
Input	%Lowbase	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsLowbase	15	Mid-Atlantic TRM V10.0, p.125.
Input	%Medbase	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsMedbase	34	Mid-Atlantic TRM V10.0, p.125.
Input	%Highbase	0.2	Mid-Atlantic TRM V10.0, p.125.
Input	WattsHighbase	67	Mid-Atlantic TRM V10.0, p.125.
Input	%LowES	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsLowES	6	Mid-Atlantic TRM V10.0, p.125.
Input	%MedES	0.4	Mid-Atlantic TRM V10.0, p.125.
Input	WattsMedES	23	Mid-Atlantic TRM V10.0, p.125.
Input	%HighES	0.2	Mid-Atlantic TRM V10.0, p.125.
Input	WattsHighES	56	Mid-Atlantic TRM V10.0, p.125.
Input	CF	0.3	Mid-Atlantic TRM V10.0, p.126.
EUL		15	Mid-Atlantic TRM V10.0, p. 128.
Measure Name: Smart Thermostat			

Variable Type	Variable Name	Variable Value	Variable Value Source
Savings	ΔkWh		(Capacity_cool / SEER * EFLH_cool * SF_cool / 1000) + (Capacity_heat / HSPF * EFLH_heat * SF_heat / 1000)
Savings	ΔkW		0
Input	Capacity_cool	Varies	Tracking data.
Input	SEER	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	Capacity_heat	Varies	Tracking data.
Input	HSPF	Varies	Tracking data.
Input	EFLH_heat	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	SF_cool	0.07	Mid-Atlantic TRM V10.0, p. 104.
Input	SF_heat	0.06	Mid-Atlantic TRM V10.0, p. 104.
EUL		7.5	Mid-Atlantic TRM V10.0, p. 106.
Measure Name: Attic Insulation			
Savings	ΔkWh		((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool * ADJcool) + ((1 / Rexist - 1 / Rnew) * HDD * 24 * Area / 1000000 / ηHeat * 293.1 * ADJheat)
Savings	ΔkW		((1 / Rexist - 1 / Rnew) * CDH * DUA * Area / 1000 / ηCool) / EFLH_cool * CF
Input	Rexist	Varies	Tracking data.
Input	Rnew	Varies	Tracking data.
Input	CDH	Varies	Applicable weather data.
Input	DUA	0.75	Mid-Atlantic TRM V9.0, p. 261.
Input	Area	Varies	Tracking data.
Input	ηCool	Varies	Tracking data.
Input	ADJcool	0.8	Mid-Atlantic TRM V9.0, p. 261.
Input	HDD	Varies	Applicable weather data.
Input	ηHeat	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	ADJheat	0.6	Mid-Atlantic TRM V9.0, p. 263.
Input	CF	0.66	Mid-Atlantic TRM V9.0, p. 263.
EUL		15	PA TRM V2021 Vol. 2, p. 158.
Measure Name: Duct Sealing			
Savings	ΔkWh		((((Pre_CFM25 - Post_CFM25) / (Cool_Capacity * 400)) * EFLH_cool * BTUH_cool) / 1000 / ηCool) + ((((Pre_CFM25 - Post_CFM25) / (Heat_Capacity * 400)) * EFLH_heat * BTUH_heat) / 1000000 / ηHeat * 293.1)
Savings	ΔkW		((((Pre_CFM25 - Post_CFM25) / (Cool_Capacity * 400)) * EFLH_cool * BTUH_cool) / 1000 / ηCool) / EFLH_cool * CF
Input	Pre_CFM25	Varies	Tracking data.
Input	Post_CFM25	Varies	Tracking data.
Input	Cool_Capacity	Varies	Tracking data.
Input	EFLH_cool	Varies	Based on location: Mid-Atlantic TRM EFLH method.

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Input	*BTUH_cool*	Varies	Tracking data.
Input	*ηCool*	Varies	Tracking data.
Input	*Heat_Capacity*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*BTUH_heat*	Varies	Tracking data.
Input	*ηHeat*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 257.
EUL		15	PA TRM V2021 Vol. 2, p. 42.
Measure Name: Heat Pump Clean & Tune			
Savings	*ΔkWh*		*(((EFLH_cool * Capacity_cool * (1 / SEER)) / 1000 * Mfe) + (EFLH_heat * Capacity_heat * (1 / HSPF)) / 1000 * Mfe)*
Savings	*ΔkW*		*Capacity_cool * (1 / EER) / 1000 * MFd * CF*
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*Capacity_cool*	Varies	Tracking data.
Input	*Mfe*	0.05	Illinois TRM V11.0 Vol. 3, p. 167.
Input	*SEER*	Varies	Tracking data.
Input	*Capacity_heat*	Varies	Tracking data.
Input	*HSPF*	Varies	Tracking data.
Input	*EER*	Varies	Calculation: (-0.02 * SEER * SEER) + (1.12 * SEER).
Input	*MFd*	0.02	Illinois TRM V11.0 Vol. 3, p. 168.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 124.
EUL		3	Illinois TRM V11.0 Vol. 3, p. 165.
Measure Name: Smart Powerstrip			
Savings	*ΔkWh*		*Annual_kWh * ERPenergy*
Savings	*ΔkW*		*Load * ERP_peak*
Input	*Annual_kWh*	449	Mid-Atlantic TRM V10.0, p. 200.
Input	*ERPenergy*	0.25	Mid-Atlantic TRM V10.0, p. 200.
Input	*Load*	0.052	Mid-Atlantic TRM V10.0, p. 200.
Input	*ERP_peak*	0.18	Mid-Atlantic TRM V10.0, p. 200.
EUL		5	Mid-Atlantic TRM V10.0, p. 201.
Measure Name: Mini Split Heat Pump			
Savings - 1	*ΔkWh Baseline 1*		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool) + ((Heating_kwh_exist - ((Capacity_heat_ee / HSPF_base) / 1000 * EFLH_heat)) * ER_Factor) + (((Capacity_cool_exist / SEER_exist) - (Capacity_cool_ee / SEER_base)) / 1000 * ER_Factor * EFLH_cool)*
Savings - 2	*ΔkW Baseline 1*		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF + ((Capacity_cool_exist / EER_exist) - (Capacity_cool_exist / EER_base)) / 1000 * CF * ER_Factor*

Variable Type	*Variable Name*	*Variable Value*	*Variable Value Source*
Savings - 2	*ΔkWh* (Baseline 2)		*(((Capacity_heat_ee / HSPF_base) - (Capacity_heat_ee / HSPF_ee)) / 1000 * EFLH_heat) + (((Capacity_cool_ee / SEER_base) - (Capacity_cool_ee / SEER_ee)) / 1000 * EFLH_cool)*
Savings - 2	*ΔkW* (Baseline 2)		*((Capacity_cool_ee / EER_base) - (Capacity_cool_ee / EER_ee)) / 1000 * CF*
Input	*Capacity_cool_exist*	Varies	Tracking data.
Input	*Capacity_cool_ee*	Varies	Tracking data.
Input	*EFLH_cool*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*SEER_exist*	Varies	Tracking data.
Input	*SEER_base*	14	Mid-Atlantic TRM V10.0, p. 88.
Input	*SEER_ee*	Varies	Tracking data.
Input	*EER_exist*	Varies	Calculation: (-0.02 * SEER_exist * SEER_exist) + (1.12 * SEER_exist).
Input	*EER_base*	11.8	Mid-Atlantic TRM V10.0, p. 88.
Input	*EER_ee*	Varies	Tracking data.
Input	*Capacity_heat_ee*	Varies	Tracking data.
Input	*EFLH_heat*	Varies	Based on location: Mid-Atlantic TRM EFLH method.
Input	*HSPF_base*	8.2	Mid-Atlantic TRM V10.0, p. 88.
Input	*HSPF_ee*	Varies	Tracking data.
Input	*CF*	0.66	Mid-Atlantic TRM V9.0, p. 124.
Input	*Heating_kwh_exist*	Varies	Pre-project annual electric energy usage. Based on econometric analysis of interval meter data and capped at estimate of electric resistance baseline usage.
Input	*ER_Factor*	1	Assume early replacement for income qualified program.
EUL - 1		6	Mid-Atlantic TRM V10.0, p. 94.
EUL - 2		12	Mid-Atlantic TRM V10.0, p. 94.

8.3.2 Methodology for Estimating Net Savings

The purpose of the Residential Low-Income Multifamily Program is to assist income-qualified customers who would benefit from higher level standard home weatherization measures such as ceiling insulation, home infiltration reduction, and duct sealing. The NTG ratio for the LIMFP was assumed to be 1.0 in line with common practice for estimation of low-income program net savings.[10]

8.3.3 Impact Evaluation Results

The following subsections summarize the results of the impact evaluation conducted for the 2023 Low-Income Multifamily Program.

10 See Violette and Rathbun, Chapter 21: Estimating Net Savings: Common Practices. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, available electronically at https://www.nrel.gov/docs/fy17osti/68578.pdf, p. 45

8.3.3.1 Results of Database Review

The Evaluation Team first examined the tracking database for systemic entry errors for each channel, i.e., duplicate entries and/or erroneous entries (such as data entered into improper columns). Upon receiving final program tracking databases, the Evaluation Team found quantities and unit specifications to match the implementer's records.

8.3.3.2 Annual kWh Savings and Peak kW Reduction

The program-level PY2023 realized net energy savings are presented below in Table 8-7. During this period, realized gross and net energy savings totaled 320,034 kWh. The gross kWh realization rate of the program is 57%. The net-to-gross ratio for the program is assumed to be 1.0 in line with common practice for estimation of net energy savings for low-income programs.[11] An error that doubled the number of feet of hot water pipe insulation resulted in an overestimation in pipe insulation savings.

Table 8-7 Low-Income Multifamily Program Realized Net Energy Savings

Measure Name	*Ex Ante kWh Savings*	*Gross Ex Post kWh Savings*	*Gross Realization Rate*	*Net Ex Post kWh Savings*	*Net-to-Gross Ratio*	*Net Lifetime kWh Savings*
Air Sealing	1,365	1,378	101%	1,378	100%	20,665
Attic Insulation	3,226	1,751	54%	1,751	100%	26,262
Mini Split Heat Pump	217,872	195,927	90%	195,927	100%	2,468,752
Smart Thermostat	25,825	25,817	100%	25,817	100%	193,626
Heat Pump Clean & Tune	13,590	13,590	100%	13,590	100%	40,771
Direct Install Lighting	4,139	5,835	141%	5,835	100%	49,490
Low Flow Faucet Aerator	7,652	8,048	105%	8,048	100%	80,477
Low Flow Showerhead	22,088	19,402	88%	19,402	100%	194,018
Water Heater Tank Wrap	26,026	26,024	100%	26,024	100%	390,359
Water Heater Pipe Insulation	242,780	22,264	9%	22,264	100%	333,961
Total	564,565	320,034	57%	320,034	100%	3,798,382

Table 8-8 shows the realized net peak kW reduction attributable to the Low-Income Multifamily Program for PY2023.

11 See Violette and Rathbun, Chapter 21: Estimating Net Savings: Common Practices. The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures, available electronically at https://www.nrel.gov/docs/fy17osti/68578.pdf, p. 45.

Table 8-8 Low-Income Multifamily Program Realized Peak kW Reductions

Measure Name	*Ex Ante kW Savings*	*Gross Ex Post kW Savings*	*Gross Realization Rate*	*Net Ex Post kW Savings*	*Net-to-Gross Ratio*
Air Sealing	0.15	0.14	93%	0.14	100%
Attic Insulation	0.07	0.10	140%	0.10	100%
Mini Split Heat Pump	42.24	88.34	209%	88.34	100%
Smart Thermostat	-	-	N/A	-	N/A
Heat Pump Clean & Tune	1.94	1.83	94%	1.83	100%
Direct Install Lighting	0.55	0.68	125%	0.68	100%
Low Flow Faucet Aerator	0.53	0.49	92%	0.49	100%
Low Flow Showerhead	2.19	1.69	77%	1.69	100%
Water Heater Tank Wrap	2.97	2.97	100%	2.97	100%
Water Heater Pipe Insulation	27.71	2.54	9%	2.54	100%
Total	78.36	98.79	126%	98.79	100%

8.3.3.3 Supplementary Econometric Analysis

To supplement the impact evaluation, the Evaluation Team utilized IPMVP Option C by performing regression analysis to assess the presence of energy savings during the period subsequent to implementation of program measures. The Evaluation Team obtained energy usage data of program participants from the Company. The analysis was performed using data associated with customers with energy usage data available for at least 11 months after implementation of program measures. For the Low-Income Multifamily Program, such data was available for a total of 120 PY2023 program participants. The variables described in Table 8-9 were included in the analysis.

Table 8-9 Analysis Model Variables

Variable Name	*Variable Description*
kWh	Dependent variable; participant daily energy use.
CDH	MAX (Outdoor Temperature - 75°F, 0) calculated hourly and averaged across month.
HDH	MAX (55°F - Outdoor Temperature, 0) calculated hourly and averaged across month.
Post	1 during post-implementation period; otherwise 0.

A mixed effects regression model was employed to estimate the incremental impact of implementation of program measures on participant energy use. The following equation was modeled:

Equation 8.1

$$kWh_{it} = \beta_0 + \beta_1 Post_{it} + \beta_2 CDH_{it} + \beta_3 HDH_{it} + e_{it}$$

Table 8-10 presents the results of the regression analysis.

Table 8-10 Parameter Estimates for Regression Model

Variable Name	*Estimate*	*Standard Error*	*Z score*	*p value*	*90% Confidence Interval*	
					Lower Bound	*Upper Bound*
CDH	0.002	0	12.96	0	0.002	0.002
HDH	0	0	28.14	0	0	0
Post	-0.398	0.323	-1.23	0.217	-0.929	0.132
Intercept	10.129	0.578	17.53	0	9.179	11.08
Number of Observations						2,687
Number of Groups						120

Intuitively, the weather variables (*CDH* and *HDH*) have positive coefficients indicating the presence of weather-sensitive energy usage and the *Post* variable has a negative coefficient indicating lower energy use during the post-implementation period. The coefficient of *Post* indicates that average daily energy use of Low-Income Multifamily participants included in the analysis during the period after implementation of program measures is about 0.40 kWh lower, controlling for weather-related effects.

The energy savings estimate of 0.40 kWh associated with the Low-Income Multifamily Program mixed effects regression model is equal to 23% of the average daily ex post gross kWh savings value of 1.73 kWh per account included in the econometric analysis. The average daily ex post gross kWh savings estimate is above the 90% confidence interval of the savings estimate associated with the model *Post* variable.

8.4 Process Evaluation

This chapter presents key findings from the limited process evaluation conducted for the 2023 Low-Income Multifamily Program through the Company.

8.4.1 Program Design and Operations

The LIMF Program aims to reduce energy consumption by educating residential customers about the energy and money-saving benefits associated with energy efficiency in the home. Community Housing Partners (CHP) implement the program. CHP's weatherization crews may perform the weatherization work or subcontract it to another weatherization agency. CHP is also responsible for the recruiting and training of the contractors, and all aspects of program implementation.

The Evaluation Team conducted an in-depth interview with the Company program coordinator for the LIMF program in Virginia. The purpose of the interview was to gain insight into program design and operations for PY2023.

No major changes have occurred in the design or operations of the LIMF program in Virginia.

CHP takes the lead in outreach efforts with property managers. While the Company includes a banner in their emails that informs customers about the program, CHP primarily manages the outreach and communication efforts. CHP has the knowledge and expertise to identify target areas and engage with property managers and other stakeholders to effectively promote the program.

No challenges were identified regarding engaging multifamily properties this year. The number of applications received for the program for PY2023 has remained relatively stable compared to the previous year.

8.4.1.1 Quality Control Procedures

The program implementation contractor engages in multiple quality assurance and control procedures. The procedures used to confirm that the property meets the income qualification requirement and the procedures to verify and inspect the installation of the measures installed are documented below.

8.4.1.1.1 Income Verification

The LIMF program is targeted towards low-income customers and there are two pathways to qualify a building as meeting the income requirement:

- The building is on the HUD-DOE approved multifamily list; and
- A minimum of 66% of the units in the building have an income that does not exceed 80% of Virginia State Median Income. If the building has fewer than 5 units, the requirement is 50% of the units.

Although there are formally two independent pathways, the implementation contractor reported that they perform the income verification step, regardless of the buildings listed on the HUD-DOE website. Property management has this income information as part of qualifying tenants for rent subsidies, and the information is obtained from them.

The entire building is qualified if the standard for the share of income-qualified units is met.

8.4.1.1.2 Measure Installation Quality Control

As an initial step of the project process, an energy audit is performed on the building. The audit is composed of a visual inspection of the entire property, diagnostic testing (duct and air leakage) on a minimum of 15% of the units, and delivery of a client education packet.

During the measure installation process, each measure is documented in terms of specifications (existing lamp wattage, flow rates) and photographs are taken of the installed and replaced measures.

The measure installation process is followed by the quality control inspection performed by the Weatherization Service Provider (WSP). The WSP performing the inspection must be a certified Building Performance Institute (BPI) Quality Control Inspector (QCI), which was a new requirement added for PY2022). The quality control inspection consists of a visual inspection of all work performed, review of energy audit diagnostic numbers, and diagnostic testing of each unit that received such testing during the audit. This testing is essentially the test-out procedure used to record changes in leakage rates. The visual inspection consists of comparing the measure installations against the National Renewable Energy Laboratory Standard Work Specifications requirements. The requirements of the inspection are:

- Inspect each job funded by the Companies.
- Ensure that measures are installed in accordance with the Virginia Standard Work Specification Field Guide and the State Plan of Virginia.

- Maintain a copy of inspection results and make results available to CHP as requested.
- Provide any additional information as requested to CHP, including the inspection report, pre- and post-photos, the energy models, subcontractor invoicing, and Manual J sizing calculations if applicable.
- Correct any issues identified by CHP within 14 days of notification.

The final step is a quality assurance inspection by CHP program management. This inspection is performed on 10% of multifamily properties and 100% of sites with HVAC upgrades. The quality assurance inspection consists of a visual inspection of all the installation work, review of the energy audit and quality control inspection diagnostic results, re-testing of units that received diagnostic testing.

A final step of the process is compiling information for case studies of the projects. The case studies involve speaking with property management staff and tenants to get feedback on the work performed.

Overall, the quality control process as described is thorough and aligns with the quality control process for the Federal Weatherization Program.

8.5 Findings and Recommendations

The Low-Income Multifamily Weatherization program in Virginia has experienced no significant changes in design or operations. CHP leads outreach efforts, collaborating with property managers, while the Company contributes through email banners. No notable challenges in engaging multifamily properties were identified, and the program has maintained a consistent number of applications for PY2023 compared to the previous year.

9 Cost Effectiveness Evaluation

The following cost effectiveness tests were performed for each program: Total Resource Cost (TRC) test, Program Administrator Cost Test (PACT), Participant Cost Test (PCT), and Ratepayer Impact Measure (RIM) test. A score above one signifies that, from the perspective of the test, the program benefits were greater than the program costs. The benefits and costs associated with each test are defined in Table 9-1.

Table 9-1 Summary of Benefits and Costs Included in each Cost Effectiveness Test

Variable	*Definition*	*PCT*		*PACT*		*RIM*		*TRC*	
		Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	Incentives paid to customers.	✓			✓		✓		
Program Installation Costs	Installation costs paid by program.				✓		✓		✓
Bill Savings / Lost Revenue	Reduction in electricity costs faced by customers as a result of implementation of program measures. Equal to revenue lost to the utility.	✓					✓		
Avoided Energy Costs	Energy-related costs avoided by utility.			✓		✓		✓	
Avoided Capacity Costs	Capacity-related costs avoided by utility, including T&D.			✓		✓		✓	
Incremental Costs	Incremental costs associated with measure implementation, as compared with what would have been done in absence of program.		✓						✓
Program Overhead Costs	Program costs other than incentive or installation costs.				✓		✓		✓

Detailed results of program-level cost effectiveness testing is presented below in Table 9-2 through Table 9-8.

Table 9-2 Home Performance Program Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 946,785			$ 946,785		$ 946,785		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 3,398,119							
Lost Revenue (NPV)						$ 3,398,119		
Avoided Energy Costs (NPV)			$ 815,635		$ 815,635		$ 815,635	
Avoided Capacity Costs (NPV)			$ 412,684		$ 412,684		$ 412,684	
Avoided T&D Costs (NPV)			$ 579,069		$ 579,069		$ 579,069	
Incremental Costs		$ 536,830						$ 536,830
Program Overhead Costs				$ 846,823		$ 846,823		$ 846,823
Total Benefits	$ 4,344,904		$ 1,807,389		$ 1,807,389		$ 1,807,389	
Total Costs	$ 536,830		$ 1,793,607		$ 5,191,726		$ 1,383,653	
Test Score	8.09		1.01		0.35		1.31	

Table 9-3 Efficient Products Program Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 843,672			$ 843,672		$ 843,672		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 6,012,638							
Lost Revenue (NPV)						$ 6,012,638		
Avoided Energy Costs (NPV)			$ 1,430,486		$ 1,430,486		$ 1,430,486	
Avoided Capacity Costs (NPV)			$ 401,083		$ 401,083		$ 401,083	
Avoided T&D Costs (NPV)			$ 565,287		$ 565,287		$ 565,287	
Incremental Costs		$ 354,099						$ 354,099
Program Overhead Costs				$ 831,041		$ 831,041		$ 831,041
Total Benefits	$ 6,856,310		$ 2,396,855		$ 2,396,855		$ 2,396,855	
Total Costs	$ 354,099		$ 1,674,713		$ 7,687,351		$ 1,185,140	
Test Score	19.36		1.43		0.31		2.02	

Table 9-4 Energy Efficiency Kits Program Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 155,271			$ 155,271		$ 155,271		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 1,423,654							
Lost Revenue (NPV)						$ 1,423,654		
Avoided Energy Costs (NPV)			$ 321,833		$ 321,833		$ 321,833	
Avoided Capacity Costs (NPV)			$ 71,710		$ 71,710		$ 71,710	
Avoided T&D Costs (NPV)			$ 106,135		$ 106,135		$ 106,135	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 78,879		$ 78,879		$ 78,879
Total Benefits	$ 1,578,925		$ 499,677		$ 499,677		$ 499,677	
Total Costs	$ -		$ 234,149		$ 1,657,804		$ 78,879	
Test Score	N/A		2.13		0.30		6.33	

Table 9-5 Home Energy Reports Program Cost Effectiveness Test Results

Variable	PCT		UCT		RIM		TRC	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ -			$ -		$ -		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 5,112,422							
Lost Revenue (NPV)						$ 5,112,422		
Avoided Energy Costs (NPV)			$ 1,076,128		$ 1,076,128		$ 1,076,128	
Avoided Capacity Costs (NPV)			$ 123,601		$ 123,601		$ 123,601	
Avoided T&D Costs (NPV)			$ 937,450		$ 937,450		$ 937,450	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 727,919		$ 727,919		$ 727,919
Total Benefits	$ 5,112,422		$ 2,137,178		$ 2,137,178		$ 2,137,178	
Total Costs	$ -		$ 727,919		$ 5,840,341		$ 727,919	
Test Score	N/A		2.94		0.37		2.94	

Table 9-6 Bring Your Own Thermostat Program Cost Effectiveness Test Results

Variable	*PCT*		*UCT*		*RIM*		*TRC*	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 253,583			$ 253,583		$ 253,583		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 26,116							
Lost Revenue (NPV)						$ 26,116		
Avoided Energy Costs (NPV)			$ 6,228		$ 6,228		$ 6,228	
Avoided Capacity Costs (NPV)			$ 106,976		$ 106,976		$ 106,976	
Avoided T&D Costs (NPV)			$ 811,356		$ 811,356		$ 811,356	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 593,589		$ 593,589		$ 593,589
Total Benefits	$ 279,699		$ 924,560		$ 924,560		$ 924,560	
Total Costs	$ -		$ 847,172		$ 873,288		$ 593,589	
Test Score	N/A		1.09		1.06		1.56	

Table 9-7 Low-Income Single-Family Program Cost Effectiveness Test Results

Variable	*PCT*		*UCT*		*RIM*		*TRC*	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 3,110,912			$ 3,110,912		$ 3,110,912		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 1,890,157							
Lost Revenue (NPV)						$ 1,890,157		
Avoided Energy Costs (NPV)			$ 430,838		$ 430,838		$ 430,838	
Avoided Capacity Costs (NPV)			$ 311,472		$ 311,472		$ 311,472	
Avoided T&D Costs (NPV)			$ 426,323		$ 426,323		$ 426,323	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 1,914,238		$ 1,914,238		$ 1,914,238
Total Benefits	$ 5,001,070		$ 1,168,633		$ 1,168,633		$ 1,168,633	
Total Costs	$ -		$ 5,025,151		$ 6,915,308		$ 1,914,238	
Test Score	N/A		0.23		0.17		0.61	

Table 9-8 Low-Income Multifamily Program Cost Effectiveness Test Results

Variable	*PCT*		*UCT*		*RIM*		*TRC*	
	Benefit	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*	*Benefit*	*Cost*
Incentives	$ 2,439,836			$ 2,439,836		$ 2,439,836		
Program Installation Costs				$ -		$ -		$ -
Bill Savings (NPV)	$ 460,906							
Lost Revenue (NPV)						$ 460,906		
Avoided Energy Costs (NPV)			$ 108,536		$ 108,536		$ 108,536	
Avoided Capacity Costs (NPV)			$ 121,584		$ 121,584		$ 121,584	
Avoided T&D Costs (NPV)			$ 165,656		$ 165,656		$ 165,656	
Incremental Costs		$ -						$ -
Program Overhead Costs				$ 975,360		$ 975,360		$ 975,360
Total Benefits	$ 2,900,742		$ 395,777		$ 395,777		$ 395,777	
Total Costs	$ -		$ 3,415,196		$ 3,876,102		$ 975,360	
Test Score	N/A		0.12		0.10		0.41	

10 Carbon Emissions Reduction

The Evaluation Team developed estimates of avoided carbon emissions associated with estimates of program energy savings impacts. This was accomplished by applying the utility-specific residual mix emissions rate of approximately 1,384 lbs CO2/MWh to the applicable estimates of energy savings.[12]

Separate estimates of avoided carbon emissions are developed for each of the four energy savings estimates:

Annual ex post gross;

Annual ex post net;

Lifetime ex post gross; and

Lifetime ex post net.

Avoided emissions (*avoided_emissions*) estimates are calculated as follows:

$$\mathit{avoided\_emissions} = \text{emissions\_rate} * \mathit{energy\_savings} / 2{,}204.62$$

where:

energy_savings is the applicable energy savings value, in megawatt-hours;

emissions_rate is the estimated pounds of carbon emissions per megawatt-hour; and

2,204.62 is the number of pounds per metric ton.

Table 10-1 presents the estimates of avoided carbon emissions

Table 10-1 Avoided Carbon Emissions (Metric Tons)

Program Name	*MWh Savings Referenced*			
	Annual Ex Post Gross	*Annual Ex Post Net*	*Lifetime Ex Post Gross*	*Lifetime Ex Post Net*
Home Performance Program	1,692	1,349	21,470	17,644
Low-Income Single Family Program	916	916	9,404	9,404
Low-Income Multifamily Program	201	201	2,385	2,385
Efficient Products Program	4,195	2,270	57,197	30,888
Energy Efficiency Kits Program	673	667	6,930	6,812
Home Energy Reports Program	19,826	19,826	19,826	19,826
Bring Your Own Thermostat Program	57	101	57	101
Residential Portfolio Totals	**27,559**	**25,330**	**117,267**	**87,060**

[12] Edison Electric Institute, *Emissions Electric Company Carbon Emissions and Electricity Mix Reporting Database for Corporate Customers* (May 2023). Value referenced is applicable to Appalachian Power Company.

2023 Virginia Residential Portfolio EM&V Report

Volume II of II

Prepared for:
Appalachian Power Company

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Table of Contents

1. Introduction

Under contract with Appalachian Power Company (herein referred to as the "Company" or "APCo"), ADM Associates, Inc., (ADM) performed evaluation, measurement and verification (EM&V) activities to confirm the energy savings (kWh) and demand reduction (kW) realized through the energy efficiency programs that APCo implemented in Virginia in 2023.

This report is divided into two volumes providing information on the impact, process, and cost effectiveness evaluation of APCo's portfolio of residential programs implemented in Virginia during the 2023 program year. Volume II contains appendices presenting detailed information including data collection instruments and survey results. Volume II is organized as follows:

- Chapter 2: Home Performance Participant Survey Instrument
- Chapter 3: Efficient Products Participant Survey Instrument
- Chapter 4: Low-Income Single-Family Participant Survey Instrument
- Chapter 5: Low Income Multifamily Tenant Survey Instrument
- Chapter 6: Home Performance Program Participant Survey Results
- Chapter 7: Efficient Products Participant Survey Results
- Chapter 8: Low-Income Single-Family Participant Survey Results
- Chapter 9: Low Income Multifamily Tenant Survey Results
- Chapter 10: Confidential: EM&V Costs

See report Volume I for narrative and summary information pertaining to the evaluation methods and results.

2. Home Performance Participant Survey Instrument

INTRODUCTION

Welcome! Thank you for taking this survey to tell us about your experience with Appalachian Power's Home Performance Program. Your feedback is very important to us and will help Appalachian Power improve its programs for customers like you.

Your responses are confidential and will be used for research purposes only. ADM Associates does not share survey data with third parties for marketing purposes. Our full privacy statement is linked here: admenergy.com/privacy

Once you have entered a response for each question, use the arrow at the bottom right of the screen to get to the next question.

[Add Captcha]

SCREENING

1. Our records indicate that you participated in the Appalachian Power Home Performance program in [year].
2. Through this program you received [project_description].
3. Do you recall your household's participation in this program?
    1. Yes
    2. No [TERMINATE]

AWARENESS AND PROJECT INITIATION

4. How did you first hear about the Home Performance Program?

    [Randomize order of 1 – 7]

    1. An Appalachian Power newsletter or email
    2. Appalachian Power website
    3. From a participating contractor
    4. From a program representative who visited my home
    5. While receiving services at my home through another Appalachian Power program
    6. Social networking site such as Facebook or Twitter
    7. Friend, relative, coworker, or neighbor
    8. In some other way (Please describe)
    98. Do not recall
5. How did you begin your participation in the program?
    1. You called the program contact number
    2. You enrolled using the program website

3. The contractor that completed the efficiency improvements enrolled you
98. Do not recall

6. What were you hoping to get from participating in the program? Please select all the reasons that apply.

[Randomize 1-7]

1. Make your home more comfortable
2. Save on energy costs
3. Help the environment by using less energy
4. Get information on my home / receive the home energy report with recommendations
5. Get the free energy saving items
6. Get a rebate to add insulation or reduce air leaks
7. Improve the value of your home
8. For some other reason (Please describe)
98. Do not recall

ASSESSMENT

[Display if assessment = 1]

7. According to our records, a Home Performance Energy Advisor completed an energy assessment of your home. Did you schedule the home energy assessment?

a) 1. Yes
b) 2. No, someone else did
c) 3. No, did not have a home energy assessment completed

[Display if Q7 = 1]

8. On a scale of 1 to 5, where 1 is "very difficult" and 5 is "very easy," how would you rate the process of scheduling of your home energy assessment?

1. 1 (Very difficult)
2. 2
3. 3
4. 4
5. 5 (Very easy)

[Display if assessment = 1]

9. Were you at home during the energy assessment?

1. Yes
2. No

[Display if Q9 = 1]

10. Using a scale where 1 means completely disagree and 5 means completely agree, how much do you agree with the following statements about the home energy assessment:

[Scale: 1 (Completely disagree) = 1, 2 = 2, 3 = 3, 4 = 4, 5 (Completely agree) = 5]

d) The Home Performance Energy Advisor was timely in completing the assessment
e) The Home Performance Energy Advisor was courteous and professional
f) The information provided by the home energy assessment was useful
g) The information provided by the home energy assessment was easy to understand

[Display if insulation <> 1 AND Q9 = 1]

11. Did the Home Performance Energy Advisor recommend that you install insulation in your home?

1. Yes
2. No
98. Do not recall

[Display if blower_air_sealing <> 1 and Q9= 1]

12. Did the Home Performance Energy Advisor recommend that you perform a blower door test to see if you could make air sealing improvements?

1. Yes
2. No
98. Do not recall

[Display if Q11 = 1]

13. Based on our records, you did not install any attic insulation through the program. What are the main reasons why you did not install attic insulation? Please select all that apply.

1. It would cost too much
2. You did not think it would be much of a benefit
3. You haven't had time to schedule the work
4. You don't know who to contact to schedule the installation of insulation
5. You did install insulation but did not get a rebate
6. Some other reason (Please describe)

[Display if Q13 = 5]

14. Why did you not get a rebate?

[Display if Q11= 1 and Q13 <> 5]

15. How likely are you to install the attic insulation in the next 12 months?

    1. Extremely unlikely
    2. Somewhat unlikely
    3. Neither likely nor unlikely
    4. Somewhat likely
    5. Extremely likely

[Display if Q15 = 4 or Q15 = 5]

16. Will you apply for a program rebate if you install the attic insulation?

    1. Yes
    2. No

[Display if q16 = 2]

17. Why will you not seek a rebate?

18. The next few questions are about the energy efficiency improvements made to your home.

VERIFICATION

[Display if AIR SEALING = 1 OR insulation = 1 OR duct_improvement = 1 OR heatpump = 1 OR DUCTLESS = 1 OR fan = 1 OR smart_thermostat = 1 OR tuneup = 1 OR pipewrap = 1 OR tankwrap= 1 OR turndown = 1 OR ecm = 1]

19. According to our records you received the following energy efficiency improvements through the program.
20. Please indicate if the information seems correct.

[Scale: 1 = Correct, 2 = Incorrect , 98 = Not Sure]

a) [Display if air_sealing= 1] Air sealing to reduce drafts in your home. Air sealing can include applying caulking to exterior wall penetrations or installing gaskets on outlets.
b) [Display if insulation = 1] Attic and/or wall insulation
c) [Display if duct_improvement = 1] Sealing and/or insulating of your heating and cooling system ducts. This is done to make your heating and cooling system work better.
d) [Display if heatpump = 1] Energy efficient ductless heat pump
e) [Display if fan = 1] High efficiency furnace fan motor
f) [Display if smart_thermostat = 1] Smart thermostat
g) [Display if tuneup = 1] Heating and cooling system tune-up or maintenance
h) [Display if pipewrap = 1] Hot water heater pipe wrap
i) [Display if tankwrap = 1] Hot water heater tank wrap
j) [Display if turndown = 1] Reduction in hot water heater temperature

k) [Display if LED_quantity > 0] [LED_quantity] LED light bulbs
l) [Display if filter_quantity > 0] [filter_quantity] air filter whistles
m) [Display if bath_aerator_quantity > 0] [bath_aerator_quantity] bathroom faucet aerator(s)
n) [Display if kitchen_quantity > 0] [kitchen_quantity] kitchen faucet aerator(s)
o) [Display if shower_quantity > 0] [shower_quantity] showerhead(s)
p) [Display if nightlight_quantity > 0] [nightlight_quantity] nightlights

[DISPLAY IF Q20k = 2]

21. How many LED bulbs were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q20l = 2]

22. How many air filter whistles were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q20m = 2]

23. How many bathroom aerators were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q20n = 2]

24. How many kitchen faucet aerators were installed in your home?

[TEXT BOX]

[DISPLAY IF Q20o = 2]

25. How many showerheads were installed in your home?

[TEXT BOX]

[DISPLAY IF Q20p = 2]

26. How many nightlights were installed in your home?

[TEXT BOX]

IN-SERVICE RATES

[Display if LED_installed > 0 OR filter_installed > 0 OR bath_aerator_installed > 0 OR shower_installed > 0 OR nightlight_installed > 0]

[Display if LED_installed > 0]

27. Are you currently using all of the [LED_installed] LED light bulb(s) that were installed in your home?

    1. Yes
    2. No

[Display if Q27 = 2]

28. How many of the ${e://Field/LED_installed} LED light bulbs are you currently using?

[TEXT BOX]

[Display if filter_quantity > 0]

29. Are all of the [filter_installed] air filter whistle(s) installed in your home currently installed in an air filter?

    1. Yes
    2. No, removed some and are no longer using
    3. No, removed some when changing the air filter and then reinstalled it

[Display if Q29 = 2]

30. How many of the ${e://Field/filter_installed} air filter whistles did you remove and no longer use?

[TEXT BOX]

[Display if bath_aerator_installed > 0]

31. Are the [bath_aerator_installed] bathroom faucet aerator(s) you received currently installed in your home?

    1. Yes
    2. No

[Display if Q31 = 2]

32. How many of the [bath_aerator_installed] bathroom faucet aerator(s) you received are currently installed in your home?

[TEXT BOX]

[Display if kitchen_installed > 0]

33. Are the [kitchen_installed] kitchen faucet aerator(s) you received currently installed in your home?

    1. Yes
    2. No

[Display if Q34 = 2]

34. How many of the [kitchen_installed] kitchen faucet aerator(s) you received are currently installed in your home?

[TEXT BOX]

[Display if shower_installed > 0]

35. Are the ${e://Field/shower_installed} low flow showerhead(s) you received currently installed in your home?

    1. Yes
    2. No

[Display if Q35 = 2]

36. How many of the [shower_installed] low flow showerhead(s) you received are currently installed in your home?

[TEXT BOX]

[Display if shower_installed > 0]

37. How many showers does your home have?

    1. 1
    2. 2
    3. 3
    4. 4
    5. More than 4

[Display if nightlight_installed > 0]

38. Are you currently using all the [nightlight_installed] nightlight(s) that you received?

    1. Yes
    2. No

[Display if Q38 =2]

39. About how many of the [nightlight_installed] nightlight(s) are you currently using?

[TEXT BOX]

NIGHTLIGHT REPLACEMENT

[Display if Q38 = 1 OR Q39]

40. How many of the [nightlight_inuse nightlight(s) that you are currently using replaced a different nightlight that you had before participating in the program?

[TEXT BOX]

SMART THERMOSTAT BLOCK

[Display if smart_thermostat = 1]

41. Does the smart Wi-Fi thermostat that you got a rebate for control a central cooling system, a central heating system, or both?

    1. Central cooling system
    2. Central heating system
    3. Both cooling and heating systems
    98. Don't know

[Display if Q41 = 1 or 3]

42. Is your central air conditioning system a heat pump?

    1. Yes
    2. No
    98. Don't know

[Display if Q41 = 2 or 3]

43. What type of central heating system do you have?

    1. Central furnace
    2. Heat pump
    3. Other (please specify)
    98. Don't know

[Display if Q41 = 2 or 3]

44. What type of fuel does your central heating system use?

    1. Natural gas
    2. Electricity
    3. Oil
    4. Propane
    5. Wood
    98. Don't know

[Display if smart_thermostat = 1]

45. What type of thermostat did the rebated smart Wi-Fi thermostat replace?

    1. A standard manual thermostat that lets you set on/off temperatures
    2. A programmable thermostat that allows you to schedule the temperature settings for different times of the day
    3. A different Wi-Fi smart thermostat
    4. It was not a replacement
    98. Don't know

[Display if Q45 = 3]

46. Which of the following best describes why you replaced your old Wi-Fi smart thermostat with a new one?

    1. The old Wi-Fi thermostat was not working
    2. The old Wi-Fi thermostat was hard to use
    3. You wanted to replace it for some other reason
    4. You did not replace a Wi-Fi thermostat

HVAC EARLY REPLACEMENT [Display PAGE if Q19d) = 1]

47. Did the [heatpump_type] replace some old heating and cooling equipment?

    1. Yes, it replaced both cooling and heating equipment
    2. Yes, it replaced cooling equipment
    3. Yes, it replaced heating equipment
    4. No, it was a new installation that did not replace any equipment

[Display Q48 if Q47 = 1]

48. Did the [heatpump_type] replace a heat pump?

    1. Yes
    2. No
    98. Don't know

HEAT PUMP REPLACEMENT SECTION

[Display Q49 if Q48 = 1, REPLACED HEAT PUMP]

49. Thinking about the old heat pump you replaced, which of the following best describes when and how it was originally installed in.

    1. You bought the house new and the unit was original equipment when you bought it.
    2. It was original equipment in a newly constructed home when the previous owner bought it.
    3. It was there when you bought the house from a previous owner.
    4. You or your family installed the old unit.
    5. Other (Please specify)

[Display Q50 if Q48 = 1]

50. Was the old heat pump working at the time it was replaced?

1. Yes
2. No

[Display Q51 if Q49 = 3]

51. Do you know the approximate age of the old heat pump that was replaced?

1. Yes (How old was it?)
2. No

[Display Q52 if Q51 = 1]

52. How were you able to determine the age of the old heat pump?

1. Documentation included with the unit
2. Contractor knew or estimated it
3. Age of units was included in description of home when we bought it
4. Previous owner told us
5. Other (Please specify)

[Display Q53 if Q51= 2]

53. Which of the following do you think is the most likely age of the old heat pump:

1. More than 20 years old
2. 15 – 20 years old
3. 10 – 15 years old
4. Less than 10 years old

[Display Q54 if Q49= 4]

54. About what year did you install the old heat pump?

[Display Q55 if Q48 = 1, REPLACED HEAT PUMP]

55. Please provide the seasonal energy efficiency ratio or SEER of the heat pump that you replaced?

1. SEER [TEXT BOX]
98. Don't know

[Display Q56 if Q48 = 1, REPLACED HEAT PUMP]

56. Please provide the Heating Seasonal Performance Factor or HSPF of the heat pump that you replaced?

    1. HSPF [TEXT BOX]
    98. Don't know

OTHER HEATING EQUIPMENT REPLACEMENT SECTION

[Display Q57 if [Q47=1 AND Q48 <>1] OR Q47=3, REPLACED HEATING EQUIPMENT]

57. What type of heating system did you have before you installed the [heatpump_type]?

    1. Electric resistance heating
    2. An air source heat pump
    3. Some other kind of heating system
    4. No heating equipment
    98. Don't know

[Display Q58 if Q57=1]

58. Was your electric resistance heating system an electric furnace or baseboard heating?

    1. Electric furnace
    2. Electric baseboard heating
    98. Don't know

[Display Q59 if Q57= 3]

59. What type of heating system did you have before installing the [heatpump_type]?

[Display Q60 if [Q47=1 AND Q48 <>1] OR Q47=3, REPLACED HEATING EQUIPMENT]

60. Thinking about the old heating system you replaced, which of the following best describes when and how it was originally installed in.

    1. You bought the house new and the unit was original equipment when you bought it.
    2. It was original equipment in a newly constructed home when the previous owner bought it.
    3. It was there when you bought the house from a previous owner.
    4. You or your family installed the old unit.
    5. Other (Please specify)

[Display Q61 [[if Q47 = 1 and Q48 = 2 or 98] or [Q47 = 3]]

61. Was the old heating system working at the time it was replaced?

    1. Yes (How old was it?)
    2. No

[Display Q62 if Q60 = 3]

62. Do you know the approximate age of the old heating equipment that was replaced?

    1. Yes (How old was it?)
    2. No

[Display Q63 if Q62 = 1]

63. How were you able to determine the age of the old heating equipment?

    1. Documentation included with the unit
    2. Contractor knew or estimated it
    3. Age of units was included in description of home when we bought it
    4. Previous owner told us
    5. Other (Please specify)

[Display Q64 if Q62 = 2]

64. Which of the following do you think is the most likely age of the old heating equipment:

    1. More than 20 years old
    2. 15 – 20 years old
    3. 10 – 15 years old
    4. Less than 10 years old

[Display Q65 if Q60= 4]

65. About what year did you install the old heating equipment?

OTHER COOLING EQUIPMENT REPLACEMENT SECTION

[Display Q66 if [Q47=1 AND Q48 <>1] OR Q47=2, REPLACED COOLING EQUIPMENT]

66. Was the cooling equipment that you replaced a central air condition?

    1. Yes
    2. No
    98. Don't know

[Display Q67 if [Q47=1 AND Q48 <>1] OR Q47=2, REPLACED COOLING EQUIPMENT]

67. Thinking about the old cooling equipment you replaced, which of the following best describes when and how it was originally installed in.

    1. You bought the house new and the unit was original equipment when you bought it.
    2. It was original equipment in a newly constructed home when the previous owner bought it.
    3. It was there when you bought the house from a previous owner.
    4. You or your family installed the old unit.
    5. Other (Please specify)

[Display Q61 [[if Q47 = 1 OR 2] and [Q48 = 2 or 98] or [Q66 = 3]]

68. Was the cooling equipment working at the time you replaced it?

[Display Q69 if Q67 = 3]

69. Do you know the approximate age of the old cooling equipment that was replaced?

    1. Yes (How old was it?)
    2. No

[Display Q70 if Q69 = 1]

70. How were you able to determine the age of the old cooling equipment?

    1. Documentation included with the unit
    2. Contractor knew or estimated it
    3. Age of units was included in description of home when we bought it
    4. Previous owner told us
    5. Other (Please specify)

[Display Q71 if Q69 = 2]

71. Which of the following do you think is the most likely age of the old cooling equipment:

    1. More than 20 years old
    2. 15 – 20 years old
    3. 10 – 15 years old
    4. Less than 10 years old

[Display Q72 if Q67 = 4]

72. About what year did you install the old cooling equipment?

[Display Q73 if [Q47=1 AND Q48 <>1] OR Q47=2, REPLACED COOLING EQUIPMENT]

73. Please provide the seasonal energy efficiency ratio or SEER of the air conditioner that you replaced?

1. SEER [TEXT BOX]
98. Don't know

FREE RIDERSHIP – MAJOR MEASURES FIRST

[Display Page if major_measure_type_count > 0]

[Display if Q74 if eff_measure_num = 4, 5 or 6]

74. Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [standard_measure1/2] that you installed?

1. Yes
2. No
98. Don't know

[Display q75 if eff_measure_num = 4, 5 or 6]

75. Did the contractor that you worked with recommend that you install the [efficient_measure1/2] instead of a standard efficiency [standard_measure1/2]?

1. Yes
2. No
98. Don't know

[Display q76 if eff_measure_num = 4, 5 or 6]

76. Did the contractor that you worked with tell you there was a rebate available for the efficient equipment through the Home Performance program?

1. Yes
2. No
98. Don't know

[Display Q77 if Q75 = 1]

77. On a scale where 0 means "not at all important" and 10 means "very important," how important was the recommendation in your decision to install the [efficient_measure1/2]?

[Scale: 0 (Not at all important) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7, 8=8, 9=9, 10 (Very important) = 10]

78. Prior to learning about the Home Performance program, did you have plans to [install1/2] the [efficient_measure1/2]?

    1. Yes
    2. No
    98. Don't know

[Display if efficient_measure_number1/2 = 4, 5, 6]

79. Just to be clear, did you have plans to specifically [install1/2] an [efficient_measure1/2] as opposed to a standard efficiency [standard_measure1/2]?

    1. Yes
    2. No
    98. Don't know

[Display if assessment = 1]

80. Was the [efficient_measure1/2] recommended during the home energy assessment?

    1. Yes
    2. No
    98. Don't know

[Display if Q80 = 1]

81. On a scale of 0 to 10 where 0 represents "Not at all important" and 10 represents "Very important," how important was the home energy assessment in your decision to [INSTALL1/2] the [efficient_measure1/2]?

[Scale: 0 (Not at all important) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7, 8=8, 9=9, 10 (Very important) = 10]

82. Would you have been financially able to [install1/2] the [efficient_measure1/2] without the financial incentive provided through the program?

    1. Yes
    2. No
    98. Don't know

[Display if efficient_measure_number1/2 = 4, 5, 6]

83. Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [efficient_measure1/2] instead of a [standard_measure1/2]?

1. Yes
2. No
98. Don't know

[Display if efficient_measure_number1/2 = 4, 5, 6]

84. If the financial incentive was not available, what do you think you most likely would have done at the time when you purchased the [efficient_measure1/2]?

    1. Not installed anything
    2. Installed a new but less energy efficient [standard_measure1/2]
    3. Installed a similarly energy efficient [standard_measure1/2]
    4. Installed the exact same [standard_measure1/2]
    98. Don't know

85. On a scale of 0 to 10 where 0 represents "Not at all important" and 10 represents "Very important," how important was the financial incentive in your decision to [install1/2] the [efficient_measure1/2]?

[Scale: 0 (Not at all important) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7, 8=8, 9=9, 10 (Very important) = 10]

86. Did you [install1/2] [a_more_efficient_more1/2] [efficient_measure1/2] than you would have if you had not received the financial incentive through the program?

    1. Yes
    2. No
    98. Don't know

87. Did you [install1/2] the [efficient_measure1/2] sooner than you would have if the information and financial incentive from the program had not been available?

    1. Yes
    2. No
    98. Don't know

[Display Q88 if Q87 = 1]

88. When might you have [installed1/2] the [efficient_measure1/2] if you had not participated in the program? Would you say ...

    1. Within 6 months of when you purchased or installed it
    2. Between 6 months and 1 year
    3. In more than 1 year to 2 years
    4. In 2 to 3 years
    5. In more than 3 years
    6. Never

98. Don't know

[REPEAT FOR FREE RIDERSHIP – MAJOR MEASURES SECOND 2 if major_measure_type_count > 1 FOR SECOND MEASURES]

FREE RIDERSHIP – DIRECT install MEASURES 1

[Display if di_measure_type_count > 0]

89. Had you [DI_installed] any [dimeasure1/2/3] in your home before participating in the program?
    1. Yes
    2. No
    98. Don't know
90. Did you have plans to [DI_install] install [dimeasure1/2/3] before you learned about the Home Performance program?
    1. Yes
    2. No
    98. Don't know
91. If you had not participated in the program, do you think you would have [DI_installed1/2/3] none, a smaller amount, or the same amount of the [dimeasure1/2/3] [DI_installed1/2/3] through the program?
    1. Would have [DI_installed1/2/3] none of the [dimeasure1/2/3]
    2. Would have [DI_installed1/2/3] a smaller amount of [dimeasure1/2/3]
    3. Would have [DI_installed1/2/3] the exact same amount of [dimeasure1/2/3]
    98. Don't know

[Display if dimeasure_quantity1/2/3 > 1 AND Q91 = 2]

92. If you had not received them for free through the program, how many of the [dimeasure_quantity1/2/3] [dimeasure1/2/3] that you received would you have installed?
93. Using a scale where 0 means "not at all likely" and 10 means "very likely", how likely is it that you would have [DI_installed] the [dimeasure1/2/3] on your own if you hadn't participated in the program?

[Scale: 0 (Not at all likely) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7, 8=8, 9=9, 10 (Very likely) = 10]

[REPEAT FOR FREE RIDERSHIP – DIRECT install MEASURES 2 AND 3 if di_measure_type_count > 1, AND REPEAT AGAIN if di_measure_type_count >2]

SPILLOVER

94. Have you bought and installed any additional energy efficient items on your own in the past 12 months without a financial incentive or rebate from Appalachian Power because of your experience with the program?

 1. Yes
 2. No

[Display if Q94 =1]

95. What did you purchase and install without getting an Appalachian Power rebate or discount? (Select all that apply)

[MULTISELECT]

 1. ENERGY STAR appliance such as a refrigerator, dishwasher, clothes washer, or clothes dryer
 2. Water heater pipe insulation
 3. Water heater jacket, blanket, or insulation
 4. Energy and water efficient faucet aerators
 5. Energy and water efficient showerheads
 6. ENERGY STAR room air conditioner
 7. Energy efficient water heater
 8. Smart thermostat
 9. Something else
 98. Don't know

[Display if Q95 = 1 - 9]

96. Why did you not get an Appalachian Power rebate, or discount for that energy saving equipment?

 1. Did not know an incentive, rebate, or discount was available
 2. Did not want to complete an application
 3. For some other reason (Please explain)
 4. I did get an incentive
 98. Don't know

[Display if Q95 = 1]

97. What kind of appliance did you purchase?

[TEXT BOX]

[Display if Q95 = 1]

98. How do you know it is an energy efficient appliance?

[Display if Q95 = 2]

99. About how many feet of water heater pipe insulation did you purchase and install?

[TEXT BOX]

[Display if Q95 = 4]

100. How many energy and water efficient faucet aerators did you install in bathroom sinks?

[TEXT BOX]

[Display if Q95 = 4]

101. How many energy and water efficient faucet aerators did you install in kitchen sinks?

[TEXT BOX]

[Display if Q95 = 5]

102. How many energy and water efficient showerheads did you install?

[TEXT BOX]

[Display if Q95 = 6]

103. How many ENERGY STAR room air conditioners did you install?

[TEXT BOX]

[Display if Q95 = 6]

104. How many square feet is the room that the ENERGY STAR air conditioner is installed in? If multiple units installed, how many square feet on average are the rooms you installed the air conditioners in?

[TEXT BOX]

[Display if Q95 = 7]

105. How do you know that the water heater you installed is an energy efficient water heater?

[Display Q95 =7]

106. What type of water heater did you install? Was it a…

1. Natural gas storage tank water heater
2. Electric storage tank water heater
3. Heat pump water heater
4. A natural gas tankless water heater
5. Some other type of water heater (Specify)
98. Don't know

[Display if Q95 = 8]

107. How many other energy efficient items did you install?

[TEXT BOX]

[Display if Q95 = 1 - 9]

108. In approximately what month and year did you install the energy efficient items that you did not receive an discount for?

[TEXT BOX]

[Display if Q95 = 1 - 9]

109. On a scale of 0 to 10, where 0 represents "not at all important" and 10 represents "extremely important", how important was the experience with the program in your decision to purchase the items you just mentioned?

[Scale: 0 = 0 (Not at all important), 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9 = 9, 10 = 10 (Extremely important)]

[Display if Q95 = 1 - 9]

110. On a scale of 0 to 10, where 0 represents "not at all likely" and 10 represents "extremely likely," how likely would you have been to purchase those additional items if you had not participated in the program?

[Scale: 0 = 0 (Not at all likely), 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9= 9, 10 = 10 (Extremely likely)]

CONTRACTOR EXPERIENCE [major_measure_type_count > 0]

111. Thinking about the contractor that completed the work in your home for the [all_major_measures], how much do you agree with the following statements:

[Scale: 1 (Completely disagree) = 1, 2 = 2, 3 = 3, 4 = 4, 5 (Completely agree) = 5]

a) The contractor was timely in completing the work
b) The contractor's work was of high quality
c) The contractor was courteous and professional

SATISFACTION

[Display Q112 if major_measure_type_count > 0 OR di_measure_type_count > 0]

112. Overall, how satisfied are you with the efficiency improvements to your home? Would you say you are…

5. Very satisfied
4. Somewhat satisfied
3. Neither satisfied nor dissatisfied
2. Somewhat dissatisfied
1. Very dissatisfied

[Display if Q112 = 1 OR 2]

113. Why are you dissatisfied with the efficiency improvements?
114. How satisfied are you with the Appalachian Power Home Performance program, overall? Would you say you are…

5. Very satisfied
4. Somewhat satisfied
3. Neither satisfied nor dissatisfied
2. Somewhat dissatisfied
1. Very dissatisfied
98. Don't know

[Display if Q114 = 1 OR 2]

115. Why are you dissatisfied with the program?
116. Do you have any suggestions for how Appalachian Power could improve its Home Performance program?

HOME CHARACTERISTICS

117. The last few final questions are about your household. This information will be kept confidential but you do not need to answer any question you do not want to answer.
118. Do you own the home where the project was completed, rent it, or own it and rent it to someone else?

1. Own

2. Rent
3. Own and rent to someone else
98. Don't know/Prefer not to state

119. Which of the following best describes your home? Is it a...

1. Manufactured home
2. Single-family house detached from any other house
3. Single family house attached to one or more other houses, for example, duplex, row house, or townhome
4. Apartment in a building with 2 to 3 units
5. Apartment in a building with 4 or more units
6. Other (Please describe)
98. Don't know/ Prefer not to state

[Display if Q119= 2 OR 3]

120. Is your home...

1. Single story
2. A one and a half story home
3. A two story home
4. A three story home

121. What fuel does your main water heater use?

1. Electricity
2. Natural Gas
3. Propane
4. Something else (Please describe)
5. Don't heat home
98. Don't know/Prefer not to state

122. What fuel does your main heating system use?

1. Electricity
2. Natural Gas
3. Propane
4. Something else (Please specify)
98. Don't know/ Prefer not to state

PERMISSION TO REPRINT COMMENTS

123. Appalachian Power may want to use the comments you made in this survey in its marketing materials. If your comments are selected, only your first name and first initial of your last name will be associated with your comment.

Do you permit Appalachian Power to reprint comments you made in this survey along with your first name and first initial of your last name?

1. Yes
2. No, Appalachian Power does not have permission to reprint my comment.

3. Efficient Products Participant Survey Instrument

Survey Instrument

Introduction

According to our records you participated in Appalachian Power's [program_name] Program by receiving a rebate from Appalachian Power for the following energy saving appliances or equipment.

1. Welcome! Thank you for taking this survey to tell us about your experience with Appalachian Power's [program_name] Program. Your feedback is very important and will help Appalachian Power improve its programs for customers like you.

   ADM Associates is asking you to take this survey on behalf of Appalachian Power. Your responses are confidential and will be used for research purposes only.

   ADM Associates does not share survey data with third parties for marketing purposes. Our full privacy statement is linked here: admenergy.com/privacy

   Once you have entered a response for each question, use the arrow at the bottom right of the screen to get to the next question.
2. reCAPTCHA

Verification

3. According to our records you participated in Appalachian Power's [Program] Program by receiving a rebate from Appalachian Power for energy saving appliances or equipment.

   Please mark "Yes" if you received a rebate for the following energy saving appliances or improvements listed below and "No" if you did not receive a rebate.

[SCALE: 1 = YES, 2 = NO, 98 = NOT SURE]

a) [If Air Purifier=1] ENERGY STAR air purifier or cleaner
b) [If Central AC=1] ENERGY STAR central air conditioner
c) [If Ductless minisplit=1] Ductless mini-split heat pump(s)
d) [If ECM=1] Central furnace efficient fan motor
e) [If Clothes dryer=1] ENERGY STAR clothes dryer
f) [If Clothes washer=1] ENERGY STAR clothes washer
g) [If Computer monitor=1] ENERGY STAR computer monitor
h) [If Dehumidifier=1] ENERGY STAR dehumidifier
i) [If EVSE=1] ENERGY STAR level 2 electric vehicle charger
j) [If Heat pump water heater=1] ENERGY STAR heat pump water heater
k) [If Pool pump two speed = 1 OR Pool pump variable speed = 1] ENERGY STAR pool pump
l) [If Refrigerator=1] ENERGY STAR refrigerator
m) [If Freezer=1] ENERGY STAR freezer
n) [If Room AC=1] ENERGY STAR room air conditioner
o) [If Shower Thermostatic Restriction Valve=1] Shower thermostatic restriction valve
p) [If DIY insulation = 1] R-30 insulation roll(s)

q) [If Water dispenser = 1] ENERGY STAR water dispenser / water cooler
r) [If Vent = 1] Ventilation fan
s) [If Smart thermostat = 1] Smart thermostat(s)

[DISPLAY IF ALL IN Q1 = 2]

4. Did you apply for any rebates from Appalachian Power for an energy efficient product?

1. Yes (What products?)
2. No
98. Not sure

[After Q4 is answered, terminate and display: Thank you for that information. We will review our records. Thank you for your time.]

Measure Specific Questions

Air purifier

[DISPLAY SECTION IF Air Purifier = 1 AND Q1A = 1]

5. About how many hours per day do you run the air purifier?

1. None
2. 1 – 4 hours
3. 5 – 8 hours
4. 8 – 12 hours
5 12- 16 hours
6. 16 – 24 hours

ENERGY STAR central air conditioner

[DISPLAY SECTION IF Central AC = 1 AND Q1B = 1]

6. Did the new air conditioner replace another central air conditioner?

1. Yes
2. No
98. Don't know

[Display if Q6 = 1]

7. Which of the following best describes how well the old central air conditioner worked?

1. It turned on and kept the home comfortable
2. It turned on but did not keep the home comfortable
3. It did not turn on

[Display if Q7 = 2 or 3]

8. Did your contractor provide you the option of repairing the old air conditioner?

1. Yes
2. No

[Display if Q8= 1]

9. Why did you not repair the old air conditioner?

    1. The cost was too high
    2. The unit was old / worried there would be more repairs needed
    3. Preferred a more energy efficient option
    4. A new system would have worked better
    5. APCo provided a rebate
    6. The old unit was noisy
    7. Getting parts would take too long
    8. Wanted the warranty that came with the new unit
    9. Other (Please describe)

10. Do you know the approximate age of the old air conditioner that was replaced?

    1. Yes (How old was it?)
    2. No

[Display if Q10 = 2]

11. Which of the following do you think is the most likely age of the old air conditioner:

    1. More than 20 years old
    2. 15 – 20 years old
    3. 10 – 15 years old
    4. Less than 10 years old

Ductless mini-split heat pump

[DISPLAY SECTION IF Ductless minisplit = 1 AND Q1C = 1]

12. Did the ductless mini-split(s) replace some old heating and cooling equipment?

    1. Yes, it replaced both cooling and heating equipment
    2. Yes, it replaced cooling equipment
    3. Yes, it replaced heating equipment
    4. No, it was a new installation that did not replace any equipment

[DISPLAY IF Q12 = 1]

Heat Pump Replacement Section

[Display if Q12 = 1 or 3]

13. What type of heating equipment did it replace?

    1. Heat pump
    2. Electric resistance heating
    3. Gas furnace

98. Something else

[Display if Q13= 1 or 2]

14. Which of the following best describes how well the [Q13 response] that you replaced worked?

    1. It turned on and kept the home comfortable
    2. It turned on but did not keep the home comfortable
    3. It did not turn on

[Display if Q14 = 2 or 3]

15. Did your contractor provide you the option of repairing the [Q13 response]?

    1. Yes
    2. No

[Display if Q15= 1]

16. Why did you not repair the [Q13 response]? Please select all that apply.

    1. The cost was too high
    2. The unit was old / worried there would be more repairs needed
    3. Preferred a more energy efficient option
    4. A new system would have worked better
    5. Appalachian Power provided a rebate
    6. The old unit was noisy
    7. Getting parts would take too long
    8. Wanted the warranty that came with the new unit
    9. Other (Please describe)

17. Do you know the approximate age of the old [Q13 response] that was replaced?

    1. Yes (How old was it?)
    2. No

[Display section if Q17 = 2]

18. Which of the following do you think is the most likely age of the old [Q13 response]:

    1. More than 20 years old
    2. 15 to 20 years old
    3. 10 – 15 years old
    4. Less than 10 years old

Cooling equipment replacement

[Display section if Q12 = 2 or [Q12 = 1 and Q13<> 1]]

19. Did the ductless minisplit(s) replace a central air conditioning system?

1. Yes
2. No
98. Don't know

[Display if Q19 = 1]

20. Which of the following best describes how well the old central air conditioner worked?

    1. It turned on and kept the home comfortable
    2. It turned on but did not keep the home comfortable
    3. It did not turn on

[Display if Q20 = 2 or 3]

21. Did your contractor provide you the option of repairing the old air conditioner?

    1. Yes
    2. No

[Display if Q21= 1]

22. Why did you not repair the old air conditioner?

    1. The cost was too high
    2. The unit was old / worried there would be more repairs needed
    3. Preferred a more energy efficient option
    4. A new system would have worked better
    5. Appalachian Power provided a rebate
    6. The old unit was noisy
    7. Getting parts would take too long
    8. Wanted the warranty that came with the new unit
    9. Other (Please describe)

23. Do you know the approximate age of the old air conditioner that was replaced?

    1. Yes (How old was it?)
    2. No

[Display if Q23 = 2]

24. Which of the following do you think is the most likely age of the old air conditioner:

    1. More than 20 years old
    2. 15 to 20 years old
    3. 10 – 15 years old
    4. Less than 10 years old

Central furnace efficient fan motor

[DISPLAY SECTION IF ECM = 1 AND Q1D = 1]

25. Did install the central furnace efficient fan motor when replacing your furnace or did you install the fan motor without replacing your furnace?

    1. Installed as part of furnace replacement
    2. Installed the fan motor without replacing your furnace

26. What type of fuel does your current furnace use?

    1. Electricity
    2. Natural gas
    3. Propane
    4. Other

Clothes dryer

[DISPLAY SECTION IF Clothes dryer = 1 AND Q1E = 1]

27. Did the clothes dryer that you received a rebate for replace another clothes washer?

    1. Yes
    2. No

[DISPLAY IF Q27 = 1]

28. Was the clothes dryer that you replaced working at the time when you replaced it?

    1. Yes
    2. No

[DISPLAY IF Q28 = 1]

29. Was the clothes dryer you replaced purchased before 2015?

    1. Yes, purchased before 2015
    2. No, purchased in 2015 or later

Clothes washer

[DISPLAY SECTION IF Clothes washer = 1 AND Q1F = 1]

30. Did the clothes washer that you received a rebate for replace another clothes washer?

    1. Yes
    2. No

[DISPLAY IF Q30 = 1]

31. Was the clothes washer that you replaced working at the time when you replaced it?

    1. Yes
    2. No

[DISPLAY IF Q31= 1]

32. Was the washer you replaced purchased before 2018?

    1. Yes, purchased before 2018
    2. No, purchased in 2018 or later

ENERGY STAR computer monitor

[DISPLAY SECTION IF Computer monitor = 1 AND Q1G = 1]

33. Approximately how many hours per day is the computer monitor that you received the rebate for turned on?

    1. Less than 1 per day
    2. 2 to 3 hours per day
    3. 4 to 5 hours per day
    4. 6 to 8 hours per day
    5. More than 8 hours per day

Dehumidifier

[DISPLAY SECTION IF Dehumidifier = 1 AND Q1H = 1]

34. About how many hours per day do you run or plan on running the dehumidifier during the warmer summer months?

    1. None
    2. 1 – 4 hours
    3. 5 – 8 hours
    4. 8 – 12 hours
    5 12- 16 hours
    6. 16 – 24 hours

35. About how many hours per day do you run or plan on running the dehumidifier during the cooler months?

    1. None
    2. 1 – 4 hours
    3. 5 – 8 hours
    4. 8 – 12 hours
    5 12- 16 hours
    6. 16 – 24 hours

ENERGY STAR level 2 electric vehicle charger

[DISPLAY SECTION IF EVSE = 1 AND Q1I = 1]

36. Is the ENERGY STAR Level 2 charger that you received the Appalachian Power rebate for…

    1. A replacement for a Level 1 charger (a Level 1 charger plugs into a standard household outlet)
    2. A replacement for a Level 2 charger
    3. A new installation that did not replace another charger

37. When you bought your Level 2 charger, were you aware that it uses less electricity to charge a car than a Level 1 charger?

    1. Yes
    2. No

38. Do you currently own a plug-in electric vehicle?

    1. Yes
    2. No

[DISPLAY IF Q38= 2]

39. Do you have plans to purchase or have you ordered an electric vehicle that has not been delivered yet?

    1. I have plans to purchase an electric vehicle
    2. I have ordered an electric vehicle that has not been delivered
    3. No, I do not have plans to purchase an electric vehicle

40. Have you installed the ENERGY STAR Level 2 charger you received the rebate for?

    1. Yes
    2. No

[DISPLAY IF Q40 = 1]

41. Why haven't you installed it yet? Please select all that apply.

[Multiselect]

    1. The electrical panel for my home does not have room for a new dedicated circuit
    2. I have not had time to install it
    3. I don't have the correct type of outlet to install it
    4. I cannot find an electrician to install it
    5. I don't know how to install it
    7. Other (Please specify)

[DISPLAY IF Q38 = 1 and Q40 = 1 (HAS PLUG IN AND INSTALLED CHARGER)]

42. What type of plug-in electric vehicle do you most often use the Level 2 charger for?

    1. A plug-in hybrid that can run on electricity or gasoline
    2. A fully electric vehicle that does not use gasoline

[DISPLAY IF Q38 = 1 and Q40 = 1 (HAS PLUG IN AND INSTALLED CHARGER)]

43. How often do you plug your vehicle into the rebated ENERGY STAR Level 2 charger?

1. At least once day
2. Not every day, but a few times a week
3. Once a week or less often
98. I don't know

[DISPLAY IF Q38 = 1 and Q40 = 1 (HAS PLUG IN AND INSTALLED CHARGER)]

44. For each of the following times, please mark how many days you charge your vehicle at home during a typical Monday through Friday workweek.

[SCALE: 0 = Do not charge at this time, 1 = 1 day a week, 2 = 2 days a week, 3 = 3 days a week, 4 = 4 days a week, 5 = 5 days a week]

a. 12am to 6am
b. 6 am to 3 pm
c. 3 pm to 6 pm
d. 6 pm to 12 am

[DISPLAY IF Q38 = 1 and Q40 = 1 (HAS PLUG IN AND INSTALLED CHARGER)]

45. How long does it typically take to charge your electric vehicle with the rebated ENERGY STAR Level 2 charger?

1. Less than 30 minutes
2. 31 minutes – 60 minutes
3. 1 – 3 hours
4. 4 – 6 hours
5. 6 – 8 hours
6. More than 8 hours
98. I don't know

[DISPLAY IF Q38 = 1]

46. How often do you charge your vehicle using a public charging stations (as opposed to the rebated Level 2 charger)?

1. At least once day
2. A few times a week
3. Less than once a week
4. Never
98. I don't know

Heat pump water heater

[DISPLAY SECTION IF Heat pump water heater = 1 AND Q1J = 1]

47. Did the heat pump water heater that you received a rebate for replace another water heater?

1. Yes
2. No

[DISPLAY IF Q47 = 1]

48. Did the heat pump water heater that you received a rebate replace...

    1. A natural gas water heater
    2. An electric resistance water heater
    3. A heat pump water heater
    4. Another type of water heater (Please describe)

ENERGY STAR pool pump

[DISPLAY SECTION IF (Pool pump two speed = 1 OR Pool pump variable speed = 1) AND Q1K = 1]

49. Was the pool pump that you got a rebate for...

    1. A replacement for a working pool pump
    2. A replacement for a broken pool pump
    3. An additional pump or a pump for a new swimming pool (it did not replace a pool pump)

[DISPLAY IF Q49 = 1]

50. Did the new pool pump replace a single speed, two speed, or variable speed pool pump?

    1. Single speed pool pump
    2. Two speed pool pump
    3. Variable Speed pool pump
    98. I'm not sure

51. Do you know the programmed running times and speeds for the new pool pump?

    1. Yes
    2. No

[DISPLAY IF Q51 = 1 AND Pool pump variable speed =1]

52. Select the programmed speed settings in your variable speed pump. (Select all that apply)

[Multiselect]

    1. 500 to 1000 rpm
    2. 1001 to 1500 rpm
    3. 1501 to 2500 rpm
    4. 2501 rpm to 3600 rpm

[DISPLAY IF Q52 = 1 AND Pool pump variable speed =1]

53. Which of the following best describes the time of day when the pool pump is running in a speed range of 500 to 1000 rpm?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

[DISPLAY IF Q52 = 2 AND Pool pump variable speed =1]

54. Which of the following best describes the time of day when the pool pump is running in a speed range of 1001 to 1500 rpm?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

[DISPLAY IF Q52 = 3 AND Pool pump variable speed =1]

55. Which of the following best describes the time of day when the pool pump is running in a speed range of 1501 to 2500 rpm?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

[DISPLAY IF Q52 = 4 AND Pool pump variable speed =1]

56. Which of the following best describes the time of day when the pool pump is running in a speed range of 2501 to 3600 rpm?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

[DISPLAY IF Q51 = 1 AND Pool pump two speed = 1]

57. Which of the following best describes the time of day when the pool pump is running at high speed?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

[DISPLAY IF Q51 = 1 AND Pool pump two speed = 1]

58. Which of the following best describes the time of day when the pool pump is running at low speed?

    1. Does not run at this speed
    2. 0-6 hours during the day and may operate at night
    3. 7-12 hours during the day and may operate at night
    4. Operates only at night

Room AC

[DISPLAY SECTION IF Room AC = 1 AND Q1N = 1]

59. If you received a rebate for more than one room air conditioner, please think of the unit that you use most often when answering the following questions.
60. Did the room air conditioner that you received a rebate for replace another room air conditioner?

    1. Yes
    2. No

[DISPLAY IF Q60= 1]

61. Was the room air conditioner that you replaced working at the time you replaced it?

    1. Yes
    2. No

[DISPLAY IF Q61 = 1]

62. How old was the room air conditioner that you replaced?

    1. 0 to 3 years
    2. 4 to 12 years
    3. More than 12 years

Shower thermostatic restriction valve

[DISPLAY SECTION IF Shower thermostatic restriction valve = 1 AND Q1O = 1]

63. Is the shower thermostatic restriction valve currently installed?

    1. Yes
    2. No

[DISPLAY IF Q63= 2]

64. Why is the shower thermostatic restriction valve not currently installed?

    1. I haven't had time to install
    2. I don't know how to install it
    3. I uninstalled it because I didn't like it
    4. Some other reason (Please describe)

65. What fuel does your main water heater use?

    1. Electricity
    2. Natural Gas
    3. Propane
    4. Something else (Please describe)
    98. Don't know

DIY Insulation

[DISPLAY SECTION IF DIY insulation = 1 AND Q1P = 1]

66. Where did you install the insulation that you received a rebate for? Please select all that apply.

[MULTISELECT]

1. Exterior above ground wall
2. Exterior basement wall
3. Ceiling or attic
4. Crawlspace
5. Some other location
98. Don't know

[DISPLAY IF Q66 = 5]

67. What is the other location where you installed the insulation?

[DISPLAY IF Q66 = 1]

68. Approximately how many square feet of exterior wall space was insulated using the rebated insulation?

[DISPLAY IF Q66 = 1]

69. Approximately how many inches of insulation did your existing walls have before you installed the new insulation?

   1. Inches of insulation____
   2. There was no insulation

[DISPLAY Q10 IF Q66 = 2]

70. Approximately how many square feet of exterior basement wall space was insulated using the rebated insulation?

[DISPLAY IF Q66 = 2]

71. Approximately how many inches of insulation did your exterior basement wall space have before you installed the new insulation?

   1. Inches of insulation____
   2. There was no insulation

[DISPLAY IF Q66= 3]

72. Approximately how may square feet of ceiling or attic space was insulated using the rebated insulation?

[DISPLAY IF Q66 = 3]

73. Approximately how many inches of insulation did your ceiling or attic have before you installed the new insulation?

    1. Inches of insulation____
    2. There was no insulation

[DISPLAY IF Q66= 4]

74. Approximately how may square feet of crawlspace was insulated?

[DISPLAY IF Q66= 4]

75. Approximately how many inches of insulation did your crawlspace have before you installed the new insulation?

    1. Inches of insulation____
    2. There was no insulation

Ventilation fan

[Display if Q3R = 1]

76. Which of the following best describes how often your ventilation fan runs?

    1. It runs all the time
    2. It runs about half the day
    3. It runs a few hours or less a day
    98. Don't know

Smart Thermostats

77. The next few questions are about the smart Wi-Fi thermostat that you received a rebate for.

    Was your rebated thermostat professionally installed or did a member of your household install it?

    1. Professionally installed
    2. Self-installed
    98. Don't know

78. Does the rebated smart Wi-Fi thermostat control a central cooling system, a central heating system, or both?

    1. Central cooling system
    2. Central heating system
    3. Both cooling and heating systems
    98. Don't know

[DISPLAY IF Q78= 1 OR 3]

79. Is your central air conditioning system a heat pump?

1. Yes
2. No
98. Don't know

[DISPLAY IF Q78 = 2 OR 3]

80. What type of central heating system do you have?

1. Central furnace
2. Heat pump
3. Other (Please specify)
98. Don't know

81. What type of thermostat did the rebated smart Wi-Fi thermostat replace?

1. A standard manual thermostat that lets you set on/off temperatures
2. A programmable thermostat that allows you to schedule the temperature settings for different times of the day
3. A different Wi-Fi smart thermostat
4. It was not a replacement
98. Don't know

[DISPLAY IF Q81 = 3]

82. Which of the following best describes why you replaced your old Wi-Fi smart thermostat with a new one?

1. The old Wi-Fi thermostat was not working
2. The old Wi-Fi thermostat was hard to use
3. You wanted to replace it for some other reason
4. You did not replace a Wi-Fi thermostat

Free Ridership

[REPEAT SECTION ONE TIME IF measure_type_count > 1]

[DISPLAY IF measure_number1 = 2, 4, OR 10 (AC, ECM, HPWH)]

83. Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [standard_measure1/2] that you installed?

1. Yes
2. No

98. Don't know

[DISPLAY IF measure_number1 = 2, 4, OR 10 (AC, ECM, HPWH)]

84. Did the contractor that you worked with tell you there was an Appalachian Power rebate available for the efficient equipment?

1. Yes
2. No

[DISPLAY IF measure_number1 = 2, 4, OR 10 (AC, ECM, HPWH)]

85. Did the contractor that you worked with recommend that you install the [efficient_measure1/2] instead of a standard efficiency [standard_measure1/2]?

1. Yes
2. No

[DISPLAY IF Q85 = 1]

86. On a scale where 0 means "not at all influential and 10 means "extremely influential," how influential was the recommendation in your decision to install the [efficient_measure1/2]?

[SCALE: 0 (Not at all influential) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7, 8=8, 9=9, 10 (Very influential) = 10]

87. Did you learn about the rebate from Appalachian Power before or after you purchased the [efficient_measure1/2]?

1. Before
2. After
98. Don't know

88. Were you planning to purchase an [efficient_measure1/2] before you learned that a rebate was available from Appalachian Power?

1. Yes
2. No
98. Don't know

[DISPLAY IF measure_number1 <> 15 (Thermostatic valve) AND measure_number1 <> 16 (DIY Insulation)]

89. Just to be clear, did you have plans to specifically purchase an [efficient_measure1/2] instead of a standard [standard_measure1/2]?

1. Yes
2. No
98. Don't know

90. Would you have been financially able to purchase the [efficient_measure1/2] if you had not received the rebate through Appalachian Power?

1. Yes
2. No
98. Don't know

[DISPLAY IF measure_number1 <> 15 (Thermostatic valve) AND measure_number1 <> 16 (DIY Insulation)]

91. Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [efficient_measure1/2] instead of a standard [standard_measure1/2]?

1. Yes
2. No
98. Don't know

92. Which of the following do you think you would have most likely done if the Appalachian Power rebate was not available?

1. Purchased the exact same [efficient_measure1/2]
2. Purchased a different [efficient_measure1/2]
3. [DISPLAY IF measure_number1/2 = 2, 3, 4, or10] Purchased a [standard_measure1/2] that used more electricity
4. [DISPLAY IF measure_number1/2 = 1,5,6,7,8,12, 13, or 14] Purchased a [standard_measure1/2] that was not ENERGY STAR certified
5. [DISPLAY IF measure_number1/2 = 9] Purchased a level 1 car charger
6. [DISPLAY IF measure_number1/2 = 11] Purchased a single speed pool pump
7. Not purchased a [standard_measure1/2]
8. Something else (Please describe)

93. On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely", how likely is it that you would have purchased the same [efficient_measure1/2] if you had not received rebate or informational assistance through the Appalachian Power program?

[SCALE: 0 (Not at all likely) = 0, 1=1, 2=2, 3=3, 4=4, 5=5, 6=6, 7=7,8=8,9=9, 10 (Very likely) = 10]

94. Did you purchase the [efficient_measure1/2] sooner than you would have if the information and financial assistance from the program had not been available?

1. Yes
2. No
98. Don't know

[DISPLAY IF Q94 = 1]

95. When might you have purchased the same [efficient_measure1/2] if you had not participated in the program? Would you say…

    1. Within 6 months of when you purchased it
    2. Between 6 months and 1 year
    3. In more than 1 year to 2 years
    4. In two years or more
    98. Don't know

Spillover

96. Have you bought and installed any additional energy efficient items on your own in the past 12 months because of your experience with the program?

    1. Yes
    2. No

[DISPLAY IF Q96 =1]

97. Did you make any of those purchases without getting a rebate or discount from Appalachian Power?

    1. Yes
    2. No

[DISPLAY IF Q97 =1]

98. What did you purchase and install without getting an Appalachian Power rebate or discount? (Select all that apply)

[MULTISELECT]

    1. ENERGY STAR appliance such as a refrigerator, dishwasher, clothes washer, or clothes dryer
    2. Water heater pipe insulation
    3. Water heater jacket, blanket, or insulation
    4. Energy and water efficient faucet aerators
    5. Energy and water efficient showerheads
    6. ENERGY STAR room air conditioner
    7. Energy efficient water heater
    8. Smart thermostat
    9. Something else
    98. Don't know

[DISPLAY IF Q98 = 1 - 9]

99. Why did you not get an Appalachian Power rebate, or discount for that energy saving equipment?

    1. Did not know an incentive, rebate, or discount was available
    2. Did not want to complete an application

3. For some other reason (Please explain)
3. I did get an incentive
98. Don't know

[DISPLAY IF Q98 = 1]

100. What kind of appliance did you purchase?

[TEXT BOX]

[DISPLAY IF Q98 = 1]

101. How do you know it is an energy efficient appliance?

[DISPLAY IF Q98 = 2]

102. About how many feet of water heater pipe insulation did you purchase and install?

[TEXT BOX]

[DISPLAY IF Q98 = 4]

103. How many energy and water efficient faucet aerators did you install in bathroom sinks?

[TEXT BOX]

[DISPLAY IF Q98 = 4]

104. How many energy and water efficient faucet aerators did you install in kitchen sinks?

[TEXT BOX]

[DISPLAY IF Q98 = 5]

105. How many energy and water efficient showerheads did you install?

[TEXT BOX]

[DISPLAY IF Q98 = 5]

106. How many total showerheads are there in your home?

[DISPLAY IF Q98 = 6]

107. How many ENERGY STAR room air conditioners did you install?

[TEXT BOX]

[DISPLAY IF Q98 = 6]

108. How many square feet is the room that the ENERGY STAR air conditioner is installed in? (If multiple units installed, ask how many square feet on average are the rooms you installed the air conditioners in)

[TEXT BOX]

[DISPLAY IF Q98 = 7]

109. How do you know that the water heater you installed is an energy efficient water heater?

[DISPLAY IF Q98 =7]

110. What type of water heater did you install? Was it a…

1. Natural gas storage tank water heater
2. Electric storage tank water heater
3. Heat pump water heater
4. A natural gas tank less water heater
5. Some other type of water heater (Specify)
98. Don't know

[DISPLAY IF Q98 = 8]

111. What type of thermostat did the smart thermostat replace?

1. A programmable thermostat that allows you to schedule the temperature settings for different times of the day
2. A standard thermostat that lets you set on/off temperatures
3. A different Wi-Fi smart thermostat
98 Don't know

[DISPLAY IF Q98 = 8]

112. Does the smart thermostat control a central cooling system, a central heating system, or both?

1. Central cooling system
2. Central heating system
3. Both cooling and heating systems
98. Don't know

[DISPLAY IF Q112 = 1 OR 3]

113. Is your central air conditioning system a heat pump?

1. Yes
2. No
98. Don't know

[DISPLAY IF Q112 = 2 OR 3]

114. What type of central heating system do you have?

1. Central furnace
2. Heat pump
3. Other (Please specify)
98. Don't know

[DISPLAY IF Q112 = 2 OR 3]

115. What is the main fuel used by the central heating system?

1. Natural gas
2. Electricity
3. Oil
4. Propane
5. Wood
98. Don't know

[DISPLAY IF Q98 = 9]

116. What other energy efficient items did you install?

[TEXT BOX]

[DISPLAY IF Q98 = 1 - 9]

117. In approximately what month and year did you install the energy efficient items that you did not receive an incentive for?

[TEXT BOX]

[DISPLAY IF Q98 = 1 - 9]

118. On a scale of 0 to 10, where 0 represents "not at all important" and 10 represents "extremely important", how important was the experience with the program in your decision to purchase the items you just mentioned?

[SCALE: 0 = 0 (Not at all important), 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9 = 9, 10 = 10 (Extremely important), 98 = Don't know]

[DISPLAY IF Q98= 1 - 9]

119. On a scale of 0 to 10, where 0 represents "not at all likely" and 10 represents "extremely likely," how likely would you have been to purchase those additional items if you had not participated in the program?

[SCALE: 0 = 0 (Not at all likely), 1 = 1, 2 = 2, 3 = 3, 4 = 4, 5 = 5, 6 = 6, 7 = 7, 8 = 8, 9= 9, 10 = 10 (Extremely likely), 98 = Don't know]

Program feedback

120. How did you hear about the rebates available through Appalachian Power's program? Please select all that apply.

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[MULTISELECT. RANDOMIZE 1 – 8]

1. An Appalachian Power newsletter or email
2. Appalachian Power website
3. A contractor you worked with
4. While receiving services at my home through another Appalachian Power program
5. Social networking site such as Facebook or Twitter
6. Friend, relative, coworker, or neighbor
7. An Appalachian Power home energy report
8. At a store that sold the rebated product
9. In some other way

121. Who completed your Appalachian Power rebate application? Please select all that apply.

[MULTISELECT]

1. Yourself
2. A contractor or retailer you worked with
3. Someone else

[DISPLAY IF Q121 = 1]

122. Thinking back to the application process, please rate the clarity of information on how to complete the application to get the program incentives using the scale below.

[SCALE: 1 (Not at all clear) = 1, 2 = 2, 3 = 3, 4 = 4, 5 (Completely clear) = 5]

[DISPLAY IF Q122 < 3]

123. What was unclear about the application process?

124. How long did it take to get the rebate compared to what you expected?

1. A lot less time than expected
2. Somewhat less time than expected
3. About as much time as expected
4. Somewhat more time than expected
5. A lot more time than expected
98. Don't know

125. How long did it take to get the rebate?

1. Less than 2 weeks
2. 2 – 4 weeks
3. 5 – 6 weeks
4. 7 – 8 weeks
5. More than 8 weeks
98. Don't know

126. Overall, how satisfied are you with your new energy efficient product(s)?

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat dissatisfied
5. Very dissatisfied

[DISPLAY IF Q126 = 4 OR 5]

127. Why are you dissatisfied with the product(s)?

128. How satisfied are you with the Appalachian Power [Program] Program, overall?

1. Very satisfied
2. Somewhat satisfied
3. Neither satisfied nor dissatisfied
4. Somewhat dissatisfied
5. Very dissatisfied

129. Why do you give the program that rating?

130. Please share any additional comments or feedback regarding the [Program] Program in the space provided below.

[Display if Q129 or Q130 are answered]

131. Appalachian Power may want to use the comments you made in this survey in its marketing materials. If your comments are selected, only your first name and first initial of your last name will be associated with your comment.

Do you permit Appalachian Power to reprint comments you made in this survey along with your first name and first initial of your less name?

1. Yes
2. No, Appalachian Power does not have permission to reprint my comment.

Home Characteristics

132. The final few final questions are about your household. This information will be kept confidential, but you do not need to answer any question you do not want to answer.

133. Do you own the home where the rebated equipment was installed, rent it, or own it and rent it to someone else?

1. Own
2. Rent
3. Own and rent to someone else

98. Don't know

134. Which of the following best describes your home?

1. Manufactured home

2. Single-family house detached from any other house
3. Single family house attached to one or more other houses, for example, duplex, row house, or townhome
4. Apartment in a building with 2 to 3 units
5. Apartment in a building with 4 or more units
6. Other (Please describe)
98. Don't know

135. What fuel does your main heating system use?

1. Electricity
2. Natural Gas
3. Propane
4. Something else (Please specify)
98. Don't know

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4. Low-Income Single-Family Participant Survey Instrument

INTRODUCTION [DISPLAY IF MODE = Phone]

1. We are conducting a study to evaluate the Appalachian Power Weatherization Assistance Program. Appalachian Power will use the results of this evaluation to determine the effectiveness of the program and to make improvements.
   This is not a sales call, and I am not going to ask you to buy anything. If you are interested, you can view our privacy policy statement at admenergy.com/privacy.
   May I ask you a few questions?

   1. Yes
   2. No *(Thank respondent and terminate interview)*

INTRODUCTION [DISPLAY IF MODE =Email]

Thank you for taking this survey to tell us about your experience with Appalachian Power's Weatherization Assistance Program.

Your feedback is very important and will help Appalachian Power improve its programs for customers like you.

ADM Associates is asking you to take this survey on behalf of Appalachian Power. Your responses are confidential and will be used for research purposes only. ADM Associates does not share survey data with third parties for marketing purposes. ADM's full privacy statement is linked here: admenergy.com/privacy

Once you have entered a response for each question, use the arrow at the bottom right of the screen to get to the next question.

[DISPLAY IF Q1= 1 or MODE = Email]

2. Our records indicate that you participated in the Weatherization Assistance Program by completing an energy audit and receiving some energy efficiency improvements in your home in [MONTH] of [YEAR].
   Do you recall participating in this program?

   1. Yes
   2. No
   98. Don't know
   99. Refused

AWARENESS AND MOTIVATION

At this time, I'd like to let you know that your responses to this survey will be kept completely confidential. I'll begin with a few questions about your decision to participate in the program.

3. How did you learn of the Weatherization Assistance Program sponsored by Appalachian Power and administered by your local Community Action Agency? *(Select all that apply)*

[MULTISELECT]

1. An Appalachian Power representative mentioned it
2. The Appalachian Power website
3. From a local Community Action Agency or weatherization service provider
4. Friend, relative, coworker, or neighbor
5. In some other way (Please describe)
98. Don't know
99. Refused

4. Why did you choose to participate in the program? *(Select all that apply)*

[MULTISELECT]

1. To save money on energy bill(s)
2. To reduce energy use for environmental reasons
3. The services were provided free of charge
4. Improve home comfort
5. Improve value of the home
6. Other (Specify)
98. Don't know
99. Refused

PARTICIPATION EFFICIENCY

5. Now I'll ask some questions about the energy audit that was provided as a part of this program. Did someone visit your household to discuss ways of savings energy and to install energy efficient equipment?

1. Yes
2. No
98. Don't know
99. Refused

[DISPLAY IF Q5 = 1]

6. Did you schedule that appointment?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY IF Q6 = 1]

7. On a scale of 1 to 5, where 1 is "very difficult" and 5 is "very easy," how would you rate the process of scheduling of the visit?
    1. 1 (Very difficult)
    2. 2
    3. 3
    4. 4
    5. 5 (Very easy)
    98. Don't know

[DISPLAY IF Q5 = 1]

8. Were you in your household at the time of this visit?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY IF Q8 = 1]

9. Did the person who visited your home examine your appliances or building structure for energy efficiency?
    1. Yes
    2. No
    98. Don't know
    99. Refused

[DISPLAY IF Q8 = 1]

10. During the visit to your home, did the program representative talk to you about how to save energy in your home, or provide recommendations about how to use your appliances and equipment in an energy efficient way?
    1. Yes
    2. No

98. Don't know
99. Refused

[DISPLAY IF Q8 = 1]

11. Using a scale where 1 means completely disagree and 5 means completely agree, how much do you agree with the following statements about the work that was done on the home:

[SCALE: 1 (Completely disagree) = 1, 2 = 2, 3 = 3, 4 = 4, 5 (Completely agree) = 5, 98 = Don't know]

a) The completion of the work was timely and efficient
b) The work crew was courteous and professional
c) The information provided about your home's energy use was useful
d) The information provided about your home's energy use was easy to understand

MEASURE VERIFICATION

[DISPLAY IF AIR SEALING = 1 OR INSULATION = 1 OR DUCT_SEALING = 1 OR HEAT_PUMP = 1 OR FURNACE = 1 OR TUNEUP = 1 OR PIPEWRAP = 1 OR REFRIGERATOR = 1 OR TANKWRAP = 1 OR TURNDOWN = 1 OR DHW_TANK_REPLACEMENT = 1 OR WINDOW_AC = 1 OR IF LED_QUANT>0 OR CFL_QUANT>0 OR BATH_AERATOR_QUANT>0 OR KITCHEN_AERATOR_QUANT>0 OR UNSPECIFIED_AERATOR_QUANT>0 OR SHOWER_QUANT>0 OR APS=1]

12. Now we would like some information on the efficiency improvements made through the program.
According to our records you received the following energy efficiency improvements through the program.
Please indicate if the information seems correct. (READ LIST)

[SCALE: 1 = Correct, 2 = Incorrect, 98 = Don't know, 99 = Refused]

a. [DISPLAY IF AIR SEALING= 1] Air sealing to reduce drafts in your home
b. [DISPLAY IF INSULATION = 1] Ceiling, attic, wall, and/or floor insulation
c. [DISPLAY IF DUCT_SEALING = 1] Sealing or insulating your heating and cooling system ducts
d. [DISPLAY IF HEAT_PUMP = 1] An energy efficient heat pump
e. [DISPLAY IF FURNACE = 1] An energy efficient furnace
f. [DISPLAY IF TUNEUP = 1] Heating and cooling system tune-up or maintenance
g. [DISPLAY IF PIPEWRAP = 1] Hot water heater pipe wrap
h. [DISPLAY IF TANKWRAP = 1] Hot water heater tank wrap
i. [DISPLAY IF TURNDOWN = 1] Reduction in hot water heater temperature
j. [DISPLAY IF DHW_TANK_REPLACEMENT = 1] An energy efficient hot water heater
k. [DISPLAY IF REFRIGERATOR = 1] An energy efficient refrigerator
l. [DISPLAY IF WINDOW_AC = 1] An energy efficient window air conditioner
m. [DISPLAY IF VENTILATION_FAN = 1] Kitchen or bathroom ventilation fan
n. [DISPLAY IF FREEZER = 1] An energy efficient freezer

o. [DISPLAY IF SMART_TSTAT = 1] Smart thermostat
p. [DISPLAY IF CEILING_FAN = 1] Ceiling fan
q. [DISPLAY IF DUCTLESS_HEATPUMP = 1] Ductless heat pump
r. [DISPLAY IF LED_QUANT > 0] [LED_QUANT] LED light bulbs
s. [DISPLAY IF CFL_QUANT > 0] [CFL_QUANT] CFL light bulbs
t. [DISPLAY IF BATH_AERATOR_QUANT > 0] [BATH_AERATOR_QUANT] bathroom faucet aerators
u. [DISPLAY IF KITCHEN_AERATOR_QUANT > 0] [KITCHEN_AERATOR_QUANT] kitchen faucet aerator(s)
v. [DISPLAY IF UNSPECIFIED_AERATOR_QUANT > 0] [UNSPECIFIED_AERATOR_QUANT] faucet aerator(s)
w. [DISPLAY IF SHOWER_QUANT > 0] [SHOWER_QUANT] low-flow showerhead(s)
x. [DISPLAY IF APS = 1] Advanced power strip

[DISPLAY IF Q12q = 2]

13. How many LEDs were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q12r = 2]

14. How many CFL lightbulbs were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q12s = 2]

15. How many bathroom faucet aerators were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q12t = 2]

16. How many kitchen faucet aerators were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q12u = 2]

17. How many faucet aerators were installed in your home?

    [TEXT BOX]

[DISPLAY IF Q12v = 2]

18. How many showerheads were installed in your home?

[TEXT BOX]

[DISPLAY IF Q12w = 1]

19. What type of equipment is plugged into the advanced power strip?

   1. Audio/visual/entertainment equipment
   2. Computer/office equipment
   3. Other types of equipment
   4. Nothing is plugged into it/ I am not using it

IN SERVICE RATES

[DISPLAY IF LED_INSTALLED > 0]

20. Are you currently using all of the [LED_INSTALLED] LED light bulb(s) were installed in your home?

   1. Yes
   2. No

[DISPLAY IF Q20 = 2]

21. How many of the [LED_INSTALLED] LED light bulb(s) are you currently using?

   [TEXT BOX]

[DISPLAY IF CFL_INSTALLED > 0]

22. Are you currently using all of the [CFL_INSTALLED] CFL light bulb(s) that were installed in your home?

   1. Yes
   2. No

[DISPLAY IF Q22 = 2]

23. How many of the [CFL_INSTALLED] CFL light bulb(s) are you currently using?

   [TEXT BOX]

[DISPLAY IF BATH_AERATOR_INSTALLED > 0]

24. Are you currently using all of the [BATH_AERATOR_INSTALLED] bathroom faucet aerator(s) that were installed in your home?

   1. Yes
   2. No

[DISPLAY IF Q24 = 2]

25. How many of the [BATH_AERATOR_INSTALLED] bathroom faucet aerator(s) are currently installed?

    [TEXT BOX]

[DISPLAY IF KITCHEN_AERATOR_INSTALLED > 0]

26. Are you currently using all of the [KITCHEN_AERATOR_INSTALLED] kitchen faucet aerator(s) that were installed in your home?

    1. Yes
    2. No

[DISPLAY IF Q26 = 2]

27. How many of the [KITCHEN_AERATOR_INSTALLED] kitchen faucet aerator(s) are currently installed?

    [TEXT BOX]

[DISPLAY IF UNSPECIFIED_AERATOR_INSTALLED > 0]

28. Are you currently using all of the [UNSPECIFIED_AERATOR_INSTALLED] faucet aerator(s) that were installed in your home?

    1. Yes
    2. No

[DISPLAY IF Q28 = 2]

29. How many of the [UNSPECIFIED_AERATOR_INSTALLED] faucet aerator(s) are currently installed?

    [TEXT BOX]

[DISPLAY IF SHOWER_INSTALLED > 0]

30. Are you currently using all of the [SHOWER_INSTALLED] showerhead(s) that were installed in your home?

    1. Yes
    2. No

[DISPLAY IF Q30 = 2]

31. How many of the [SHOWER_INSTALLED] showerhead(s) are currently installed in your home?

    [TEXT BOX]

PROGRAM FEEDBACK

32. Overall, how satisfied are you with the efficiency improvements to your home? Would you say you are...

    5. Very satisfied

4. Somewhat satisfied
3. Neither satisfied nor dissatisfied
2. Somewhat dissatisfied
1. Very dissatisfied
98. Don't know

[DISPLAY IF Q32 = 1 OR 2]

33. Why are you dissatisfied with it?
34. How satisfied are you with the Appalachian Power Weatherization Program, overall? Would you say you are…

5. Very satisfied
4. Somewhat satisfied
3. Neither satisfied nor dissatisfied
2. Somewhat dissatisfied
1. Very dissatisfied
98. Don't know

[DISPLAY IF Q34 = 1 OR 2]

35. Why are you dissatisfied with it?
36. Do you have any suggestions for how the Weatherization Program could be improved?

HOME CHARACTERISTICS

37. The final few final questions are about your household. This information will be kept confidential, but you do not need to answer any question you do not want to answer.
38. Do you own the home where the project was completed, rent it, or own it and rent it to someone else?

1. Own
2. Rent
3. Own and rent to someone else
98. Don't know/Prefer not to state

39. Which of the following best describes your home? Is it a…

1. Manufactured home
2. Single-family house detached from any other house
3. Single family house attached to one or more other houses, for example, duplex, row house, or townhome
4. Apartment in a building with 2 to 3 units
5. Apartment in a building with 4 or more units

6. Other (Please describe)
98. Don't know/Prefer not to state

40. What fuel does your main water heater use?

1. Electricity
2. Natural Gas
3. Propane
4. Something else (Please describe)
5. Don't heat home
98. Don't know/Prefer not to state

41. What fuel does your main heating system use?

1. Electricity
2. Natural Gas
3. Propane
4. Something else (Please specify)
98. Don't know/Prefer not to state

PERMISSION TO REPRINT COMMENTS

42. Appalachian Power may want to use the comments you made in this survey in its marketing materials. If your comments are selected, only your first name and first initial of your last name will be associated with your comment.

    Do you permit Appalachian Power to reprint comments you made in this survey along with your first name and first initial of your last name?

1. Yes
2. No, Appalachian Power does not have permission to reprint my comment.

5. Low-Income Multifamily Tenant Survey Instrument

Screening and Verification [do not display in survey]

1. This survey is about your experience with the energy efficiency improvements made to your living unit through Appalachian Power Multifamily Program.
   Our records indicate that the following energy saving improvements were made to your residence through Appalachian Power Multifamily Program. Can you confirm that the following improvements were made?

   [1 = Yes, this improvement was made 2 = No, this improvement was not made 98 = Don't know]

a) [If insulation = 1] Added insulation
b) [If tune up = 1] Completed heat pump or air conditioner tune ups
c) [If mini split = 1] Installed mini split heat pumps
d) [If ceiling fan = 1] Installed ceiling fans
e) [If heat pump water heaters = 1] Installed heat pump water heaters
f) [If refrigerator = 1] Installed refrigerators
g) [If smart thermostat = 1] Installed smart thermostats
h) [If tankwrap = 1] Installed water heater blankets / tank wraps
i) [If window AC = 1] Installed window air conditioners
j) [If air source heat pump = 1] Installed air source heat pumps
k) [If faucet aerator = 1] Installed faucet aerators
l) [If pipe insulation = 1] Installed hot water pipe wrap
m) [If LED = 1] Installed LED light bulbs
n) [If showerhead = 1] Installed low flow showerheads
o) [If power strip = 1] Installed advanced power strips
p) [If duct insulation= 1] Insulated your heating and cooling ducts
q) [If duct sealing = 1] Sealed heating and cooling ducts
r) [If setback = 1] Lowered the temperatures on water heaters
s) [If air sealing = 1] Sealed air leaks

[TERMINATE IF NONE = 1]

2. We would also like to know if you have removed and are no longer using any of the equipment that was installed through Appalachian Power Multifamily Program. [1 = No, have not removed equipment, 2 = Yes, removed equipment, 98 = Don't know]

a) [If LEDs verified] LED lightbulb(s)
b) [If faucet aerators verified] Faucet aerator(s)
c) [If showerheads verified] Showerhead(s)
d) [If advanced power strips verified] Advanced power strip(s)

3. [Display if Q2a = 2] How many LED light bulbs did you remove?
4. [Display if Q2b = 2] How many faucet aerators did you remove?
5. [Display if Q2c = 2] How many showerheads did you remove?
6. [Display if Q2d = 2] How many advance power strips did you remove?

7. Were you home when the energy efficiency improvements were completed?

   1. Yes
   2. No

8. Did a program representative speak with you about tips on how to save energy?

   1. Yes
   2. No

9. Did you receive any printed material from the program with tips on how to save energy?

   1. Yes
   2. No

10. Using the scale below, how satisfied or dissatisfied are you with the following...
    [Very satisfied, somewhat satisfied, neither satisfied nor dissatisfied, somewhat dissatisfied, very dissatisfied, Don't know/not applicable]

    a) The energy efficiency improvements made to your living unit?
    b) [Display if Q7 = 1] The interactions you had with the people who completed the energy efficiency improvements in your living unit?
    c) [Display if Q8 = 1 or Q9 = 1] The information about the improvements made to your living unit or tips on how to save energy?
    d) The savings on your monthly utility bills?
    e) Your overall experience?

11. Have you seen any benefits from the energy efficiency improvements made to your living units? Please select up to three.

    1. My living unit feels more comfortable
    2. Reduced my electricity costs
    3. There is less noise from the outside
    4. There is less noise from the appliances
    5. I or my family have experienced health improvements
    6. The living unit is safer
    7. The appliances and heating or cooling equipment are more reliable
    8. Other (Please describe)
    9. I have not seen any benefits

12. Using the scale below, please rate how important saving energy in your living unit is to you?

    1. Not at all important

2. Slightly important
3. Moderately important
4. Very important
5. Extremely important

13. Is there anything Appalachian Power could do to help you save energy in your living unit?
14. Do you have any other comments about the Appalachian Power Multifamily Program, or the improvements made to your living unit?

PERMISSION TO REPRINT COMMENTS

15. Appalachian Power may want to use the comments you made in this survey in its marketing materials. If your comments are selected, only your first name and first initial of your last name will be associated with your comment.

    Do you permit Appalachian Power to reprint comments you made in this survey along with your first name and first initial of your last name?

    1. Yes
    2. No, Appalachian Power does not have permission to reprint my comment.

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6. Home Performance Program Participant Survey Results

QID1 - Our records indicate that you participated in the Appalachian Power Home Performance program in [Field-year]. Through this program you received [Field-project_description]. Do you recall your household's participation in this program?

#	Answer	%	Count
1	Yes	98.2%	221
2	No	1.8%	4
	Total	100%	225

QID2 - How did you first hear about the Home Performance Program?

#	Answer	%	Count
1	An Appalachian Power newsletter or email	50.7%	108
2	Appalachian Power website	16.9%	36
3	From a participating contractor	11.7%	25
4	From a program representative who visited my home	3.8%	8
5	While receiving services at my home through another Appalachian Power program	0.5%	1
6	Social networking site such as Facebook or Twitter	0.9%	2
7	Friend, relative, coworker, or neighbor	10.8%	23
8	In some other way (Please describe)	4.7%	10
	Total	100%	213

QID3 - How did you begin your participation in the program?

#	Answer	%	Count
1	You called the program contact number	36.5%	70
2	You enrolled using the Home Performance portal	46.4%	89
3	The contractor that completed the efficiency improvements enrolled you	17.2%	33
	Total	100%	192

QID140 - What were you hoping to get from participating in the program? Please select all the reasons that apply.

#	Answer	%	Count
1	Make your home more comfortable	31.7%	70
4	Save on energy costs	88.7%	196
5	Help the environment by using less energy	42.5%	94
6	Get information on my home / receive the home energy report with recommendations	47.1%	104
7	Get the free energy saving items	45.2%	100
8	Get a rebate to add insulation or reduce air leaks	12.7%	28
9	Improve the value of your home	13.6%	30
10	For some other reason	2.3%	5
98	Do not recall	0.0%	0
	Total	100%	221

QID4 - According to our records, a Home Performance Energy Advisor completed an energy assessment of your home. Did you schedule the home energy assessment?

#	Answer	%	Count
1	Yes	80.5%	177
2	No, someone else did	13.6%	30
3	No, did not have a home energy assessment completed	5.9%	13
	Total	100%	220

QID5 - On a scale of 1 to 5, where 1 is "very difficult" and 5 is "very easy," how would you rate the process of scheduling of your home energy assessment?

#	Answer	%	Count
1	1 (Very difficult)	1.7%	3
2	2	1.7%	3
3	3	5.6%	10
4	4	17.5%	31
5	5 (Very easy)	73.4%	130
	Total	100%	177

QID6 - Were you at home during the energy assessment?

#	Answer	%	Count
1	Yes	97.6%	202
2	No	2.4%	5
	Total	100%	207

QID7 - Using a scale where 1 means completely disagree and 5 means completely agree, how much do you agree with the following statements about the home energy assessment:

#	Question	1 (Completely disagree)		2		3		4		5 (Completely agree)		Total
1	The Home Performance Energy Advisor was timely in completing the assessment	1.0%	2	1.0%	2	8.0%	16	11.4%	23	78.6%	158	201
2	The Home Performance Energy Advisor was courteous and professional	0.5%	1	1.5%	3	2.5%	5	9.4%	19	86.1%	174	202
3	The information provided by the home energy assessment was useful	6.0%	12	6.0%	12	14.4%	29	16.4%	33	57.2%	115	201
4	The information provided by the home energy assessment was easy to understand	3.5%	7	2.0%	4	8.9%	18	15.8%	32	69.8%	141	202

QID141 - Did the Home Performance Energy Advisor recommend that you install insulation in your home?

#	Answer	%	Count
1	Yes	26.9%	53
2	No	57.9%	114
3	Do not recall	15.2%	30
	Total	100%	197

QID142 - Did the Home Performance Energy Advisor recommend that you perform a blower door test to see if you could make air sealing improvements?

#	Answer	%	Count
1	Yes	7.5%	15
2	No	74.0%	148
3	Do not recall	18.5%	37
	Total	100%	200

QID143 - Based on our records, you did not install any attic insulation through the program. What are the main reasons why you did not install attic insulation? Please select all that apply.

#	Answer	%	Count
1	It would cost too much	26.4%	14
4	You did not think it would be much of a benefit	3.8%	2
5	You haven't had time to schedule the work	7.5%	4
6	You don't know who to contact to schedule the installation of insulation	13.2%	7
7	Some other reason (Please describe)	34.0%	18
8	You did install the insulation but did not get a rebate	24.5%	13
9	The installer hasn't had time to do the work	1.9%	1
10	Did not need it, had enough insulation	5.7%	3
	Total	100%	53

QID145 - How likely are you to install the attic insulation in the next 12 months?

#	Answer	%	Count
9	Extremely unlikely	25.6%	10
10	Somewhat unlikely	15.4%	6
11	Neither likely nor unlikely	20.5%	8
12	Somewhat likely	23.1%	9
13	Extremely likely	15.4%	6
	Total	100%	39

QID146 - Will you apply for a program rebate if you install the attic insulation?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID8 - According to our records you received the following energy efficiency improvements through the program. Please indicate if the information seems correct.

#	Question	Correct		Incorrect		Not sure		Total
1	Air sealing to reduce drafts in your home. Air sealing can include applying caulking to exterior wall penetrations or installing gaskets on outlets.	73.2%	123	10.1%	17	16.7%	28	168
2	Attic and/or wall insulation	100.0%	6	0.0%	0	0.0%	0	6
3	Sealing and/or insulating of your heating and cooling system ducts. This is done to make your heating and cooling system work better.	65.0%	80	17.1%	21	17.9%	22	123
4	Energy efficient ductless heat pump	0.0%	0	100.0%	1	0.0%	0	1
5	High efficiency furnace fan motor	0.0%	0	0.0%	0	0.0%	0	undefined
6	Smart thermostat	0.0%	0	0.0%	0	0.0%	0	undefined
7	Heating and cooling system tune-up or maintenance	0.0%	0	0.0%	0	0.0%	0	undefined
8	Hot water heater pipe wrap	72.2%	39	16.7%	9	11.1%	6	54
9	Hot water heater tank wrap	100.0%	1	0.0%	0	0.0%	0	1
10	Reduction in hot water heater temperature	40.0%	2	40.0%	2	20.0%	1	5
11	[Field-LED_quantity] LED light bulbs	91.0%	152	2.4%	4	6.6%	11	167
12	[Field-filter_quantity] air filter whistles	0.0%	0	0.0%	0	0.0%	0	undefined
13	[Field-bath_aerator_quantity] bathroom faucet aerator(s)	86.7%	13	6.7%	1	6.7%	1	15
14	[Field-kitchen_quantity] kitchen faucet aerator(s)	71.4%	5	14.3%	1	14.3%	1	7
15	[Field-shower_quantity] showerhead(s)	98.0%	48	0.0%	0	2.0%	1	49
16	[Field-nightlight_quantity] nightlights	84.1%	53	4.8%	3	11.1%	7	63

QID10 - Are all of the [Field-filter_installed] air filter whistle(s) installed in your home currently installed in an air filter?

#	Answer	%	Count
1	Yes	0.0%	0
2	No, removed some and are no longer using	0.0%	0
99	No, removed some when changing the air filter and then reinstalled it	0.0%	0
	Total		0

QID79 - How many showers does your home have?

#	Answer	%	Count
1	1	16.7%	8
2	2	27.1%	13
3	3	43.8%	21
4	4	10.4%	5
5	More than 4	2.1%	1
	Total	100%	48

QID16 - Does the smart Wi-Fi thermostat that you got a rebate for control a central cooling system, a central heating system, or both?

#	Answer	%	Count
1	Central cooling system	0.0%	0
2	Central heating system	0.0%	0
3	Both cooling and heating systems	0.0%	0
	Total		0

QID17 - Is your central air conditioning system a heat pump?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID18 - What type of central heating system do you have?

#	Answer	%	Count
1	Central furnace	0.0%	0
2	Heat pump	0.0%	0
3	Other (Please specify)	0.0%	0
	Total		0

QID80 - What type of fuel does your central heating system use?

#	Answer	%	Count
1	Natural gas	0.0%	0
2	Electricity	0.0%	0
3	Oil	0.0%	0
4	Propane	0.0%	0
5	Wood	0.0%	0
	Total		0

QID19 - What type of thermostat did the rebated smart Wi-Fi thermostat replace?

#	Answer	%	Count
1	A standard manual thermostat that lets you set on/off temperatures	0.0%	0
2	A programmable thermostat that allows you to schedule the temperature settings for different times of the day	0.0%	0
3	A different Wi-Fi smart thermostat	0.0%	0
4	It was not a replacement	0.0%	0
	Total		0

QID81 - Which of the following best describes why you replaced your old Wi-Fi smart thermostat with a new one?

#	Answer	%	Count
1	The old Wi-Fi thermostat was not working	0.0%	0
2	The old Wi-Fi thermostat was hard to use	0.0%	0
3	You wanted to replace it for some other reason	0.0%	0
4	You did not replace a Wi-Fi thermostat	0.0%	0
	Total		0

QID20 - Did the [Field-heatpump_type] replace some old heating and cooling equipment?

#	Answer	%	Count
1	Yes, it replaced both cooling and heating equipment	0.0%	0
2	Yes, it replaced cooling equipment	0.0%	0
3	Yes, it replaced heating equipment	0.0%	0
4	No, it was a new installation that did not replace any equipment	0.0%	0
	Total		0

QID110 - Did the [Field-heatpump_type] replace a heat pump?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID112 - Thinking about the old heat pump you replaced, which of the following best describes when and how it was originally installed in.

#	Answer	%	Count
1	You bought the house new and the unit was original equipment when you bought it.	0.0%	0
2	It was original equipment in a newly constructed home when the previous owner bought it.	0.0%	0
3	It was there when you bought the house from a previous owner.	0.0%	0
4	You or your family installed the old unit.	0.0%	0
5	Other (Please specify)	0.0%	0
	Total		0

QID134 - Was the old heat pump working at the time it was replaced?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID113 - Do you know the approximate age of the old heat pump that was replaced?

#	Answer	%	Count
4	Yes (How old was it?)	0.0%	0
5	No	0.0%	0
	Total		0

QID114 - How were you able to determine the age of the old heat pump?

#	Answer	%	Count
1	Documentation included with the unit	0.0%	0
4	Contractor knew or estimated it	0.0%	0
5	Age of units was included in description of home when we bought it	0.0%	0
6	Previous owner told us	0.0%	0
7	Other (Please specify)	0.0%	0
	Total		0

QID115 - Which of the following do you think is the most likely age of the old heat pump:

#	Answer	%	Count
1	More than 20 years old	0.0%	0
4	15 – 20 years old	0.0%	0
5	10 – 15 years old	0.0%	0
6	Less than 10 years old	0.0%	0
	Total		0

QID117 - Please provide the seasonal energy efficiency ratio or SEER of the heat pump that you replaced?

#	Answer	%	Count
1	SEER	0.0%	0
	Total		0

QID118 - Please provide the Heating Seasonal Performance Factor or HSPF of the heat pump that you replaced?

#	Answer	%	Count
1	HSPF	0.0%	0
	Total		0

QID21 - What type of heating system did you have before you installed the [Field-heatpump_type]?

#	Answer	%	Count
1	Electric resistance heating	0.0%	0
2	An air source heat pump	0.0%	0
3	Some other kind of heating system	0.0%	0
4	No heating equipment	0.0%	0
	Total		0

QID22 - Was your electric resistance heating system an electric furnace or baseboard heating?

#	Answer	%	Count
1	Electric furnace	0.0%	0
3	Electric baseboard heating	0.0%	0
	Total		0

QID26 - Thinking about the old equipment you replaced, which of the following best describes when and how it was originally installed in.

#	Answer	%	Count
1	You bought the house new and the unit was original equipment when you bought it.	0.0%	0
2	It was original equipment in a newly constructed home when the previous owner bought it.	0.0%	0
3	It was there when you bought the house from a previous owner.	0.0%	0
4	You or your family installed the old unit.	0.0%	0
5	Other (Please specify)	0.0%	0
	Total		0

QID135 - Was the old heating system working at the time it was replaced?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID27 - Do you know the approximate age of the equipment that was replaced?

#	Answer	%	Count
1	Yes (How old was it?)	0.0%	0
2	No	0.0%	0
	Total		0

QID28 - How were you able to determine the age of the old equipment?

#	Answer	%	Count
1	Documentation included with the unit	0.0%	0
2	Contractor knew or estimated it	0.0%	0
3	Age of units was included in description of home when we bought it	0.0%	0
4	Previous owner told us	0.0%	0
5	Other (Please specify)	0.0%	0
	Total		0

QID29 - Which of the following do you think is the most likely age of the old equipment:

#	Answer	%	Count
1	More than 20 years old	0.0%	0
2	15 – 20 years old	0.0%	0
3	10 – 15 years old	0.0%	0
4	Less than 10 years old	0.0%	0
	Total		0

QID120 - Was the cooling equipment that you replaced a central air condition?

#	Answer	%	Count
4	Yes	0.0%	0
5	No	0.0%	0
	Total		0

QID121 - Thinking about the old cooling equipment you replaced, which of the following best describes when and how it was originally installed in.

#	Answer	%	Count
1	You bought the house new and the unit was original equipment when you bought it.	0.0%	0
2	It was original equipment in a newly constructed home when the previous owner bought it.	0.0%	0
3	It was there when you bought the house from a previous owner.	0.0%	0
4	You or your family installed the old unit.	0.0%	0
5	Other (Please specify)	0.0%	0
	Total		0

QID136 - Was the cooling system working at the time it was replaced?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID122 - Do you know the approximate age of the old cooling equipment that was replaced?

#	Answer	%	Count
1	Yes (How old was it?)	0.0%	0
2	No	0.0%	0
	Total		0

QID123 - How were you able to determine the age of the old cooling equipment?

#	Answer	%	Count
1	Documentation included with the unit	0.0%	0
2	Contractor knew or estimated it	0.0%	0
3	Age of units was included in description of home when we bought it	0.0%	0
4	Previous owner told us	0.0%	0
5	Other (Please specify)	0.0%	0
	Total		0

QID124 - Which of the following do you think is the most likely age of the old cooling equipment:

#	Answer	%	Count
4	More than 20 years old	0.0%	0
5	15 – 20 years old	0.0%	0
6	10 – 15 years old	0.0%	0
7	Less than 10 years old	0.0%	0
	Total		0

QID126 - Please provide the seasonal energy efficiency ratio or SEER of the air conditioner that you replaced?

#	Answer	%	Count
1	SEER	0.0%	0
	Total		0

QID37 - Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [Field-standard_measure1] that you installed?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don’t know	0.0%	0
	Total	100%	1

QID38 - Did the contractor that you worked with recommend that you install the [Field-efficient_measure1] instead of a standard efficiency [Field-standard_measure1] ?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don’t know	0.0%	0
	Total	100%	1

QID77 - Did the contractor that you worked with tell you there was a rebate available for the efficient equipment through the Home Performance program?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

QID39 - On a scale where 0 means "not at all influential and 10 means "extremely influential," how influential was the recommendation in your decision to install the [Field-efficient_measure1]?

#	Answer	%	Count
0	0 (Not at all influential)	100.0%	1
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very influential)	0.0%	0
	Total	100%	1

QID131 - Did you learn about the Home Performance program rebate before deciding to [Field-install1] the [Field-efficient_measure1], after deciding to [Field-install1] the [Field-efficient_measure1], or while making your decision?

#	Answer	%	Count
1	Before deciding	57.1%	4
2	After deciding	14.3%	1
3	While deciding	28.6%	2
	Total	100%	7

QID31 - Prior to learning about the Home Performance program, did you have plans to [Field-install1] the [Field-efficient_measure1]?

#	Answer	%	Count
1	Yes	57.1%	4
2	No	42.9%	3
98	Don't know	0.0%	0
	Total	100%	7

QID32 - Just to be clear, did you have plans to specifically [Field-install1] an [Field-efficient_measure1] as opposed to a standard efficiency [Field-standard_measure1]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

QID33 - Was the [Field-efficient_measure1] recommended during the home energy assessment?

#	Answer	%	Count
1	Yes	66.7%	4
2	No	33.3%	2
98	Don't know	0.0%	0
	Total	100%	6

QID34 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have [Field-installed1] the same [Field-efficient_measure1] if it was not recommended through the home energy assessment?

#	Answer	%	Count
0	0 (Not at all likely)	0.0%	0
1	1	0.0%	0
2	2	25.0%	1
3	3	25.0%	1
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	25.0%	1
9	9	0.0%	0
10	10 (Very likely)	25.0%	1
	Total	100%	4

QID35 - Would you have been financially able to [Field-install1] the [Field-efficient_measure1] without the financial assistance provided through the program?

#	Answer	%	Count
1	Yes	71.4%	5
2	No	14.3%	1
98	Don't know	14.3%	1
	Total	100%	7

QID127 - Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [Field-efficient_measure1] instead of a less efficient [Field-standard_measure1]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	100.0%	1
98	Don't know	0.0%	0
	Total	100%	1

QID128 - If the rebate was not available, what do you think you most likely would have done at the time when you purchased the [Field-efficient_measure1]?

#	Answer	%	Count
1	Not installed anything	100.0%	1
2	Installed a new but less energy efficient ${e://Field/standard_measure1}	0.0%	0
3	Installed a similarly energy efficient ${e://Field/standard_measure1}	0.0%	0
4	Installed the exact same ${e://Field/standard_measure1}	0.0%	0
98	Don't know	0.0%	0
	Total	100%	1

QID36 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have [Field-installed1] the same [Field-efficient_measure1] at about the same time if the financial assistance was not available?

#	Answer	%	Count
0	0 (Not at all likely)	14.3%	1
1	1	14.3%	1
2	2	0.0%	0
3	3	0.0%	0
4	4	14.3%	1
5	5	28.6%	2
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very likely)	28.6%	2
	Total	100%	7

QID40 - Did you [Field-install1] [Field-a_more_efficient_more1] [Field-efficient_measure1] than you would have if you had not received a rebate through the program?

#	Answer	%	Count
1	Yes	14.3%	1
2	No	71.4%	5
98	Don't know	14.3%	1
	Total	100%	7

QID41 - Did you [Field-install1] the [Field-efficient_measure1] sooner than you would have if the information and financial assistance from the program had not been available?

#	Answer	%	Count
1	Yes	42.9%	3
2	No	57.1%	4
98	Don't know	0.0%	0
	Total	100%	7

QID42 - When might you have [Field-installed1] the same [Field-efficient_measure1] if you had not participated in the program? Would you say …

#	Answer	%	Count
1	Within 6 months of when you purchased or installed it	33.3%	1
2	Between 6 months and 1 year	0.0%	0
3	In more than 1 year to 2 years	0.0%	0
4	In 2 to 3 years	0.0%	0
5	In more than 3 years	0.0%	0
6	Never	0.0%	0
98	Don't know	66.7%	2
	Total	100%	3

Part 2

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QID86 - Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [Field-standard_measure2] that you installed?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID87 - Did the contractor that you worked with recommend that you install the [Field-efficient_measure2] instead of a standard efficiency [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID88 - Did the contractor that you worked with tell you there was a rebate available for the efficient equipment through the Home Performance program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID89 - On a scale where 0 means "not at all influential and 10 means "extremely influential," how influential was the recommendation in your decision to install the [Field-efficient_measure2]?

#	Answer	%	Count
0	0 (Not at all influential)	0.0%	0
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very influential)	0.0%	0
	Total		0

QID132 - Did you learn about the Home Performance program rebate before deciding to [Field-install2] the [Field-efficient_measure2], after deciding to [Field-install] the [Field-efficient_measure2], or while making your decision?

#	Answer	%	Count
1	Before deciding	0.0%	0
2	After deciding	0.0%	0
3	While deciding	0.0%	0
	Total		0

QID90 - Prior to learning about the Home Performance program, did you have plans to [Field-install2] the [Field-efficient_measure2]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID91 - Just to be clear, did you have plans to specifically [Field-install2] an [Field-efficient_measure2] as opposed to a standard efficiency [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID92 - Was the [Field-efficient_measure2] recommended during the home energy assessment?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID93 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have [Field-installed2] the same [Field-efficient_measure2] if it was not recommended through the home energy assessment?

#	Answer	%	Count
0	0 (Not at all likely)	0.0%	0
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very likely)	0.0%	0
	Total		0

QID94 - Would you have been financially able to [Field-install2] the [Field-efficient_measure2] without the financial assistance provided through the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID129 - Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [Field-efficient_measure2] instead of a [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID130 - If the rebate was not available, what do you think you most likely would have done at the time when you purchased the [Field-efficient_measure2]?

#	Answer	%	Count
1	Not installed anything	0.0%	0
2	Installed a new but less energy efficient ${e://Field/standard_measure2}	0.0%	0
3	Installed a similarly energy efficient ${e://Field/standard_measure2}	0.0%	0
4	Installed the exact same ${e://Field/standard_measure2}	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID95 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely," how likely is it that you would have [Field-installed2] the same [Field-efficient_measure2] at about the same time if the financial assistance was not available?

#	Answer	%	Count
0	0 (Not at all likely)	0.0%	0
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very likely)	0.0%	0
	Total		0

QID97 - Did you [Field-install2] [Field-a_more_efficient_more2] [Field-efficient_measure2] than you would have if you had not received a rebate through the program?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID99 - Did you [Field-install2] the [Field-efficient_measure2] sooner than you would have if the information and financial assistance from the program had not been available?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID100 - When might you have [Field-installed2] the same [Field-efficient_measure2] if you had not participated in the program? Would you say …

#	Answer	%	Count
1	Within 6 months of when you purchased or installed it	0.0%	0
2	Between 6 months and 1 year	0.0%	0
3	In more than 1 year to 2 years	0.0%	0
4	In 2 to 3 years	0.0%	0
5	In more than 3 years	0.0%	0
6	Never	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID43 - Had you [Field-di_installed1] any [Field-dimeasure1] in your home before participating in the program?

#	Answer	%	Count
1	Yes	49.1%	108
2	No	45.9%	101
98	Don't know	5.0%	11
	Total	100%	220

QID44 - Did you have plans to [Field-di_install1] [Field-dimeasure1] before you learned about the Home Performance program?

#	Answer	%	Count
1	Yes	33.6%	74
2	No	56.4%	124
98	Don't know	10.0%	22
	Total	100%	220

QID149 - If you had not participated in the program, do you think you would have [Field-di_installed1] none of, a smaller amount, or the same amount of the [Field-dimeasure1] [Field-di_installed1] through the program?

#	Answer	%	Count
1	Would have ${e://Field/di_installed1} none of the ${e://Field/dimeasure1}	35.8%	77
2	Would have ${e://Field/di_installed1} a smaller amount of ${e://Field/dimeasure1}	46.0%	99
3	Would have ${e://Field/di_installed1} the exact same amount of ${e://Field/dimeasure1}	18.1%	39
	Total	100%	215

QID46 - Using a scale where 0 means "not at all likely" and 10 means "very likely", how likely is it that you would have [Field-di_installed1] the [Field-dimeasure1] on your own if you hadn't participated in the program?

#	Answer	%	Count
0	0 (Not at all likely)	29.5%	65
1	1	5.0%	11
2	2	6.8%	15
3	3	5.5%	12
4	4	4.1%	9
5	5	14.1%	31
6	6	5.0%	11
7	7	5.9%	13
8	8	2.7%	6
9	9	2.7%	6
10	10 (Very likely)	18.6%	41
	Total	100%	220

QID150 - Had you [Field-di_installed2] any [Field-dimeasure2] in your home before you participated in the program?

#	Answer	%	Count
1	Yes	43.9%	87
2	No	52.5%	104
98	Don't know	3.5%	7
	Total	100%	198

QID151 - Did you have plans to [Field-di_install2] [Field-dimeasure2] before you learned about the Home Performance program?

#	Answer	%	Count
1	Yes	34.8%	69
2	No	57.6%	114
98	Don't know	7.6%	15
	Total	100%	198

QID152 - If you had not participated in the program, do you think you would have [Field-di_installed2] none of, a smaller amount, or the same amount of the [Field-dimeasure2] [Field-di_installed2] through the program?

#	Answer	%	Count
1	Would have ${e://Field/di_installed2} none of the ${e://Field/dimeasure2}	42.3%	83
2	Would have ${e://Field/di_installed2} a smaller amount of ${e://Field/dimeasure2}	37.2%	73
3	Would have ${e://Field/di_installed2} the exact same amount of ${e://Field/dimeasure2}	20.4%	40
	Total	100%	196

QID154 - Using a scale where 0 means "not at all likely" and 10 means "very likely", how likely is it that you would have [Field-di_installed2] the [Field-dimeasure2] on your own if you hadn't participated in the program?

#	Answer	%	Count
0	0 (Not at all likely)	32.8%	65
1	1	6.6%	13
2	2	3.0%	6
3	3	7.6%	15
4	4	3.5%	7
5	5	10.1%	20
6	6	4.0%	8
7	7	6.6%	13
8	8	2.0%	4
9	9	1.5%	3
10	10 (Very likely)	22.2%	44
	Total	100%	198

QID155 - Had you [Field-di_installed3] any [Field-dimeasure3] in your home before you participated in the program?

#	Answer	%	Count
1	Yes	39.1%	52
2	No	60.2%	80
98	Don't know	0.8%	1
	Total	100%	133

QID156 - Did you have plans to [Field-di_install3] [Field-dimeasure3] before you learned about the Home Performance program?

#	Answer	%	Count
1	Yes	23.3%	31
2	No	68.4%	91
98	Don't know	8.3%	11
	Total	100%	133

QID157 - If you had not participated in the program, do you think you would have [Field-di_installed3] none of, a smaller amount, or the same amount of the [Field-dimeasure3] [Field-di_installed3] through the program?

#	Answer	%	Count
1	Would have ${e://Field/di_installed3} none of the ${e://Field/dimeasure3}	56.5%	74
2	Would have ${e://Field/di_installed3} a smaller amount of ${e://Field/dimeasure3}	26.7%	35
3	Would have ${e://Field/di_installed3} the exact same amount of ${e://Field/dimeasure3}	16.8%	22
	Total	100%	131

QID159 - Using a scale where 0 means "not at all likely" and 10 means "very likely", how likely is it that you would have [Field-di_installed3] the [Field-dimeasure3] on your own if you hadn't participated in the program?

#	Answer	%	Count
0	0 (Not at all likely)	40.6%	54
1	1	5.3%	7
2	2	7.5%	10
3	3	5.3%	7
4	4	3.8%	5
5	5	9.8%	13
6	6	3.0%	4
7	7	8.3%	11
8	8	1.5%	2
9	9	0.0%	0
10	10 (Very likely)	15.0%	20
	Total	100%	133

QID47 - Have you bought and installed any additional energy efficient items on your own in the past 12 months without a financial incentive or rebate from Appalachian Power because of your experience with the program?

#	Answer	%	Count
1	Yes	37.8%	82
2	No	62.2%	135
	Total	100%	217

QID48 - What did you purchase and install without getting an Appalachian Power rebate or discount? (Select all that apply)

#	Answer	%	Count
2	ENERGY STAR appliance such as a refrigerator, dishwasher, clothes washer, or clothes dryer	38.7%	29
3	Water heater pipe insulation	9.3%	7
4	Water heater jacket, blanket, or insulation	8.0%	6
5	Energy and water efficient faucet aerators	6.7%	5
6	Energy and water efficient showerheads	24.0%	18
7	ENERGY STAR room air conditioner	4.0%	3
8	Energy efficient water heater	21.3%	16
9	Smart thermostat	21.3%	16
10	Something else	44.0%	33
	Total	100%	75

QID49 - Why did you not get an Appalachian Power rebate, or discount for that energy saving equipment?

#	Answer	%	Count
1	Did not know an incentive, rebate, or discount was available	73.9%	51
2	Did not want to complete an application	2.9%	2
3	For some other reason (Please explain)	20.3%	14
4	I did get an incentive	2.9%	2
	Total	100%	69

QID61 - What type of water heater did you install? Was it a...

#	Answer	%	Count
1	Natural gas storage tank water heater	0.0%	0
2	Electric storage tank water heater	56.3%	9
3	Heat pump water heater	18.8%	3
4	A natural gas tankless water heater	12.5%	2
5	Some other type of water heater (Specify)	12.5%	2
	Total	100%	16

QID64 - On a scale of 0 to 10, where 0 represents “not at all important” and 10 represents “extremely important”, how important was the experience with the program in your decision to purchase the items you just mentioned?

#	Answer	%	Count
0	0 (Not at all important)	29.6%	21
1	1	4.2%	3
2	2	1.4%	1
3	3	2.8%	2
4	4	2.8%	2
5	5	9.9%	7
6	6	7.0%	5
7	7	7.0%	5
8	8	7.0%	5
9	9	4.2%	3
10	10 (Extremely important)	23.9%	17
	Total	100%	71

QID65 - On a scale of 0 to 10, where 0 represents “not at all likely” and 10 represents “extremely likely,” how likely would you have been to purchase those additional items if you had not participated in the program?

#	Answer	%	Count
0	0 (Not at all likely)	5.6%	4
1	1	0.0%	0
2	2	2.8%	2
3	3	2.8%	2
4	4	1.4%	1
5	5	16.7%	12
6	6	6.9%	5
7	7	11.1%	8
8	8	8.3%	6
9	9	6.9%	5
10	10 (Extremely likely)	37.5%	27
	Total	100%	72

QID66 - Thinking about the contractor that completed the work in your home for the [Field-all_major_measures] how much do you agree with the following statements:

#	Question	1 (Completely disagree)		2		3		4		5 (Completely agree)		Total
1	The contractor was timely in completing the work	0.0%	0	0.0%	0	0.0%	0	14.3%	1	85.7%	6	7
2	The contractor's work was of high quality	0.0%	0	0.0%	0	0.0%	0	14.3%	1	85.7%	6	7
3	The contractor was courteous and professional	0.0%	0	0.0%	0	0.0%	0	0.0%	0	100.0%	7	7

QID67 - Overall, how satisfied are you with the efficiency improvements to your home? Would you say you are...

#	Answer	%	Count
1	Very dissatisfied	5.1%	11
2	Somewhat dissatisfied	5.1%	11
3	Neither satisfied nor dissatisfied	14.3%	31
4	Somewhat satisfied	30.4%	66
5	Very satisfied	45.2%	98
	Total	100%	217

Q131 - How satisfied are you with the Appalachian Power Home Performance program, overall? Would you say you are...

#	Answer	%	Count
1	Very dissatisfied	4.2%	9
2	Somewhat dissatisfied	8.5%	18
3	Neither satisfied nor dissatisfied	11.3%	24
4	Somewhat satisfied	27.2%	58
5	Very satisfied	48.8%	104
	Total	100%	213

7. Efficient Products Participant Survey Results

QID4 - According to our records you participated in Appalachian Power's [Field-program_name] Program by receiving a rebate from Appalachian Power for energy saving appliances or equipment. Please mark "Yes" if you received a rebate for the following energy saving appliances or improvements listed below and "No" if you did not receive a rebate.

#	Question	Yes		No		Total
1	ENERGY STAR air purifier or cleaner	100.0%	43	0.0%	0	43
2	ENERGY STAR central air conditioner	100.0%	8	0.0%	0	8
3	Ductless mini-split heat pump(s)	100.0%	9	0.0%	0	9
4	Central furnace efficient fan motor	0.0%	0	0.0%	0	undefined
5	ENERGY STAR clothes dryer	95.5%	63	4.5%	3	66
6	ENERGY STAR clothes washer	96.9%	93	3.1%	3	96
7	ENERGY STAR computer monitor	0.0%	0	0.0%	0	undefined
8	ENERGY STAR dehumidifier	98.3%	119	1.7%	2	121
9	ENERGY STAR level 2 electric vehicle charger	100.0%	9	0.0%	0	9
10	ENERGY STAR heat pump water heater	96.7%	29	3.3%	1	30
11	ENERGY STAR pool pump	100.0%	4	0.0%	0	4
12	ENERGY STAR refrigerator	97.1%	170	2.9%	5	175
13	ENERGY STAR freezer	87.5%	7	12.5%	1	8
14	ENERGY STAR room air conditioner	100.0%	8	0.0%	0	8
15	Shower thermostatic restriction valve	100.0%	1	0.0%	0	1
16	R-30 insulation roll(s)	100.0%	5	0.0%	0	5
17	ENERGY STAR water dispenser	0.0%	0	0.0%	0	undefined
18	ENERGY STAR ventilation fan	100.0%	3	0.0%	0	3
19	Smart thermostat(s)	100.0%	20	0.0%	0	20

QID5 - Did you apply for any rebates from Appalachian Power for energy efficient products?

#	Answer	%	Count
1	Yes (What products?)	90.9%	30
2	No	6.1%	2
98	Not sure	3.0%	1
	Total	100%	33

QID6 - About how many hours per day do you run the air purifier?

#	Answer	%	Count
1	None	0.0%	0
2	1 – 4 hours	19.4%	7
3	5 – 8 hours	16.7%	6
4	8 – 12 hours	8.3%	3
5	2- 16 hours	0.0%	0
6	16 – 24 hours	55.6%	20
	Total	100%	36

QID7 - Did the new air conditioner replace another central air conditioner?

#	Answer	%	Count
1	Yes	100.0%	8
2	No	0.0%	0
98	Don't know	0.0%	0
	Total	100%	8

QID8 - Which of the following best describes how well the old central air conditioner worked?

#	Answer	%	Count
1	It turned on and kept the home comfortable	12.5%	1
2	It turned on but did not keep the home comfortable	50.0%	4
3	It did not turn on	25.0%	2
	Total	100%	8

QID9 - Did your contractor provide you the option of repairing the old air conditioner?

#	Answer	%	Count
1	Yes	28.6%	2
2	No	71.4%	5
	Total	100%	7

QID10 - Why did you not repair the old air conditioner?

#	Answer	%	Count
1	The cost was too high	0.0%	0
2	The unit was old / worried there would be more repairs needed	100.0%	2
3	Preferred a more energy efficient option	0.0%	0
4	A new system would have worked better	0.0%	0
5	Appalachian Power provided a rebate	0.0%	0
6	The old unit was noisy	0.0%	0
7	Getting parts would take too long	0.0%	0
8	Wanted the warranty that came with the new unit	0.0%	0
9	Other (Please describe)	0.0%	0
	Total	100%	2

QID11 - Did you get an estimate of how much it would have cost to fix the old equipment before you decided to install a new unit?

#	Answer	%	Count
1	Yes	60.0%	3
2	No	40.0%	2
	Total	100%	5

QID13 - Do you know the approximate age of the old air conditioner that was replaced?

#	Answer	%	Count
1	Yes (How many years old was it?)	83.3%	5
2	No	16.7%	1
	Total	100%	6

QID14 - Which of the following do you think is the most likely age of the old air conditioner:

#	Answer	%	Count
1	More than 20 years old	66.7%	2
2	15 – 20 years old	0.0%	0
3	10 – 15 years old	33.3%	1
4	Less than 10 years old	0.0%	0
	Total	100%	3

QID18 - Did the ductless mini-split(s) replace some old heating and cooling equipment?

#	Answer	%	Count
1	Yes, it replaced both cooling and heating equipment	44.4%	4
2	Yes, it replaced cooling equipment	0.0%	0
3	Yes, it replaced heating equipment	11.1%	1
4	No, it was a new installation that did not replace any equipment	44.4%	4
	Total	100%	9

QID19 - What type of heating equipment did it replace?

#	Answer	%	Count
1	Heat pump	50.0%	2
2	Electric resistance heating	0.0%	0
3	Gas furnace	25.0%	1
4	Something else	25.0%	1
	Total	100%	4

Q176 - Do you know the approximate age of the old [QID19-ChoiceGroup-SelectedChoices] that was replaced?

Q176_1_TEXT - Yes (How many years old was it?)

Yes (How many years old was it?) - Text
15
5

QID46 - Did install the central furnace efficient fan motor when replacing your furnace or did you install the fan motor without replacing your furnace?

#	Answer	%	Count
1	Installed as part of furnace replacement	0.0%	0
2	Installed the fan motor without replacing your furnace	0.0%	0
	Total		0

QID47 - What type of fuel does your current furnace use?

#	Answer	%	Count
1	Electricity	0.0%	0
2	Natural gas	0.0%	0
3	Propane	0.0%	0
4	Other	0.0%	0
	Total		0

QID48 - Did the clothes dryer that you received a rebate for replace another clothes washer?

#	Answer	%	Count
1	Yes	81.7%	49
2	No	18.3%	11
	Total	100%	60

QID49 - Was the clothes dryer that you replaced working at the time when you replaced it?

#	Answer	%	Count
1	Yes	73.5%	36
2	No	26.5%	13
	Total	100%	49

QID50 - Was the clothes dryer you replaced purchased before 2015?

#	Answer	%	Count
1	Yes, purchased before 2015	86.1%	31
2	No, purchased in 2015 or later	13.9%	5
	Total	100%	36

QID51 - Did the clothes washer that you received a rebate for replace another clothes washer?

#	Answer	%	Count
1	Yes	85.1%	74
2	No	14.9%	13
	Total	100%	87

QID52 - Was the clothes washer that you replaced working at the time when you replaced it?

#	Answer	%	Count
1	Yes	55.6%	40
2	No	44.4%	32
	Total	100%	72

QID53 - Was the washer you replaced purchased before 2018?

#	Answer	%	Count
1	Yes, purchased before 2018	90.0%	36
2	No, purchased in 2018 or later	10.0%	4
	Total	100%	40

QID54 - Approximately how many hours per day is the computer monitor that you received the rebate for turned on?

#	Answer	%	Count
1	Less than 1 per day	0.0%	0
2	2 to 3 hours per day	0.0%	0
3	4 to 5 hours per day	0.0%	0
4	6 to 8 hours per day	0.0%	0
5	More than 8 hours per day	0.0%	0
	Total		0

QID55 - About how many hours per day do you run or plan on running the dehumidifier during the warmer summer months?

#	Answer	%	Count
1	None	2.7%	3
2	1 – 4 hours	11.7%	13
3	5 – 8 hours	15.3%	17
4	8 – 12 hours	12.6%	14
5	2- 16 hours	3.6%	4
6	16 – 24 hours	54.1%	60
	Total	100%	111

QID56 - About how many hours per day do you run or plan on running the dehumidifier during the cooler months?

#	Answer	%	Count
1	None	34.3%	37
2	1 – 4 hours	20.4%	22
3	5 – 8 hours	13.0%	14
4	8 – 12 hours	4.6%	5
5	2- 16 hours	0.9%	1
6	16 – 24 hours	26.9%	29
	Total	100%	108

QID57 - Is the ENERGY STAR Level 2 charger that you received the Appalachian Power rebate for…

#	Answer	%	Count
1	A replacement for a Level 1 charger (a Level 1 charger plugs into a standard household outlet)	0.0%	0
2	A replacement for a Level 2 charger	12.5%	1
3	A new installation that did not replace another charger	87.5%	7
	Total	100%	8

QID58 - When you bought your Level 2 charger, were you aware that it uses less electricity to charge a car than a Level 1 charger?

#	Answer	%	Count
1	Yes	50.0%	4
2	No	50.0%	4
	Total	100%	8

QID59 - Do you currently own a plug-in electric vehicle?

#	Answer	%	Count
1	Yes	87.5%	7
2	No	12.5%	1
	Total	100%	8

QID60 - Do you have plans to purchase or have you ordered an electric vehicle that has not been delivered yet?

#	Answer	%	Count
1	I have plans to purchase an electric vehicle	100.0%	1
2	I have ordered an electric vehicle that has not been delivered	0.0%	0
3	No, I do not have plans to purchase an electric vehicle	0.0%	0
	Total	100%	1

QID61 - Have you installed the ENERGY STAR Level 2 charger you received the rebate for?

#	Answer	%	Count
1	Yes	100.0%	8
2	No	0.0%	0
	Total	100%	8

QID62 - Why haven't you installed it yet? Please select all that apply.

#	Answer	%	Count
1	The electrical panel for my home does not have room for a new dedicated circuit	0.0%	0
2	I have not had time to install it	16.7%	1
3	I don't have the correct type of outlet to install it	0.0%	0
4	I cannot find an electrician to install it	0.0%	0
5	I don't know how to install it	0.0%	0
6	Other (Please specify)	83.3%	5
	Total	100%	6

QID63 - What type of plug-in electric vehicle do you most often use the Level 2 charger for?

#	Answer	%	Count
1	A plug-in hybrid that can run on electricity or gasoline	14.3%	1
2	A fully electric vehicle that does not use gasoline	85.7%	6
	Total	100%	7

QID64 - How often do you plug your vehicle into the rebated ENERGY STAR Level 2 charger?

#	Answer	%	Count
1	At least once day	14.3%	1
2	Not every day, but a few times a week	42.9%	3
3	Once a week or less often	42.9%	3
98	I don't know	0.0%	0
	Total	100%	7

QID65 - For each of the following times, please mark how many days you charge your vehicle at home during a typical Monday through Friday workweek.

#	Question	Do not charge at this time		1 day a week		2 days a week		3 days a week		4 days a week		5 days a week		Total
1	12am to 6am	0.0%	0	40.0%	2	20.0%	1	20.0%	1	0.0%	0	20.0%	1	5
2	6 am to 3 pm	80.0%	4	0.0%	0	20.0%	1	0.0%	0	0.0%	0	0.0%	0	5
3	3 pm to 6 pm	66.7%	4	16.7%	1	16.7%	1	0.0%	0	0.0%	0	0.0%	0	6
4	6 pm to 12 am	14.3%	1	42.9%	3	0.0%	0	28.6%	2	0.0%	0	14.3%	1	7

QID66 - How long does it typically take to charge your electric vehicle with the rebated ENERGY STAR Level 2 charger?

#	Answer	%	Count
1	Less than 30 minutes	0.0%	0
2	31 minutes – 60 minutes	0.0%	0
3	1 – 3 hours	0.0%	0
4	4 – 6 hours	57.1%	4
5	6 – 8 hours	42.9%	3
6	More than 8 hours	0.0%	0
98	I don't know	0.0%	0
	Total	100%	7

QID67 - How often do you charge your vehicle using a public charging stations (as opposed to the rebated Level 2 charger)?

#	Answer	%	Count
1	At least once day	0.0%	0
2	A few times a week	14.3%	1
3	Less than once a week	71.4%	5
4	Never	14.3%	1
98	I don't know	0.0%	0
	Total	100%	7

QID68 - Did the heat pump water heater that you received a rebate for replace another water heater?

#	Answer	%	Count
1	Yes	100.0%	29
2	No	0.0%	0
	Total	100%	29

QID69 - Did the heat pump water heater that you received a rebate replace...

#	Answer	%	Count
1	A natural gas water heater	3.4%	1
2	An electric resistance water heater	89.7%	26
3	A heat pump water heater	3.4%	1
4	Another type of water heater (Please describe)	3.4%	1
	Total	100%	29

QID70 - Was the pool pump that you got a rebate for...

#	Answer	%	Count
1	A replacement for a working pool pump	25.0%	1
2	A replacement for a broken pool pump	25.0%	1
3	An additional pump or a pump for a new swimming pool (it did not replace a pool pump)	50.0%	2
	Total	100%	4

QID71 - Did the new pool pump replace a single speed, two speed, or variable speed pool pump?

#	Answer	%	Count
1	Single speed pool pump	100.0%	1
2	Two speed pool pump	0.0%	0
3	Variable Speed pool pump	0.0%	0
98	I'm not sure	0.0%	0
	Total	100%	1

QID72 - Do you know the programmed running times and speeds for the new pool pump?

#	Answer	%	Count
1	Yes	75.0%	3
2	No	25.0%	1
	Total	100%	4

QID73 - Select the programmed speed settings in your variable speed pump. (Select all that apply)

#	Answer	%	Count
1	500 to 1000 rpm	0.0%	0
2	1001 to 1500 rpm	100.0%	1
3	1501 to 2500 rpm	100.0%	1
4	2501 rpm to 3600 rpm	0.0%	0
	Total	100%	1

QID74 - Which of the following best describes the time of day when the pool pump is running in a speed range of 500 to 1000 rpm?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	0.0%	0
3	7-12 hours during the day and may operate at night	0.0%	0
4	Operates only at night	0.0%	0
	Total		0

QID75 - Which of the following best describes the time of day when the pool pump is running in a speed range of 1001 to 1500 rpm?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	0.0%	0
3	7-12 hours during the day and may operate at night	100.0%	1
4	Operates only at night	0.0%	0
	Total	100%	1

QID76 - Which of the following best describes the time of day when the pool pump is running in a speed range of 1501 to 2500 rpm?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	100.0%	1
3	7-12 hours during the day and may operate at night	0.0%	0
4	Operates only at night	0.0%	0
	Total	100%	1

QID77 - Which of the following best describes the time of day when the pool pump is running in a speed range of 2501 to 3600 rpm?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	0.0%	0
3	7-12 hours during the day and may operate at night	0.0%	0
4	Operates only at night	0.0%	0
	Total		0

QID78 - Which of the following best describes the time of day when the pool pump is running at high speed?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	0.0%	0
3	7-12 hours during the day and may operate at night	0.0%	0
4	Operates only at night	0.0%	0
	Total		0

QID79 - Which of the following best describes the time of day when the pool pump is running at low speed?

#	Answer	%	Count
1	Does not run at this speed	0.0%	0
2	0-6 hours during the day and may operate at night	0.0%	0
3	7-12 hours during the day and may operate at night	0.0%	0
4	Operates only at night	0.0%	0
	Total		0

QID81 - Did the room air conditioner that you received a rebate for replace another room air conditioner?

#	Answer	%	Count
1	Yes	62.5%	5
2	No	37.5%	3
	Total	100%	8

QID82 - Was the room air conditioner that you replaced working at the time you replaced it?

#	Answer	%	Count
1	Yes	80.0%	4
2	No	20.0%	1
	Total	100%	5

QID83 - How old was the room air conditioner that you replaced?

#	Answer	%	Count
1	0 to 3 years	0.0%	0
2	4 to 12 years	50.0%	2
3	More than 12 years	50.0%	2
	Total	100%	4

QID84 - Is the shower thermostatic restriction valve currently installed?

#	Answer	%	Count
1	Yes	100.0%	1
2	No	0.0%	0
	Total	100%	1

QID85 - Why is the shower thermostatic restriction valve not currently installed?

#	Answer	%	Count
1	I haven't had time to install	0.0%	0
2	I don't know how to install it	0.0%	0
3	I uninstalled it because I didn't like it	0.0%	0
4	Some other reason (Please describe)	0.0%	0
	Total		0

QID86 - What fuel does your main water heater use?

#	Answer	%	Count
1	Electricity	100.0%	1
2	Natural Gas	0.0%	0
3	Propane	0.0%	0
4	Something else (Please describe)	0.0%	0
98	Don’t know	0.0%	0
	Total	100%	1

QID87 - Where did you install the insulation that you received a rebate for? Please select all that apply.

#	Answer	%	Count
1	Exterior above ground wall	20.0%	1
2	Exterior basement wall	0.0%	0
3	Ceiling or attic	80.0%	4
4	Crawlspace	0.0%	0
5	Some other location	0.0%	0
98	Don't know	0.0%	0
	Total	100%	5

QID89 - Approximately how many square feet of exterior wall space was insulated using the rebated insulation?

Approximately how many square feet of exterior wall space was insulated using the rebated insulation?

120

QID90 - Approximately how many inches of insulation did your existing walls have before you installed the new insulation?

#	Answer	%	Count
1	Inches of insulation	100.0%	1
2	There was no insulation	0.0%	0
	Total	100%	1

QID92 - Approximately how many inches of insulation did your exterior basement wall space have before you installed the new insulation?

#	Answer	%	Count
1	Inches of insulation	0.0%	0
2	There was no insulation	0.0%	0
	Total		0

QID94 - Approximately how many inches of insulation did your ceiling or attic have before you installed the new insulation?

#	Answer	%	Count
1	Inches of insulation	100.0%	4
2	There was no insulation	0.0%	0
	Total	100%	4

QID97 - Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [Field-standard_measure1] that you installed?

#	Answer	%	Count
1	Yes	45.9%	17
2	No	40.5%	15
98	Don't know	13.5%	5
	Total	100%	37

QID98 - Did the contractor that you worked with tell you there was an Appalachian Power rebate available for the efficient equipment?

#	Answer	%	Count
1	Yes	40.5%	15
2	No	59.5%	22
	Total	100%	37

QID99 - Did the contractor that you worked with recommend that you install the [Field-efficient_measure1] instead of a standard efficiency [Field-standard_measure1]?

#	Answer	%	Count
1	Yes	45.9%	17
2	No	54.1%	20
	Total	100%	37

QID100 - On a scale where 0 means “not at all influential and 10 means “extremely influential,” how influential was the recommendation in your decision to install the [Field-efficient_measure1]?

#	Answer	%	Count
0	0 (Not at all influential)	5.9%	1
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	11.8%	2
6	6	0.0%	0
7	7	11.8%	2
8	8	5.9%	1
9	9	17.6%	3
10	10 (Very influential)	47.1%	8
	Total	100%	17

QID101 - Did you learn about the rebate from Appalachian Power before or after you purchased the [Field-efficient_measure1]?

#	Answer	%	Count
1	Before	60.8%	296
2	After	35.7%	174
98	Don’t know	3.5%	17
	Total	100%	487

QID102 - Were you planning to purchase an [Field-efficient_measure1] before you learned that a rebate was available from Appalachian Power?

#	Answer	%	Count
1	Yes	71.5%	343
2	No	18.1%	87
98	Don't know	10.4%	50
	Total	100%	480

QID104 - Just to be clear, did you have plans to specifically purchase an [Field-efficient_measure1] instead of a standard [Field-standard_measure1]?

#	Answer	%	Count
1	Yes	64.7%	308
2	No	26.1%	124
98	Don't know	9.2%	44
	Total	100%	476

QID103 - Would you have been financially able to purchase the [Field-efficient_measure1] if you had not received the rebate through Appalachian Power?

#	Answer	%	Count
1	Yes	87.2%	422
2	No	6.0%	29
98	Don't know	6.8%	33
	Total	100%	484

QID105 - Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [Field-efficient_measure1] instead of a standard [Field-standard_measure1]?

#	Answer	%	Count
1	Yes	73.2%	347
2	No	12.9%	61
98	Don't know	13.9%	66
	Total	100%	474

QID106 - Which of the following do you think you would have most likely done if the Appalachian Power rebate was not available?

#	Answer	%	Count
1	Purchased the exact same ${e://Field/efficient_measure1}	70.7%	336
2	Purchased a different ${e://Field/efficient_measure1}	12.4%	59
3	Purchased a ${e://Field/standard_measure1} that used more electricity	2.1%	10
4	Purchased a ${e://Field/standard_measure1} that was not ENERGY STAR certified	5.1%	24
5	Purchased a level 1 car charger	0.0%	0
6	Purchased a single speed pool pump	0.0%	0
7	Not purchased a ${e://Field/standard_measure1}	3.6%	17
8	Something else (Please describe)	6.1%	29
	Total	100%	475

QID107 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely", how likely is it that you would have purchased the same [Field-efficient_measure1] if you had not received rebate or informational assistance through the Appalachian Power program?

#	Answer	%	Count
0	0 (Not at all likely)	4.0%	19
1	1	1.1%	5
2	2	2.5%	12
3	3	2.5%	12
4	4	2.3%	11
5	5	10.0%	47
6	6	2.8%	13
7	7	5.5%	26
8	8	10.0%	47
9	9	5.7%	27
10	10 (Very likely)	53.5%	252
	Total	100%	471

QID108 - Did you purchase the [Field-efficient_measure1] sooner than you would have if the information and financial assistance from the program had not been available?

#	Answer	%	Count
1	Yes	20.0%	94
2	No	68.9%	323
98	Don't know	11.1%	52
	Total	100%	469

QID109 - When might you have purchased the same [Field-efficient_measure1] if you had not participated in the program? Would you say...

#	Answer	%	Count
1	Within 6 months of when you purchased it	42.6%	40
2	Between 6 months and 1 year	19.1%	18
3	In more than 1 year to 2 years	16.0%	15
4	In two years or more	7.4%	7
98	Don't know	14.9%	14
	Total	100%	94

QID110 - Did the contractor that you worked with discuss equipment with different efficiency levels when you were deciding on the [Field-standard_measure2] that you installed?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
98	Don't know	0.0%	0
	Total		0

QID111 - Did the contractor that you worked with tell you there was an Appalachian Power rebate available for the efficient equipment?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID112 - Did the contractor that you worked with recommend that you install the [Field-efficient_measure2] instead of a standard efficiency [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	0.0%	0
2	No	0.0%	0
	Total		0

QID113 - On a scale where 0 means “not at all influential and 10 means “extremely influential,” how influential was the recommendation in your decision to install the [Field-efficient_measure2]?

#	Answer	%	Count
0	0 (Not at all influential)	0.0%	0
1	1	0.0%	0
2	2	0.0%	0
3	3	0.0%	0
4	4	0.0%	0
5	5	0.0%	0
6	6	0.0%	0
7	7	0.0%	0
8	8	0.0%	0
9	9	0.0%	0
10	10 (Very influential)	0.0%	0
	Total		0

QID114 - Did you learn about the rebate from Appalachian Power before or after you purchased the [Field-efficient_measure2]?

#	Answer	%	Count
1	Before	63.1%	41
2	After	35.4%	23
98	Don’t know	1.5%	1
	Total	100%	65

QID115 - Were you planning to purchase an [Field-efficient_measure2] before you learned that a rebate was available from Appalachian Power?

#	Answer	%	Count
1	Yes	70.3%	45
2	No	23.4%	15
98	Don't know	6.3%	4
	Total	100%	64

QID116 - Just to be clear, did you have plans to specifically purchase an [Field-efficient_measure2] instead of a standard [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	68.3%	43
2	No	28.6%	18
98	Don’t know	3.2%	2
	Total	100%	63

QID117 - Would you have been financially able to purchase the [Field-efficient_measure2] if you had not received the rebate through Appalachian Power?

#	Answer	%	Count
1	Yes	90.5%	57
2	No	4.8%	3
98	Don't know	4.8%	3
	Total	100%	63

QID118 - Just to confirm, if the rebate was not available through the program, would you still have paid the additional cost to purchase an [Field-efficient_measure2] instead of a standard [Field-standard_measure2]?

#	Answer	%	Count
1	Yes	82.5%	52
2	No	7.9%	5
98	Don't know	9.5%	6
	Total	100%	63

QID119 - Which of the following do you think you would have most likely done if the Appalachian Power rebate was not available?

#	Answer	%	Count
1	Purchased the exact same ${e://Field/efficient_measure2}	73.0%	46
2	Purchased a different ${e://Field/efficient_measure2}	9.5%	6
3	Purchased a ${e://Field/standard_measure2} that used more electricity	0.0%	0
4	Purchased a ${e://Field/standard_measure2} that was not ENERGY STAR certified	6.3%	4
5	Purchased a level 1 car charger	1.6%	1
6	Purchased a single speed pool pump	0.0%	0
7	Not purchased a ${e://Field/standard_measure2}	3.2%	2
8	Something else (Please describe)	6.3%	4
	Total	100%	63

QID120 - On a scale of 0 to 10 where 0 represents "Not at all likely" and 10 represents "Very likely", how likely is it that you would have purchased the same [Field-efficient_measure2] if you had not received rebate or informational assistance through the Appalachian Power program?

#	Answer	%	Count
0	0 (Not at all likely)	4.8%	3
1	1	1.6%	1
2	2	0.0%	0
3	3	8.1%	5
4	4	1.6%	1
5	5	9.7%	6
6	6	1.6%	1
7	7	8.1%	5
8	8	8.1%	5
9	9	8.1%	5
10	10 (Very likely)	48.4%	30
	Total	100%	62

QID121 - Did you purchase the [Field-efficient_measure2] sooner than you would have if the information and financial assistance from the program had not been available?

#	Answer	%	Count
1	Yes	27.4%	17
2	No	72.6%	45
98	Don't know	0.0%	0
	Total	100%	62

QID122 - When might you have purchased the same [Field-efficient_measure2] if you had not participated in the program? Would you say...

#	Answer	%	Count
1	Within 6 months of when you purchased it	41.2%	7
2	Between 6 months and 1 year	35.3%	6
3	In more than 1 year to 2 years	0.0%	0
4	In two years or more	5.9%	1
98	Don't know	17.6%	3
	Total	100%	17

QID123 - Have you bought and installed any additional energy efficient items on your own in the past 12 months because of your experience with the program?

#	Answer	%	Count
1	Yes	20.9%	97
2	No	79.1%	367
	Total	100%	464

QID124 - Did you make any of those purchases without getting a rebate or discount from Appalachian Power?

#	Answer	%	Count
1	Yes	70.5%	67
2	No	29.5%	28
	Total	100%	95

QID125 - What did you purchase and install without getting an Appalachian Power rebate or discount? (Select all that apply)

#	Answer	%	Count
2	ENERGY STAR appliance such as a refrigerator, dishwasher, clothes washer, or clothes dryer	54.5%	36
3	Water heater pipe insulation	1.5%	1
4	Water heater jacket, blanket, or insulation	1.5%	1
5	Energy and water efficient faucet aerators	4.5%	3
6	Energy and water efficient showerheads	10.6%	7
7	ENERGY STAR room air conditioner	7.6%	5
8	Energy efficient water heater	10.6%	7
9	Smart thermostat	27.3%	18
10	Something else	21.2%	14
98	Don't know	4.5%	3
	Total	100%	66

QID126 - Why did you not get an Appalachian Power rebate, or discount for that energy saving equipment?

#	Answer	%	Count
1	Did not know an incentive, rebate, or discount was available	46.8%	29
2	Did not want to complete an application	1.6%	1
3	For some other reason (Please explain)	30.6%	19
4	I did get an incentive	6.5%	4
98	Don't know	14.5%	9
	Total	100%	62

QID138 - What type of water heater did you install? Was it a...

#	Answer	%	Count
1	Natural gas storage tank water heater	28.6%	2
2	Electric storage tank water heater	42.9%	3
3	Heat pump water heater	0.0%	0
4	A natural gas tank less water heater	14.3%	1
5	Some other type of water heater (Specify)	0.0%	0
98	Don't know	14.3%	1
	Total	100%	7

QID139 - What type of thermostat did the smart thermostat replace?

#	Answer	%	Count
1	A programmable thermostat that allows you to schedule the temperature settings for different times of the day	64.7%	11
2	A standard thermostat that lets you set on/off temperatures	17.6%	3
3	A different Wi-Fi smart thermostat	17.6%	3
98	Don't know	0.0%	0
	Total	100%	17

QID140 - Does the thermostat control your heating system, cooling system, or both?

#	Answer	%	Count
1	Central cooling system	0.0%	0
2	Central heating system	0.0%	0
3	Both cooling and heating systems	100.0%	16
98	Don't know	0.0%	0
	Total	100%	16

QID141 - Is your central air conditioning system a heat pump?

#	Answer	%	Count
1	Yes	75.0%	12
2	No	25.0%	4
3	Don't know	0.0%	0
	Total	100%	16

QID142 - What type of central heating system do you have?

#	Answer	%	Count
1	Central furnace	25.0%	4
2	Heat pump	68.8%	11
3	Other (Please describe)	0.0%	0
98	Don't know	6.3%	1
	Total	100%	16

QID143 - What is the main fuel used by the central heating system?

#	Answer	%	Count
1	Natural gas	18.8%	3
2	Electricity	75.0%	12
3	Oil	0.0%	0
4	Propane	6.3%	1
5	Wood	0.0%	0
98	Don’t know	0.0%	0
	Total	100%	16

QID145 - On a scale of 0 to 10, where 0 represents "not at all important" and 10 represents "extremely important", how important was the experience with the program in your decision to purchase the items you just mentioned?

#	Answer	%	Count
0	0 (Not at all important)	22.6%	14
1	1	3.2%	2
2	2	3.2%	2
3	3	3.2%	2
4	4	0.0%	0
5	5	6.5%	4
6	6	6.5%	4
7	7	14.5%	9
8	8	6.5%	4
9	9	1.6%	1
10	10 (Extremely important)	32.3%	20
	Total	100%	62

QID146 - On a scale of 0 to 10, where 0 represents "not at all likely" and 10 represents "extremely likely," how likely would you have been to purchase those additional items if you had not participated in the program?

#	Answer	%	Count
0	0 (Not at all likely)	1.6%	1
1	1	0.0%	0
2	2	1.6%	1
3	3	1.6%	1
4	4	1.6%	1
5	5	8.1%	5
6	6	9.7%	6
7	7	8.1%	5
8	8	9.7%	6
9	9	6.5%	4
10	10 (Extremely likely)	51.6%	32
	Total	100%	62

QID147 - How did you hear about the rebates available through Appalachian Power's program? Please select all that apply.

#	Answer	%	Count
1	An Appalachian Power newsletter or email	37.9%	174
2	Appalachian Power website	21.6%	99
3	A contractor you worked with	6.8%	31
4	While receiving services at my home through another Appalachian Power program	0.4%	2
5	Social networking site such as Facebook or Twitter	1.1%	5
6	Friend, relative, coworker, or neighbor	3.3%	15
7	An Appalachian Power home energy report	5.2%	24
8	In some other way	42.5%	195
	Total	100%	459

QID148 - Who completed your Appalachian Power rebate application? Please select all that apply.

#	Answer	%	Count
1	Yourself	96.3%	444
2	A contractor or retailer you worked with	1.5%	7
3	Someone else	3.0%	14
	Total	100%	461

QID149 - Thinking back to the application process, please rate the clarity of information on how to complete the application to get the program incentives using the scale below.

#	Answer	%	Count
1	1 (Not at all clear)	1.3%	6
2	2	3.5%	16
3	3	11.4%	52
4	4	23.5%	107
5	5 (Completely clear)	60.2%	274
	Total	100%	455

QID151 - How long did it take to get the rebate compared to what you expected?

#	Answer	%	Count
1	A lot less time than expected	5.9%	27
2	Somewhat less time than expected	10.5%	48
3	About as much time as expected	48.6%	222
4	Somewhat more time than expected	19.5%	89
5	A lot more time than expected	9.0%	41
98	Don't know	6.6%	30
	Total	100%	457

QID152 - How long did it take to get the rebate?

#	Answer	%	Count
1	Less than 2 weeks	1.3%	6
2	2 – 4 weeks	25.1%	113
3	5 – 6 weeks	26.6%	120
4	7 – 8 weeks	11.8%	53
5	More than 8 weeks	10.0%	45
98	Don't know	25.3%	114
	Total	100%	451

QID153 - Overall, how satisfied are you with your new energy efficient product(s)?

#	Answer	%	Count
1	Very satisfied	78.6%	357
2	Somewhat satisfied	15.6%	71
3	Neither satisfied nor dissatisfied	2.6%	12
4	Somewhat dissatisfied	1.3%	6
5	Very dissatisfied	1.8%	8
	Total	100%	454

QID155 - How satisfied are you with the Appalachian Power [Field-program_name] Program, overall?

#	Answer	%	Count
1	Very satisfied	67.4%	306
2	Somewhat satisfied	18.9%	86
3	Neither satisfied nor dissatisfied	9.0%	41
4	Somewhat dissatisfied	2.9%	13
5	Very dissatisfied	1.8%	8
	Total	100%	454

QID159 - Do you own the home where the rebated equipment was installed, rent it, or own it and rent it to someone else?

#	Answer	%	Count
1	Own	95.4%	415
2	Rent	3.0%	13
3	Own and rent to someone else	0.7%	3
98	Don't know	0.9%	4
	Total	100%	435

QID160 - Which of the following best describes your home?

#	Answer	%	Count
1	Manufactured home	4.3%	19
2	Single-family house detached from any other house	90.0%	395
3	Single family house attached to one or more other houses, for example, duplex, row house, or townhome	2.7%	12
4	Apartment in a building with 2 to 3 units	0.2%	1
5	Apartment in a building with 4 or more units	0.9%	4
6	Other (Please describe)	0.9%	4
98	Don't know	0.9%	4
	Total	100%	439

QID161 - What fuel does your main heating system use?

#	Answer	%	Count
1	Electricity	63.4%	277
2	Natural Gas	24.3%	106
3	Propane	3.7%	16
4	Something else (Please specify)	8.2%	36
5	Don't know	0.5%	2
	Total	100%	437

QID162 - Appalachian Power may want to use the comments you made in this survey in its marketing materials. If your comments are selected, only your first name and first initial of your last name will be associated with your comment. Do you permit Appalachian Power to reprint comments you made in this survey along with your first name and first initial of your less name?

#	Answer	%	Count
1	Yes	67.5%	241
2	No, Appalachian Power does not have permission to reprint my comment.	32.5%	116
	Total	100%	357

8. Low-Income Single-Family Participant Survey Results

Q2 - We are conducting a study to evaluate the Appalachian Power Weatherization Assistance Program. Appalachian Power will use the results of this evaluation to determine the effectiveness of the program and to make improvements. This is not a sales call, and I am not going to ask you to buy anything. If you are interested, you can view our privacy policy statement at admenergy.com/privacy. May I ask you a few questions?

#	Answer	%	Count
1	Yes	100.00%	82
2	No (Thank respondent and terminate interview)	0.00%	0
	Total	100%	82

Q6 - Our records indicate that you participated in the Weatherization Assistance Program by completing an energy audit and receiving some energy efficiency improvements in your home in [Field-MONTH] of [Field-YEAR]. Do you recall participating in this program?

#	Answer	%	Count
1	Yes	100.00%	81
2	No	0.00%	0
98	Don't know	0.00%	0
99	Refused	0.00%	0
	Total	100%	81

Q7 - How did you learn of the Weatherization Assistance Program sponsored by Appalachian Power and administered by your local Community Action Agency? (Select all that apply)

#	Answer	%	Count
1	An Appalachian Power representative mentioned it	2.47%	2
2	The Appalachian Power website	7.41%	6
3	From a local Community Action Agency or weatherization service provider	12.35%	10
4	Friend, relative, coworker, or neighbor	45.68%	37
5	In some other way	25.93%	21
98	Don't know	7.41%	6
99	Refused	0.00%	0
	Total	100%	81

Q9 - Why did you choose to participate in the program? (Select all that apply)

#	Answer	%	Count
1	To save money on energy bill(s)	60.00%	48
2	To reduce energy use for environmental reasons	5.00%	4
3	The services were provided free of charge	45.00%	36
4	Improve home comfort	62.50%	50
5	Improve value of the home	16.25%	13
6	Other	7.50%	6
98	Don't know	0.00%	0
99	Refused	0.00%	0
	Total	100%	80

Q10 - Please describe by you choose to participate in the program.

Please describe by you choose to participate in the program.

My old heat pump went completely out

I didn't have any heating or cooling

My old heat pump went out

My older heating system got broken

WE needed a new heat pump

My heat pump quit working

Q11 - Now I'll ask some questions about the energy audit that was provided as a part of this program. Did someone visit your household to discuss ways of savings energy and to install energy efficient equipment?

#	Answer	%	Count
1	Yes	60.00%	48
2	No	36.25%	29
98	Don't know	3.75%	3
99	Refused	0.00%	0
	Total	100%	80

Q12 - Did you schedule that appointment?

#	Answer	%	Count
1	Yes	87.50%	42
2	No	10.42%	5
98	Don't know	2.08%	1
99	Refused	0.00%	0
	Total	100%	48

Q13 - On a scale of 1 to 5, where 1 is "very difficult" and 5 is "very easy," how would you rate the process of scheduling of the visit?

#	Answer	%	Count
1	1 (Very difficult)	0.00%	0
2	2	0.00%	0
3	3	4.76%	2
4	4	23.81%	10
5	5 (Very easy)	69.05%	29
98	Don't know	2.38%	1
	Total	100%	42

Q14 - Were you in your household at the time of this visit?

#	Answer	%	Count
1	Yes	100.00%	48
2	No	0.00%	0
98	Don't know	0.00%	0
99	Refused	0.00%	0
	Total	100%	48

Q15 - Did the person who visited your home examine your appliances or building structure for energy efficiency?

#	Answer	%	Count
1	Yes	89.36%	42
2	No	6.38%	3
98	Don't know	4.26%	2
99	Refused	0.00%	0
	Total	100%	47

Q16 - During the visit to your home, did the program representative talk to you about how to save energy in your home, or provide recommendations about how to use your appliances and equipment in an energy efficient way?

#	Answer	%	Count
1	Yes	72.92%	35
2	No	20.83%	10
98	Don't know	6.25%	3
99	Refused	0.00%	0
	Total	100%	48

Q17 - Using a scale where 1 means completely disagree and 5 means completely agree, how much do you agree with the following statements about the work that was done on the home:

#	Question	Completely disagree1		2		3		4		Completely agree5		Don't know		Total
1	The completion of the work was timely and efficient	0.00%	0	4.17%	2	2.08%	1	6.25%	3	87.50%	42	0.00%	0	48
2	The work crew was courteous and professional	0.00%	0	0.00%	0	6.25%	3	4.17%	2	89.58%	43	0.00%	0	48
3	The information provided about your home's energy use was useful	0.00%	0	0.00%	0	4.17%	2	2.08%	1	77.08%	37	16.67%	8	48
4	The information provided about your home's energy use was easy to understand	0.00%	0	0.00%	0	4.17%	2	2.08%	1	77.08%	37	16.67%	8	48

Q18 - Now we would like some information on the efficiency improvements made through the program. According to our records you received the following energy efficiency improvements through the program. Please indicate if the information seems correct.

#	Question	Correct		Incorrect		Don't know		Refused		Total
1	Air sealing to reduce drafts in your home	97.78%	44	2.22%	1	0.00%	0	0.00%	0	45
2	Ceiling, attic, wall, and/or floor insulation	100.00%	35	0.00%	0	0.00%	0	0.00%	0	35
3	Sealing or insulating your heating and cooling system ducts	100.00%	15	0.00%	0	0.00%	0	0.00%	0	15
4	An energy efficient heat pump	98.08%	51	0.00%	0	1.92%	1	0.00%	0	52
5	An energy efficient furnace	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
6	Heating and cooling system tune-up or maintenance	100.00%	2	0.00%	0	0.00%	0	0.00%	0	2
7	Hot water heater pipe wrap	100.00%	28	0.00%	0	0.00%	0	0.00%	0	28
8	Hot water heater tank wrap	100.00%	30	0.00%	0	0.00%	0	0.00%	0	30
9	Reduction in hot water heater temperature	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
10	An energy efficient hot water heater	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
11	An energy efficient refrigerator	100.00%	5	0.00%	0	0.00%	0	0.00%	0	5
12	An energy efficient window air conditioner	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
13	Kitchen or bathroom ventilation fan	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
14	An energy efficient freezer	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
15	Smart thermostat	100.00%	1	0.00%	0	0.00%	0	0.00%	0	1
16	Ceiling fan	100.00%	4	0.00%	0	0.00%	0	0.00%	0	4

17	Ductless heat pump	100.00%	9	0.00%	0	0.00%	0	0.00%	0	9
18	[Field-LED_QUANT] LED light bulbs	100.00%	23	0.00%	0	0.00%	0	0.00%	0	23
19	[Field-CFL_QUANT] CFL light bulbs	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
20	[Field-BATH_AERATOR_QUANT] bathroom faucet aerator(s)	100.00%	9	0.00%	0	0.00%	0	0.00%	0	9
21	[Field-KITCHEN_AERATOR_QUANT] kitchen faucet aerator(s)	88.89%	8	11.11%	1	0.00%	0	0.00%	0	9
22	[Field-UNSPECIFIED_AERATOR_QUANT] faucet aerator(s)	0.00%	0	0.00%	0	0.00%	0	0.00%	0	undefined
23	[Field-SHOWER_QUANT] low-flow showerhead(s)	100.00%	6	0.00%	0	0.00%	0	0.00%	0	6
24	Advanced power strip	100.00%	2	0.00%	0	0.00%	0	0.00%	0	2

Q38 - Overall, how satisfied are you with the efficiency improvements to your home? Would you say you are…

#	Answer	%	Count
1	Very dissatisfied	0.00%	0
2	Somewhat dissatisfied	1.27%	1
3	Neither satisfied nor dissatisfied	3.80%	3
4	Somewhat satisfied	12.66%	10
5	Very satisfied	79.75%	63
98	Don't know	2.53%	2
	Total	100%	79

Q40 - How satisfied are you with the Appalachian Power Weatherization Program, overall? Would you say you are…

#	Answer	%	Count
1	Very dissatisfied	0.00%	0
2	Somewhat dissatisfied	0.00%	0
3	Neither satisfied nor dissatisfied	2.53%	2
4	Somewhat satisfied	3.80%	3
5	Very satisfied	91.14%	72
98	Don't know	2.53%	2
	Total	100%	79

Q44 - Do you own the home where the project was completed, rent it, or own it and rent it to someone else?

#	Answer	%	Count
1	Own	78.48%	62
2	Rent	20.25%	16
3	Own and rent to someone else	0.00%	0
98	Don't know	1.27%	1
	Total	100%	79

Q45 - Which of the following best describes your home?

#	Answer	%	Count
1	Manufactured home	30.38%	24
2	Single-family house detached from any other house	56.96%	45
3	Single family house attached to one or more other houses, for example, duplex, row house, or townhome	6.33%	5
4	Apartment in a building with 2 to 3 units	0.00%	0
5	Apartment in a building with 4 or more units	0.00%	0
6	Other	6.33%	5
98	Don't know	0.00%	0
	Total	100%	79

Q46 - What fuel does your main water heater use?

#	Answer	%	Count
1	Electricity	98.73%	78
2	Natural Gas	0.00%	0
3	Propane	0.00%	0
4	Something else	0.00%	0
98	Don't know	1.27%	1
	Total	100%	79

Q48 - What fuel does your main heating system use?

#	Answer	%	Count
1	Electricity	97.47%	77
2	Natural Gas	1.27%	1
3	Propane	0.00%	0
4	Something else	1.27%	1
98	Don’t know	0.00%	0
	Total	100%	79

9. Low-Income Multifamily Tenant Survey Results

Q1 - This survey is about your experience with the energy efficiency improvements made to your living unit through Appalachian Power Multifamily Program. Our records indicate that the following energy saving improvements were made to your residence through Appalachian Power Multifamily Program. Can you confirm that the following improvements were made?

#	Question	Yes, this improvement was made		No, this improvement was not made		Don't know		Total
1	Installed LED light bulb(s)	75.0%	6	0.0%	0	25.0%	2	8
2	Installed hot water heater pipe wrap	75.0%	6	12.5%	1	12.5%	1	8
3	Installed a water heater blanket / tank wrap	66.7%	6	11.1%	1	22.2%	2	9
4	Lowered the temperature on the water heater	0.0%	0	0.0%	0	0.0%	0	undefined
5	Installed faucet aerator(s)	63.6%	7	0.0%	0	36.4%	4	11
6	Installed low flow showerhead(s)	100.0%	4	0.0%	0	0.0%	0	4
7	Installed a heat pump water heater	0.0%	0	0.0%	0	0.0%	0	undefined
8	Installed an air source heat pump	68.8%	11	6.3%	1	25.0%	4	16
9	Installed a mini split heat pump	0.0%	0	0.0%	0	0.0%	0	undefined
10	Added insulation	100.0%	3	0.0%	0	0.0%	0	3
11	Sealed air leaks	66.7%	4	0.0%	0	33.3%	2	6
12	Sealed your heating and cooling ducts	100.0%	1	0.0%	0	0.0%	0	1
13	Insulated your heating and cooling ducts	0.0%	0	0.0%	0	0.0%	0	undefined

14	Completed a tune up of your heat pump or air conditioner	0.0%	0	0.0%	0	0.0%	0	undefined
15	Installed a smart thermostat	100.0%	8	0.0%	0	0.0%	0	8
16	Installed a window air conditioner(s)	0.0%	0	0.0%	0	0.0%	0	undefined
17	Installed a refrigerator	0.0%	0	0.0%	0	0.0%	0	undefined
18	Installed a ceiling fan	0.0%	0	0.0%	0	0.0%	0	undefined
19	Installed power strip(s)	100.0%	1	0.0%	0	0.0%	0	1

Q2 - We would also like to know if you have removed and are no longer using any of the equipment that was installed through Appalachian Power Multifamily Program. For each of the following, please indicate if you have removed and are no longer using that equipment. Also, please write the number of items removed, if applicable.

#	Question	No, have not removed equipment		Yes, removed equipment		Total
1	LED light bulb(s)	100.0%	4	0.0%	0	4
2	Faucet aerator(s)	83.3%	5	16.7%	1	6
3	Showerhead(s)	100.0%	3	0.0%	0	3
4	Advanced power strip(s)	0.0%	0	100.0%	1	1

Q7 - Were you home when the energy efficiency improvements were completed?

#	Answer	%	Count
1	Yes	70.0%	14
2	No	30.0%	6
	Total	100%	20

Q8 - Did a program representative speak with you about tips on how to save energy?

#	Answer	%	Count
1	Yes	35.0%	7
2	No	65.0%	13
	Total	100%	20

Q9 - Did you receive any printed material from the program with tips on how to save energy?

#	Answer	%	Count
1	Yes	40.0%	8
2	No	60.0%	12
	Total	100%	20

Q10 - Using the scale below, how satisfied or dissatisfied are you with the following...

#	Question	Very satisfied		Somewhat satisfied		Neither satisfied nor dissatisfied		Somewhat dissatisfied		Very dissatisfied		Don't know/Not applicable		Total
1	The energy efficiency improvements made to your living unit?	35.0%	7	25.0%	5	20.0%	4	5.0%	1	10.0%	2	5.0%	1	20
2	The interactions you had with the people who completed the energy efficiency improvements in your living unit?	61.5%	8	7.7%	1	23.1%	3	7.7%	1	0.0%	0	0.0%	0	13
3	The information about the improvements made to your living unit or tips on how to save energy?	77.8%	7	11.1%	1	0.0%	0	11.1%	1	0.0%	0	0.0%	0	9
4	The savings on your monthly utility bills?	20.0%	4	20.0%	4	20.0%	4	5.0%	1	35.0%	7	0.0%	0	20
5	Your overall experience?	26.3%	5	26.3%	5	10.5%	2	15.8%	3	15.8%	3	5.3%	1	19

Q12 - Have you seen any benefits from the energy efficiency improvements made to your living unit? Please select up to three.

#	Answer	%	Count
1	My living unit feels more comfortable	26.3%	5
2	Reduced my electricity costs	5.3%	1
3	There is less noise from the outside	10.5%	2
4	There is less noise from the appliances	10.5%	2
5	I or my family have experienced health improvements	0.0%	0
6	The living unit is safer	10.5%	2
7	The appliances and heating or cooling equipment are more reliable	26.3%	5
8	Other (Please describe)	0.0%	0
9	No, I have not seen any benefits	52.6%	10
	Total	100%	19

Q13 - Using the scale below, please rate how important saving energy in your living unit is to you?

#	Answer	%	Count
1	Not at all important	5.3%	1
2	Slightly important	0.0%	0
3	Moderately important	15.8%	3
4	Very important	26.3%	5
5	Extremely important	52.6%	10
	Total	100%	19

10. Confidential: EM&V Costs

Information relating to PY2023 EM&V costs is presented in Table 10-1.

Table 10-1 PY2023 EM&V Costs

Program	*EM&V Cost*
Home Performance Program	[redacted]
Efficient Products Program	[redacted]
Energy Efficient Kits Program	[redacted]
Home Energy Reports Program	[redacted]
Bring Your Own Thermostat Program	[redacted]
Low-Income Single-Family Program	[redacted]
Low-Income Multifamily Program	[redacted]
Residential Portfolio Total	[redacted]