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Fayetteville, AR 72703

May 1, 2024

Ms. Karen Shook
Secretary of the Commission
Arkansas Public Service Commission
1000 Center Street
Little Rock, AR 7223

Re: ASPC Docket No. 07-078-TF
*IN THE MATTER OF THE APPLICATION FOR APPROVAL OF ARKANSAS
WESTERN GAS COMPANY'S INITIAL ENERGY EFFICIENCY PROGRAM
PLAN*

Dear Ms. Shook:

Enclosed for filing in the above-referenced docket is Black Hills Energy Arkansas, Inc.'s Energy Efficiency Program Portfolio Annual Report for the program year 2023. The report is comprised of both a narrative report and an electronic spreadsheet.

Please contact me at Jeff.Dangeau@blackhillscorp.com or at (479) 601-8174 if you have any questions.

Respectfully,

Jeff Dangeau
Associate General Counsel
Black Hills Energy Arkansas, Inc.

Comprehensive Energy Efficiency Plan Annual Report



May 1, 2024

Table of Contents

1.0 EXECUTIVE SUMMARY	4
1.1 Historical Summary of the Comprehensive Energy Efficiency Plan.....	4
1.2 Program Year 2023 Results	6
1.2.1 Major Accomplishments	6
1.2.2 Goals and Objectives for EE Portfolio:.....	7
1.2.3 Progress Achieved vs. Target and Objectives:	8
1.2.4 High Level Recap of Portfolio Savings, Participation Levels, and Prior Year Comparisons	8
1.2.5 Highlights of Well-Performing Programs:	10
1.2.6 What’s Working and What’s Not	11
1.2.7 Planned Changes to Programs or Budgets.....	11
1.2.8 Estimation of EE Resource Potential	11
1.2.9 Training	12
1.2.10 Conclusion	12
2.0 PORTFOLIO PROGRAMS	13
2.1 Residential Solution Program - Equipment Rebate Pathway.....	13
2.1.1 Program Description	13
2.1.2 Pathway Highlights	13
2.1.3 Description of Participants.....	14
2.1.4 Challenges & Opportunities	14
2.1.5 Planned or Proposed Changes to Program & Budget	14
2.1.6 BHEA’s Response to Evaluators’ Recommendations.....	14
2.2 Residential Solution Program - Home Energy Savings Pathway.....	16
2.2.1 Program Description	16
2.2.2 Pathway Highlights	16
2.2.3 Description of Participants.....	18
2.2.4 Challenges & Opportunities	18
2.2.5 Planned or Proposed Changes to Program & Budget	18
2.2.6 BHEA’s Response to Evaluators’ Recommendations.....	18
2.3 Residential Solution Program Conclusion	19

- 2.3.1 Pathway Highlights 19
- 2.3.2 Residential Solution Budget, Savings, and Participants 19
- 2.4 Commercial & Industrial Solutions Program.....20
 - 2.4.1 Program Description 20
 - 2.4.2 Program Highlights 20
 - 2.4.3 Program Budget, Savings, and Participants 23
 - 2.4.4 Description of Participants 24
 - 2.4.5 Challenges & Opportunities 24
 - 2.4.6 Planned or Proposed Changes to Program & Budget 24
 - 2.4.7 BHEA’s Response to Evaluators’ Recommendations..... 24
- 2.5 Low Income Pilot Program24
 - 2.5.1 Program Description 24
 - 2.5.2 Program Highlights 25
 - 2.5.3 Program Budget, Savings, and Participants 26
 - 2.5.4 Description of Participants 26
 - 2.5.5 Challenges & Opportunities 26
 - 2.5.6 Planned or Proposed Changes to Program & Budget 26
 - 2.5.7 BHEA’s Response to Evaluator’s Recommendations..... 26
- 2.6 Energy Efficiency Arkansas28
 - 2.6.1 Program Description 28
 - 2.6.2 Program Highlights 28
 - 2.6.3 Program Budget, Savings, and Participants 28
 - 2.6.4 Description of Participants 28
 - 2.6.5 Challenges & Opportunities 29
 - 2.6.6 Planned or Proposed Changes to Program & Budget 29
- 3.0 SUPPLEMENTAL REQUIREMENTS30
 - 3.1 Staffing30
 - 3.2 Stakeholder Activities30
 - 3.3 Information Provided to Consumers to Promote EE.....33

1.0 EXECUTIVE SUMMARY

1.1 Historical Summary of the Comprehensive Energy Efficiency Plan

This annual report is provided to the Arkansas Public Service Commission (“APSC” or the “Commission”) as a review of Black Hills Energy Arkansas, Inc.’s (f/k/a SourceGas Arkansas, Inc., f/k/a Arkansas Western Gas Company), (“BHEA” or the “Company”) Comprehensive Energy Efficiency Plan (“CEEP”) for Program Year (“PY”)2023 and plan results pursuant to Section 9 of the “Rules for Conservation and Energy Efficiency Programs (“C&EE Rules”). These rules require that each operating utility within the jurisdiction of the Commission file an Annual Report by May 1st of each year. The report should address “the performance of each conservation and energy efficiency program operated by the utility.”¹

In July of 2021, Black Hills Energy Arkansas filed its 2023 Bridge Year Energy Efficiency Plan (“EE Plan”) in response to Commission Order No. 25 in Docket No. 13-002-U. The Arkansas Public Service Commission (“APSC”) approved the 2023 programs, which builds upon BHEA’s Quick Start Energy Efficiency programs that were implemented from late 2007 through early 2011 and the Comprehensive Programs that have been implemented in Arkansas since mid-2011. The EE Plan was filed in compliance with Order No. 43 of Docket No. 13-002-U, which required investor-owned natural gas utilities in Arkansas to capture energy savings equivalent to 0.5% of their 2018 energy sales reduced by those customers choosing to self-direct their energy efficiency efforts.

This report covers activities for the BHEA CEEP that commenced on January 1, 2023 through December 31, 2023. The BHEA CEEP consists of three separate programs with individual pathways for each.

- **Residential Solutions Program (“RSP”) Section 2.1-2.3**
 - **Equipment Rebate Pathway:** The Equipment Rebate Pathway offers residential customers rebates for purchasing energy efficient furnaces, tankless water heaters, and smart thermostats. The Equipment Rebates Pathway is designed to help provide customers assistance in identifying potential measures that are eligible for rebate and installation in qualifying residential homes.
 - **Home Energy Solutions Pathway (“HES Pathway”):** The HES Pathway offers residential customers no cost assessments and energy efficient improvements. The Consistent Weatherization Approach (“CWA”) is delivered through this program. The HES Pathway is designed to help customers achieve savings by consulting with a qualified contractor who will analyze their energy use, identify, and install core energy efficiency improvements at no cost to the customer.

¹ Section 9, Page 11 of the APSC Rules for Conservation and Energy Efficiency

- **Commercial & Industrial Solutions Program (“CISP”): Section 2.4**
 - **Custom:** CISP offers technical assistance to support Commercial and Industrial customers in identifying and implementing energy savings opportunities. In its custom program offering, the CISP offers on-site technical assistance, trade ally incentives for steam system surveys, and incentives based on verified performance of custom measures that are outside of the scope of the TRM V9.1.
 - **Prescriptive:** CISP offers prescriptive incentives for measures that have deemed savings established in the TRM, including commercial furnaces, water heaters, boilers, boiler controls, food service equipment, boiler burners, and steam traps.
 - **Direct Install:** The direct install component provides installation of high-saving, low-cost measures at no cost to the participant. Direct Install measures include low flow showerheads, faucet aerators, pre-rinse spray valves, and weather stripping for exterior doors.
 - **Strategic Energy Management (SEM):** Strategic Energy Management (SEM) is a long-term approach to energy efficiency that includes setting goals, tracking progress, and reporting results.
- **Low Income Pilot Program (“LIPP”): Section 2.5**
 - **LIPP** offers qualifying residential customers no cost assessments and energy efficient improvements along with health and safety measures. The low income carveout for the CWA is delivered through this program.

Overall, this Annual Report demonstrates the following successes, and challenges across the portfolio:

- **Portfolio**
 - The Energy Savings of 1,543,028 therms represents 102.2% of the Commission goal.
- **Residential Solutions Program**

The program met 106.9% of its filed net savings goal. The overall realization rate was 101.4%. Realization rates were high across most measure groups in ERP and HES.

- The aggregation of the Equipment Rebates and Home Energy Savings Programs has not affected service levels.

- **Commercial & Industrial Solutions Program**

- As seen in recent program years, custom projects account for a large majority share of savings in 2023.
- Program Effective Useful Life (“EUL”) has decreased due to the one-year EUL for SEM, but this is an anticipated side-effect of encouraging this measure, in PY2023.
- Food service participation has seen a slight increase over PY2021 Commercial boiler participation has seen an increase from PY2022 to PY2023.
- Water savings increased from 16,312,350 gallons to 41,015,414 gallons. This is a volatile value year-over-year as it is heavily driven by the relative prevalence of custom projects that save water. The three highest water-saving projects accounted for 85% of total PY2023 water savings. Participation increased significantly in the Prescriptive Pathway, increasing from 36,398 to 48,397.

- **Low Income Pilot Program**

- The program met savings goals and was highly cost effective and met 123%% of its net savings goal.
- Program offerings for the LIPP are an enhanced service level compared to the HES Pathway.
- The program provided very detailed Health & Safety tracking.

1.2 Program Year 2023 Results

1.2.1 Major Accomplishments

For the twelfth consecutive year, the Company achieved greater than 100% of its net savings goal as established by the APSC, realizing 1,543,028 net therms for PY 2023. The Company’s 2023 filed savings goal was 1,510,377 net therms and was designed to provide savings great enough to meet or exceed the APSC-established net target for the Company of 1,046,965. This net goal was derived by calculating 0.50% of BHEA’s 2018 retail sales (249,382,063 therms), as adjusted for the 2021 sales of Self-Direct customers (39,989,020 therms). In the end, BHEA’s total evaluated net energy savings for 2023 was 126% of the Company’s net Commission-established goal. In addition, BHEA’s portfolio was cost-effective, with a Total Resource Cost Benefit Ratio (“TRC”) of 1.76.

2023 Portfolio Summary										
Net Energy Savings		Costs			Cost-Effectiveness			Goal Achievement		
Demand Therms	Energy Therms	Actual Expenditures	LCFC	Performance Incentives	TRC Net Benefits (NPV)	TRC Ratio	PAC Ratio	Commission Established Target % of Baseline	Actual Savings Achieved % of Baseline	% of Target Achieved (%)
n/a	1,543,029	\$ 4,449,464	\$ 140,014	\$ 335,220	\$ 3,765,919	1.78	1.46	0.50%	0.63%	126%

Figure 1 – 2023 EE Portfolio Summary

1.2.2 Goals and Objectives for EE Portfolio:

BHEA’s primary goals and objectives are to provide energy savings opportunities to its customers of all rate classes and market segments. BHEA strives to meet and exceed its energy savings goal established by the APSC.

The Company has worked to achieve the following objectives in PY 2023:

Commercial & Industrial Solution Program:

- Continue evaluating, and, when possible, adding new measures for customers
- Continue to offer Direct Installation (“DI”) of measures as a gateway to further participation in BHEA’s CISP
- Continue to strive to facilitate inter-fuel coordination of projects with Southwest Electric Power Company (“SWEPCO”), Entergy Arkansas, LLC. (“Entergy”), Oklahoma Gas and Electric Company (“OG&E”), and Liberty Utilities Empire District (“Empire”) (“participating electric utilities”)
- Continue to incorporate SEM into its measure mix.
- Continue to provide energy audit services to small and large customers.

Residential Programs:

- Facilitate meetings to keep trade allies updated on changes to residential programs.
- Continue to incorporate the United States Department of Energy’s Home Performance with ENERGY STAR Program (“HPwES”) into BHEA’s HES Pathway
- Continue the successful inter-fuel promotion of HES Pathway and programs offered by SWEPCO and Entergy

The Company also worked to present all marketing materials on the website www.EnergyReady-Arkansas.com . Examples are provided in Appendix B.

BHEA’s portfolio of programs continues to seek adherence to the energy efficiency objectives listed in Section 2 of the Commission’s C&EE Rules by:

- Reducing end-use natural gas consumption in a cost-effective manner to save money for consumers and conserve non-renewable resources.

- Protecting the environment by encouraging installation of energy efficiency measures that help reduce carbon dioxide emissions and air pollutants.
- Increasing residential and commercial customer awareness of available energy efficiency opportunities, including equipment upgrades and behavioral changes.
- Generating customer awareness of energy efficiency programs through Black Hills Energy's Arkansas website at www.Energyready-Arkansas.com
- Identifying cost-effective natural gas savings measures.
- Improving relationships with customers, trade allies, and stakeholders by providing value-added energy efficiency services, training and education, hardware, verification, and support; and
- Supporting a more robust local and statewide economy by using local labor (when possible) and helping Arkansas residents reduce their monthly energy expenses.

1.2.3 Progress Achieved vs. Target and Objectives:

The APSC savings target for a gas utility in 2023 was the realization of a 0.50% reduction from the utility's 2018 baseline throughout (249,382,063 therms), excluding volumes used by Self Direct customers (39,989,020 therms). This represented a savings target for BHEA of 1,046,965.22 net therms. The Company achieved 126% of this target, and therefore qualifies for an incentive of \$335,220 according to APSC Docket 13-002-U, Order No. 7.

1.2.4 High Level Recap of Portfolio Savings, Participation Levels, and Prior Year Comparisons

The chart below details the trends of BHEA's budgets, expenses, and energy savings beginning with PY 2016 and continuing through PY 2023.

Company Statistics										
Program Year	Revenue and Expenditures					Energy				
	Total Revenue (a) (\$000's)	Budget		Actual		Total Annual Energy Sales (d) (Therms)	Plan		Evaluated	
		Portfolio Budget (b) (\$000's)	% of Revenue (% = b/a)	Portfolio Spending (c) (\$000's)	% of Revenue (% = c/a)		Net Annual Savings (e) (Therms)	% of Energy Sales (% = e/d)	Net Annual Savings (f) (Therms)	% of Energy Sales (% = f/d)
2020	\$ 184,330	\$ 4,089	2.2%	\$ 3,651	2.0%	254,846,425	1,330,541	0.52%	1,414,973	0.56%
2021	\$ 217,934	\$ 4,205	1.9%	\$ 4,156	1.9%	303,339,040	1,330,541	0.44%	1,507,349	0.50%
2022	\$ 310,466	\$ 4,524	1.5%	\$ 4,510	1.5%	317,361,270	1,330,541	0.42%	1,510,377	0.48%
2023	\$ 267,938	\$ 4,399	1.6%	\$ 4,449	1.7%	295,781,710	1,510,377	0.51%	1,543,029	0.52%

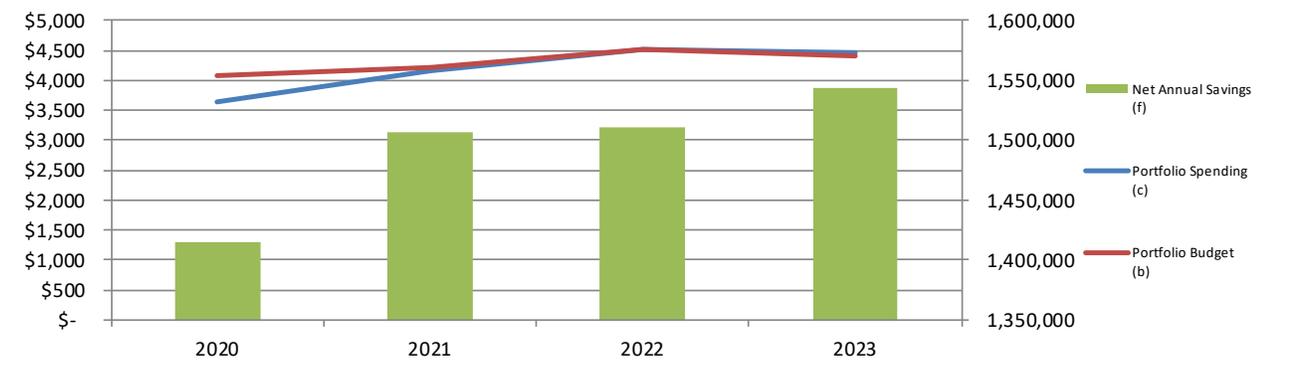


Figure 2 – Company Statistics for Program Years 2020 - 2023

BHEA spent 107.6% of its budget in 2023, as Figure 3 shows below. Most of the dollars the Company spent went to Customer Incentives and Marketing and Delivery.

EE Portfolio Expenditures by Program					
Program Name	Target Sector	Program Type	2023		% of Budget
			Budget (\$)	Actual (\$)	
Low Income Pilot Program	Residential	Market Specific/Hard to Reach	87,959	86,236	98%
Residential Solution Program	Residential	Other	2,699,719	2,688,538	100%
Commercial & Industrial Solutions Program	Commercial & Industrial	Custom	1,552,279	1,674,089	108%
Energy Efficiency Arkansas	All Classes	Behavior/Education	56,317	600	1%
Regulatory	-	-	3,000	-	0%
Total			4,399,274	4,449,464	101%

Figure 3 – BHEA's 2023 EE Portfolio Costs by Program

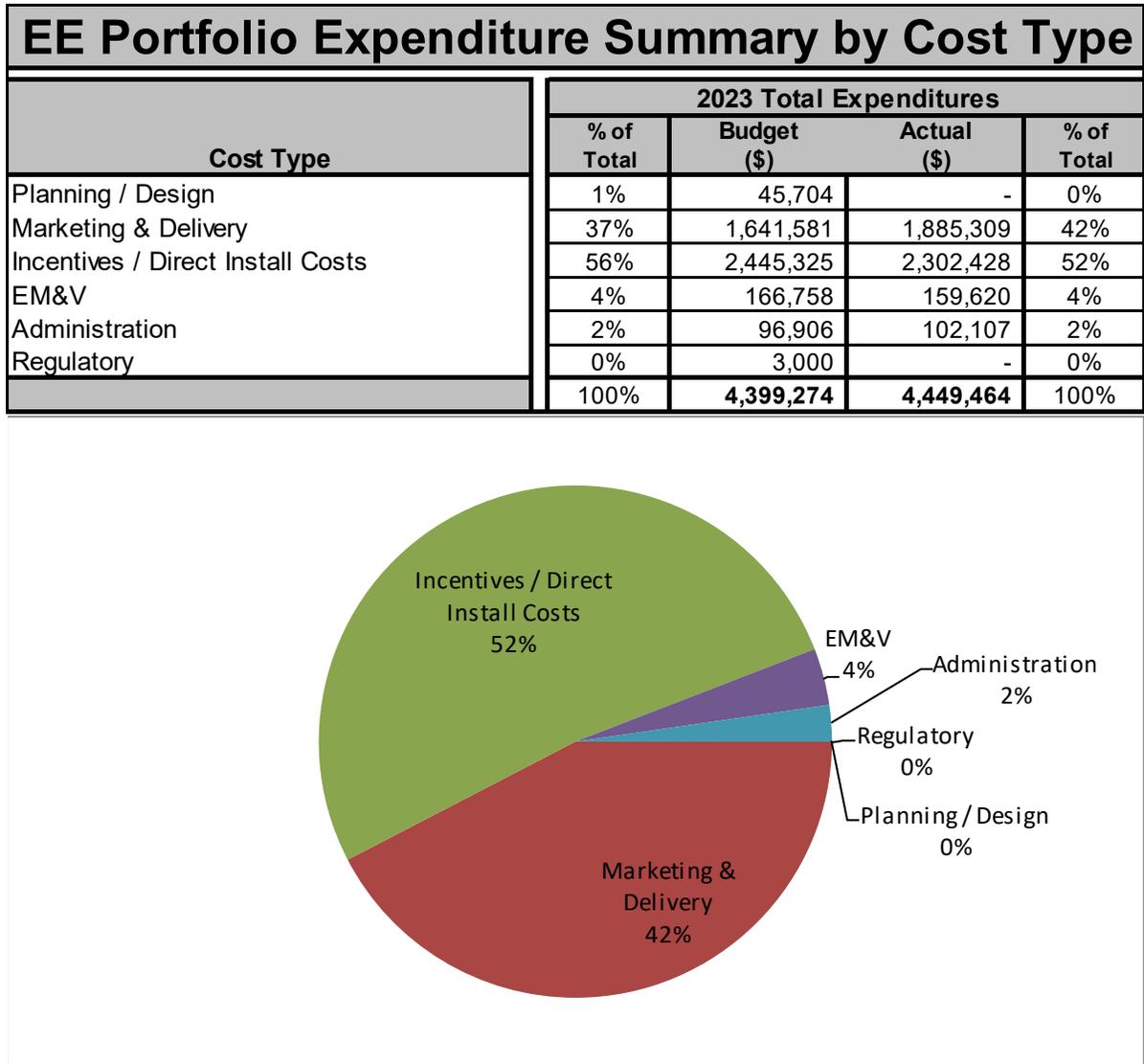


Figure 4 – BHEA’s 2023 EE Portfolio Summary by Cost Type

1.2.5 Highlights of Well-Performing Programs:

BHEA was encouraged by the performance of its CEEP as a whole. All three programs exceeded their filed goals.

Commercial & Industrial Solutions Program

BHEA had 56 C&I customers participate by installing Energy Conservation Measures (“ECM”) in 2023 through the custom and prescriptive rebates in the CISP. This represented total net savings of 762,203 therms. Energy efficient aerators, pre-rinse spray valves, showerheads, and weather stripping were installed for commercial applications at no charge to customers. Net savings for these direct install measures was 111.614 therms and involved

15 customers installing 54 measures. Ultimately, this program provided savings of 723,540 net therms or 114.8% of the goal.

Equipment Rebate Pathway

The BHEA Equipment Rebate Pathway provided rebates for 522 high efficiency furnaces and 136 tankless water heaters during 2023. In addition, 421 Smart Thermostats were rebated. BHEA experienced net savings from this pathway of 97,697 therms. Beginning in 2020, commercial prescriptive rebates for furnaces and tankless water heaters were moved into the CISP.

Home Energy Savings Pathway

This program was awarded a Home Performance with Energy Star award as a Partner of the Year for Energy Efficiency Program Delivery for the fifth year in a row in 2022, however this program was temporarily discontinued in 2023 but is again active in 2024. BHEA engaged five contractors that performed 1,200 assessments across its service territory. 4,201 measures were paid to contractors for work done in customers' homes. A total net savings of 644,354 therms was achieved for HESP.

1.2.6 What's Working and What's Not

BHEA's Equipment Rebate Pathway results were lower this year than in the previous year. Incentive funds for tankless water heaters remained available through December of 2023. Furnace and smart thermostat rebates were available through the end of 2023 as well. The HES Pathway reached its internal goal and incentive budget at the end of October. The HES Pathway customer experience with this program has been very positive. 82.1% of respondents have recommended the program to other people. 77.8% of respondents indicated that participating in the program increased their satisfaction with BHE as their energy provider.

C&I Solutions continues to be a strong program; however, the Company is beginning to see a reduction in the number of large savings projects that typically come from manufacturing facilities. BHEA believes this reduction is due to participating customers completing the major projects that have been recommended as well as additional customers choosing to self-direct their EE efforts.

1.2.7 Planned Changes to Programs or Budgets

No Changes are planned, however, BHEA may choose to use the budget flexibility approved by the Commission.

1.2.8 Estimation of EE Resource Potential

In 2015, the Arkansas Parties Working Collaboratively ("PWC") completed and filed the results of the potential study that had been commissioned in 2015 and was performed by

Navigant Consulting Group. The findings were approved by Order No. 31 in Docket 13-002-U.

1.2.9 Training

In 2023, BHEA and its implementation staff provided training to customers, trade allies, and employees of the Company, as well as continued training for the program administrator. Details of training achievements for 2023 are reported in the training sections of the Standardized Annual Report Packet (“SARP”) Workbook.

- Members of the implementation staff participated in training opportunities by attending training provided by the Association of Energy Services Professionals (“AESP”), Arkansas Chapter of The Association of Energy Engineers (“AAEE”), as well as Arkansas Manufacturing Solutions (“AMS”).
- The BHEA program administrator attended trainings to increase knowledge in marketing energy efficiency, how to incorporate new technology, and in evaluation methods. These conferences and webinars included ones held by AESP, AAEE, and the Home Performance Institute.

1.2.10 Conclusion

BHEA's success in 2023 can be attributed to being creative and adaptable during the Covid-19 pandemic. The company worked with its implementer to provide its customers and trade allies with the safest interactions possible as provided by the CDC (“Centers for Disease Control”) and the Arkansas Public Health System guidance. The Company spent 107.6% of its allotted Budget Dollars and achieved 144% of its APSC established target for the 2023 Program Year. BHEA’s portfolio performance qualified the Company to receive an EE incentive for the 2023 Program Year.

BHEA CEEP saw a portfolio TRC of 2.17 for 2023

2.0 Portfolio Programs

2.1 Residential Solution Program - Equipment Rebate Pathway

2.1.1 Program Description

BHEA's Equipment Rebate Pathway promotes high efficiency natural gas comfort heating equipment, tankless water heating equipment and Energy Star® qualified Smart Thermostats in new and existing homes. This program is available to all residential customers. Residential new construction installations are eligible. Customers must use natural gas as their primary heating fuel to receive a furnace rebate. Potential customers who have made a commitment to take natural gas service from BHEA as the primary heating fuel are also eligible for furnace rebates.

BHEA provides a financial incentive in the form of prescriptive rebates to customers who purchase and install qualifying comfort heating and water heating measures. After purchasing and installing new equipment, customers may fill out rebate forms with detailed information about the purchase and installation and mail them in, or the rebate forms may be completed online at www.energyready-arkansas.com. Customers may expect their rebate checks in four to eight weeks. Trade allies are given a \$50 rebate (except for Smart Thermostats) for each installation to help them recover costs incurred when helping customers fill out the rebate forms.

2.1.2 Pathway Highlights

- Furnace rebates were available to customers thru December 31, 2023.
- Water heater rebates were available to customers thru December 31, 2023.
- BHEA will continue to have face-to-face meetings with builders to increase new construction participation.
- A total of 1,079 rebates were paid through ERP in 2023.
 - 522 Residential furnaces were rebated.
 - 136 Residential water heaters were rebated.
 - 421 Residential Smart thermostats were rebated.
 - Net therm savings of 97,697 therms were achieved.

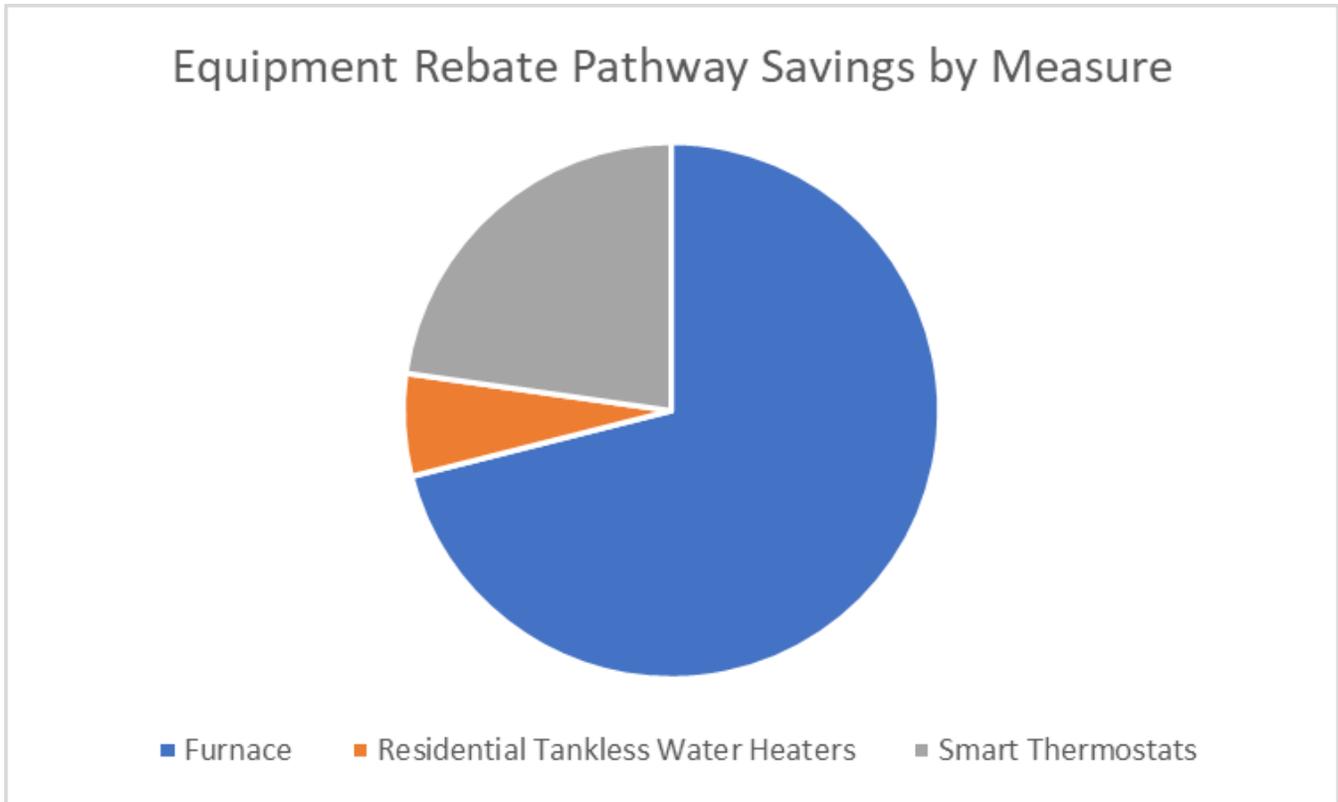


Figure 5 – 2023 Equipment Rebate Pathway Measure Mix

2.1.3 Description of Participants

- Each piece of equipment being rebated is defined as a participant.

2.1.4 Challenges & Opportunities

- Tankless rebates were available through December of 2023. The number of participating contractors who had not previously participated in the program has increased through efforts to directly contact trade allies and provide them with information about BHEA program offerings.

2.1.5 Planned or Proposed Changes to Program & Budget

- No Changes are planned, however, BHEA may choose to use the budget flexibility approved by the Commission.

2.1.6 BHEA's Response to Evaluators' Recommendations

- **Address project application timelines. Program staff should endeavor to return application processing times to PY2020 benchmarks.**

-
- BHEA will endeavor to comply with the recommendation.
 - Accepted and worked on
 - **Track purchase price for smart thermostats., RSP staff track costs for furnaces and water heaters but not smart thermostats. Doing so will allow for better cost-effectiveness tracking for new brands and models.**
 - BHEA will start tracking costs for smart thermostats.
 - Implementing and in progress

2.2 Residential Solution Program - Home Energy Savings Pathway

2.2.1 Program Description

BHEA’s HES Pathway began to offer comprehensive residential energy efficiency audits on a limited basis in November of 2013. This program was added to the Company’s portfolio in order to offer qualifying BHEA residential customers an EE program that will provide them with lasting energy savings benefits and increased home comfort. Building on the solid base established in prior years, this program was again successful in 2023.

HES Pathway is designed to fulfill the requirements established by the APSC in Docket 13-002-U, Order Nos. 22 and 23. These orders instructed the Investor-Owned Utilities (“IOUs”) – BHEA, SWEPCO, Entergy, CenterPoint, AOG, OG&E, and Empire – to design and implement a Consistent Weatherization Approach beginning in 2016. The goal of the Commission was to provide consistent weatherization programs to all residential customers in the state of Arkansas served by the IOUs.

Through this program, BHEA residential customers are connected with trained service providers (trade allies) that perform a comprehensive home energy assessment and install EE weatherization measures designed to save energy, improve indoor comfort, air quality, and safety in existing residences. The assessment and multiple building envelop measures are provided to customers at no charge. BHEA trade allies are currently providing duct sealing, air infiltration measures, ceiling insulation, combustion safety checks, and with customer approval, installation of energy efficient aerators and showerheads. After customers’ homes are weatherized, trade allies leave behind a branded folder containing information about other programs offered by BHEA, and SWEPCO when appropriate, along with a dual branded version of the U.S. Housing and Urban Development’s Safe and Healthy Home booklet. The packet is given to the customer at the completion of each job along with a report on what was accomplished by the weatherization.

The Company continued its association with the Home Performance with Energy Star® Program in 2023. HPwES is a program backed by the Department of Energy and Environmental Protection Agency that promotes a “whole-house” approach to each home being assessed that begins with a comprehensive home energy assessment. BHEA received an ENERGY STAR® Partner of the Year award in 2023 for the fifth consecutive year. SWEPCO has been an HPwES partner for some time and has, in fact, received the ENERGY STAR Partner of the Year for the ninth consecutive year in 2022 Note: the HPwES program was discontinued in 2023 but is again active in 2024.

2.2.2 Pathway Highlights

- In PY 2023 the HES Pathway achieved 106.9% of its filed savings goal with a net savings of 654,847 therms.

- The conversion rate for customers receiving an assessment that then results in weatherization being performed is 89.7%.
- Trade allies working within this program must meet minimum certification requirements (Building Performance Institute (“BPI”) or Residential Energy Service Network (“RESNET”)) as well as undergo BHEA specific program training.
- In conjunction with SWEPCO, BPI training opportunities for trade allies were provided.
- Trade allies are also required to complete online training provided by BHEA’s implementor.
- To reduce customer inconvenience, quality assurance and quality control visits were coordinated with other utilities whenever possible. During 2023, many of the quality control visits were conducted virtually with the contractor onsite.
- BHEA’s contractors provide weatherization services for the rebates.
- The Company continues to use an allotment system to increase trade ally consistency and performance along with prolonging program availability.
- In homes where the electric provider is not an IOU, BHEA pays the full cost of the audit as well as the installation of energy saving measures.
- 2023 results were as follows:
 - The HES Pathway had 1,602 participants in 2023PY2023.
 - 1,200 energy assessments were performed.
 - 604 were BHEA only homes.
 - 596 were joint homes with a participating electric utility.
 - 369 homes were install-only homes (duct sealing, air sealing, ceiling insulation but no assessment.)
 - 69% of heating systems had duct sealing done. (Some homes being weatherized had multiple heating systems)
 - 73% of homes had air infiltration measures completed.
 - 37% of homes received insulation.
 - 1% had showerheads installed.
 - 2% had aerators installed.

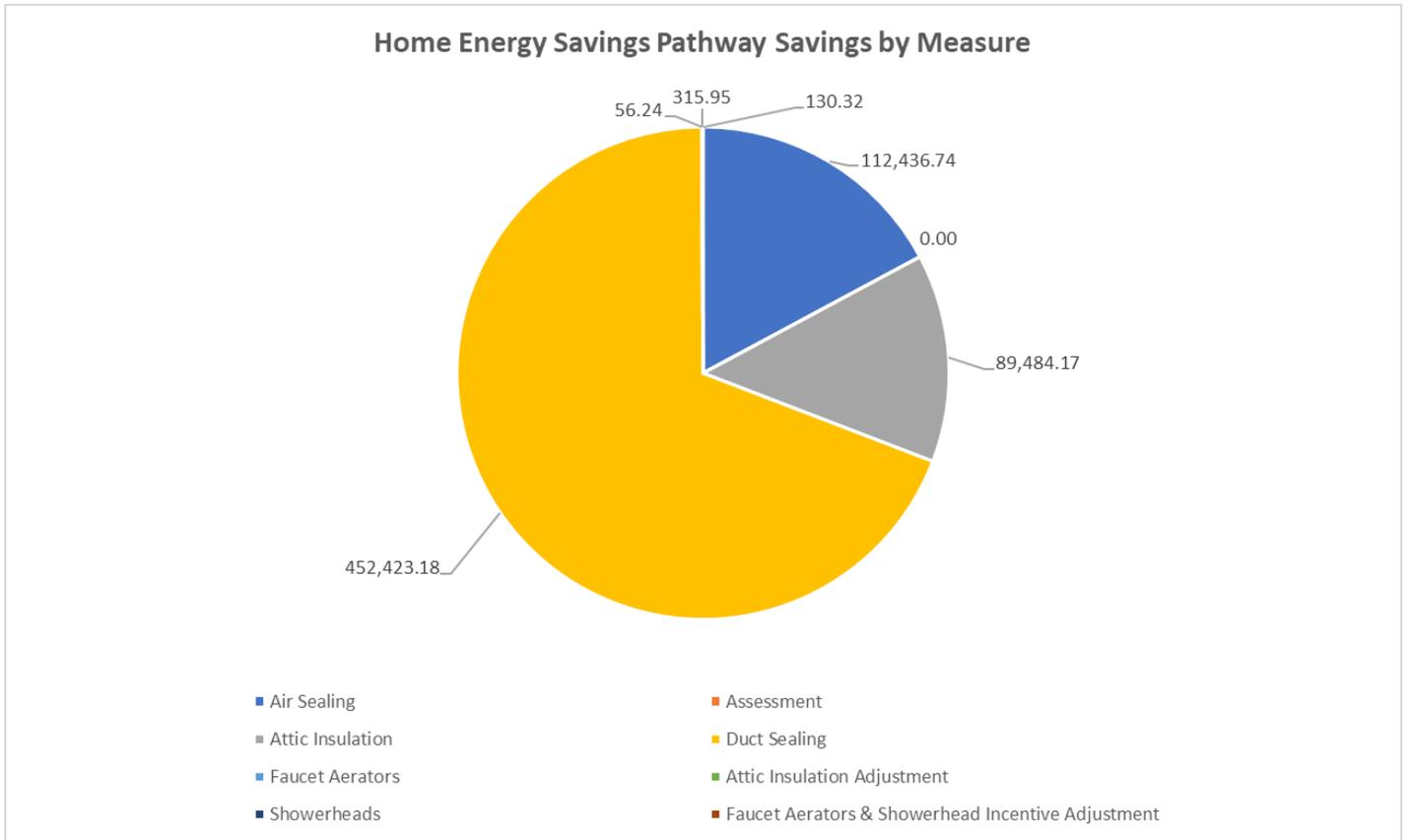


Figure 6 – 2023 HES Pathway Measure Mix2.2.3

2.2.3 Description of Participants

- A Participant of BHEA’s HES Pathway represents an incentivized measure, including assessments.

2.2.4 Challenges & Opportunities

- BHEA’s primary challenge is to strike a balance between customers wanting to participate and the funds available to provide services, particularly on assessments performed on BHEA only homes.
- Since this is the only BHEA program that requires trade allies to be registered and trained to participate, recruiting and training trade allies is critical.

2.2.5 Planned or Proposed Changes to Program & Budget

- No Changes are planned, however, BHEA may choose to use the budget flexibility approved by the Commission.

2.2.6 BHEA’s Response to Evaluators’ Recommendations

- No recommendations found for HES Pathway

2.3 Residential Solution Program Conclusion

2.3.1 Pathway Highlights

- The TRC ratio for the Residential Solution Program in 2023 was 2.11.

2.3.2 Residential Solution Budget, Savings, and Participants

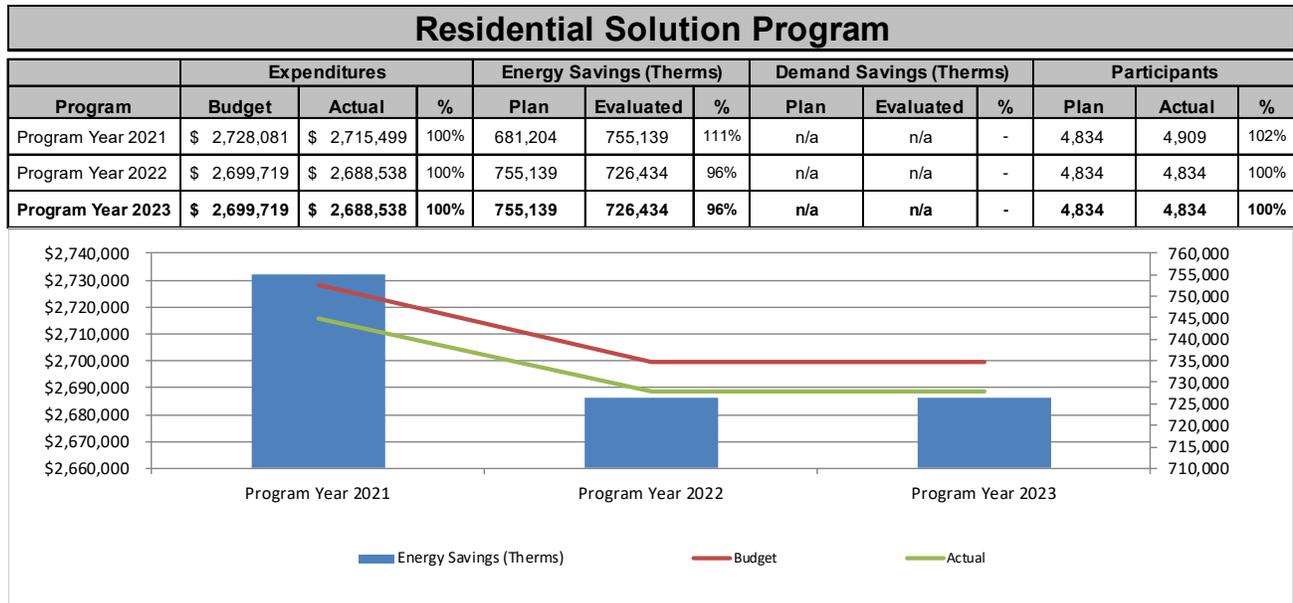


Figure 7 – 2023 Residential Solution Program Trends

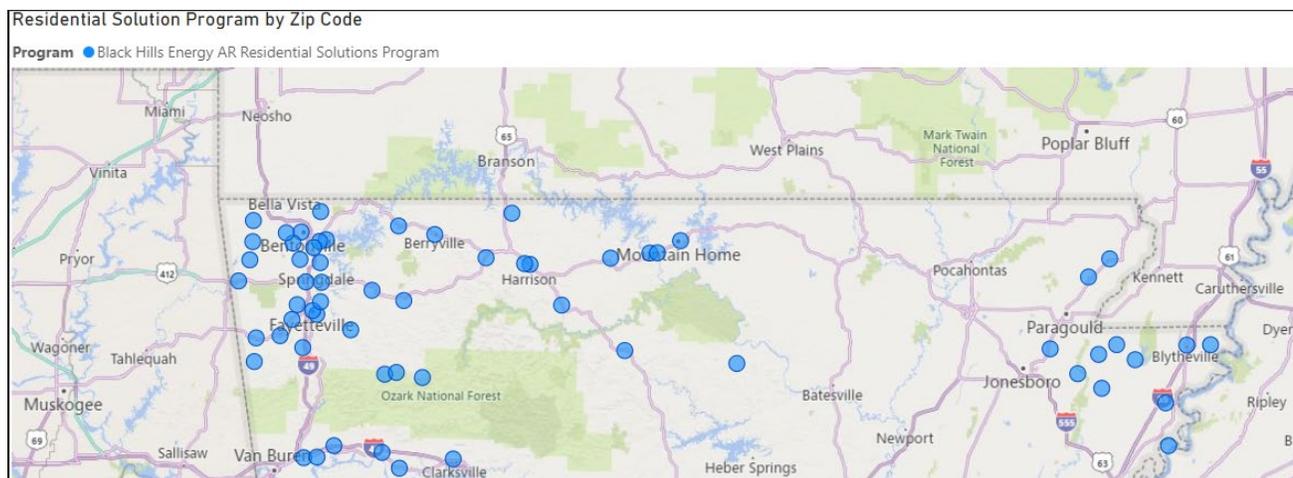


Figure 8 – 2023 Residential Solution Program Participants by Zip Code

2.4 Commercial & Industrial Solutions Program

2.4.1 Program Description

This program is available to all BHEA C&I customers, both existing facilities and new construction where natural gas is the primary heating/water heating/process fuel, or where the potential customer has made a commitment to take natural gas from BHEA as its primary heating/water heating/process fuel. BHEA provides financial incentives to encourage installation of energy efficient measures.

The CISP promotes cost effective natural gas energy savings through energy efficiency. It is a threefold program that gives C&I customers the opportunity to save on their natural gas usage. The program provides for the direct installation of water aerators, low flow showerheads, pre-rinse spray valves, and weather stripping at no cost to customers. Prescriptive rebates for comfort heating boiler equipment, boiler component installations and replacements, boiler burner replacements, commercial space heating furnaces, commercial tankless water heaters, steam traps, boiler burners, as well as qualifying Energy Star commercial cooking equipment are available. Custom incentives for specific measures are also available.

The calculation of savings for CISP may be determined through use of TRM V9.1 or through custom Measurement and Verification. This process employs point of use metering of natural gas, both prior to and after measure installation.

The custom part of CISP is highly dependent on frequent customer contact by BHEA's implementers, trade allies, and BHEA account managers. Budget cycles can be long and getting EE projects approved is difficult. Facility audits are done by the Company's implementers and are presented to the customer. Follow up is necessary to keep the customer thinking about the potential for natural gas savings and reductions in process, maintenance, and facility costs. Continued contact with potential customers is facilitated through phone calls, invitations to energy efficiency learning opportunities, along with additional site visits.

2.4.2 Program Highlights

- BHEA's CISP was available to all C&I customers in 2023, except those electing to self-direct their energy savings.
-
- Savings were distributed as follows:
 - Custom
 - 9 customers and 19 projects
 - Savings of 488,994, therms
 - Commercial Furnaces
 - 23 customers and 110 furnaces

- Savings of 16,795 therms
- Commercial Cooking Equipment
 - 3 customers and 6 pieces of equipment
 - Savings of 3,621 therms
- Commercial Tankless Water Heaters
 - 4 customers and 15 water heaters
 - Savings of 3,026 therms
- Commercial Comfort Heating Boilers
 - 2 customers and 3 boilers
 - Savings of 7,156 therms
- SEM
 - 9 participants with 3 receiving incentives.
 - 130,997 therms
- Direct Install
 - 15 premises
 - 20 Low-Flow Aerators
 - 414 feet of weather stripping (exterior walk thru doors, windows, etc.)
 - 2240 feet of overhead door weather stripping
 - 120,000 gallons of water saved
 - Savings of 111,614 therms
- The TRC for CISP was 1.25 for 2023.

C&I Therm Savings Percentage by Measure - Direct Install

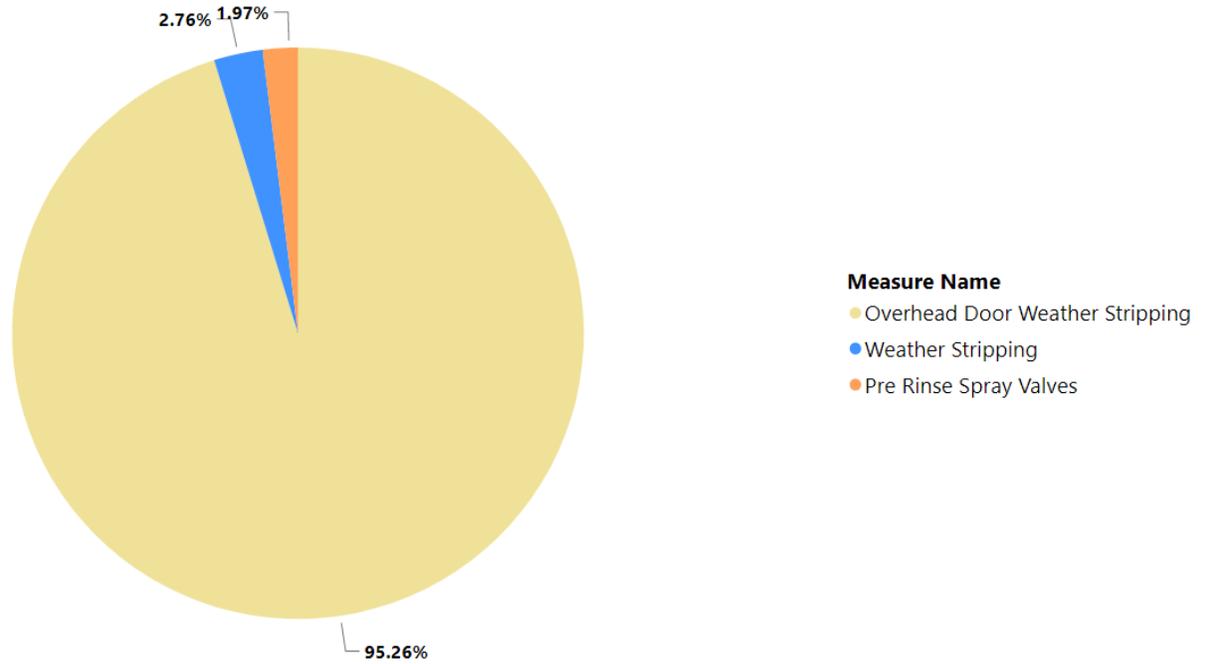


Figure 9 – 2023 Commercial & Industrial Direct Install Measure Mix

C&I Therm Savings Percentage by Measure - Custom

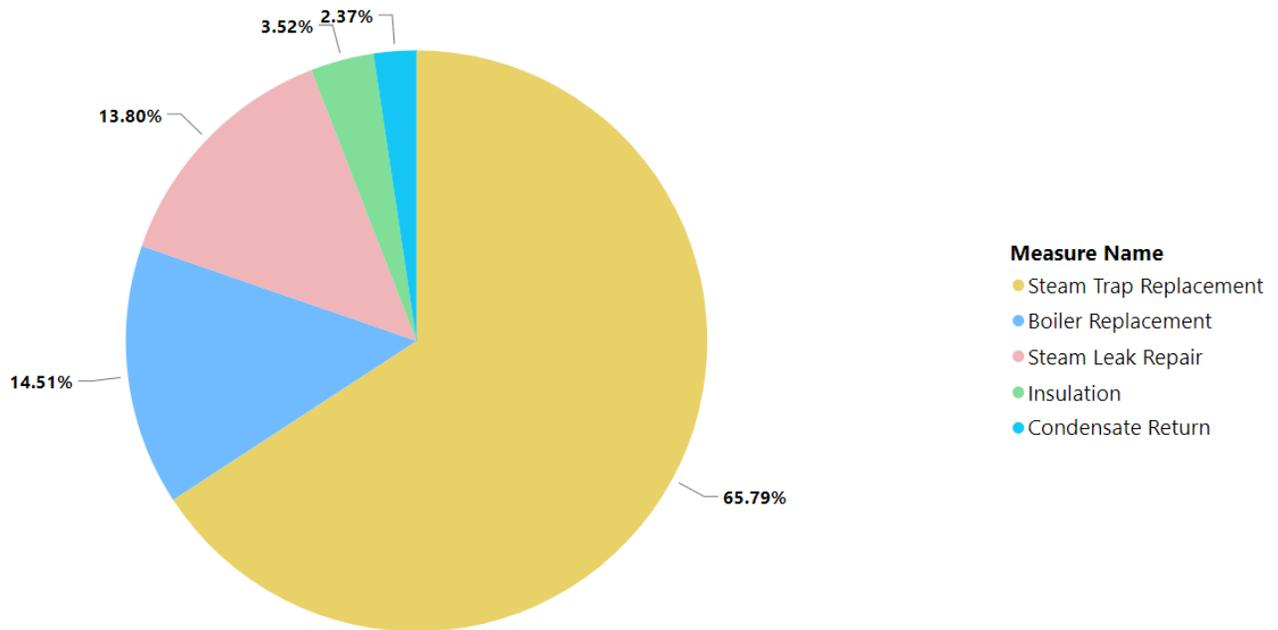


Figure 10 – 2023 Commercial & Industrial Custom Measure Mix

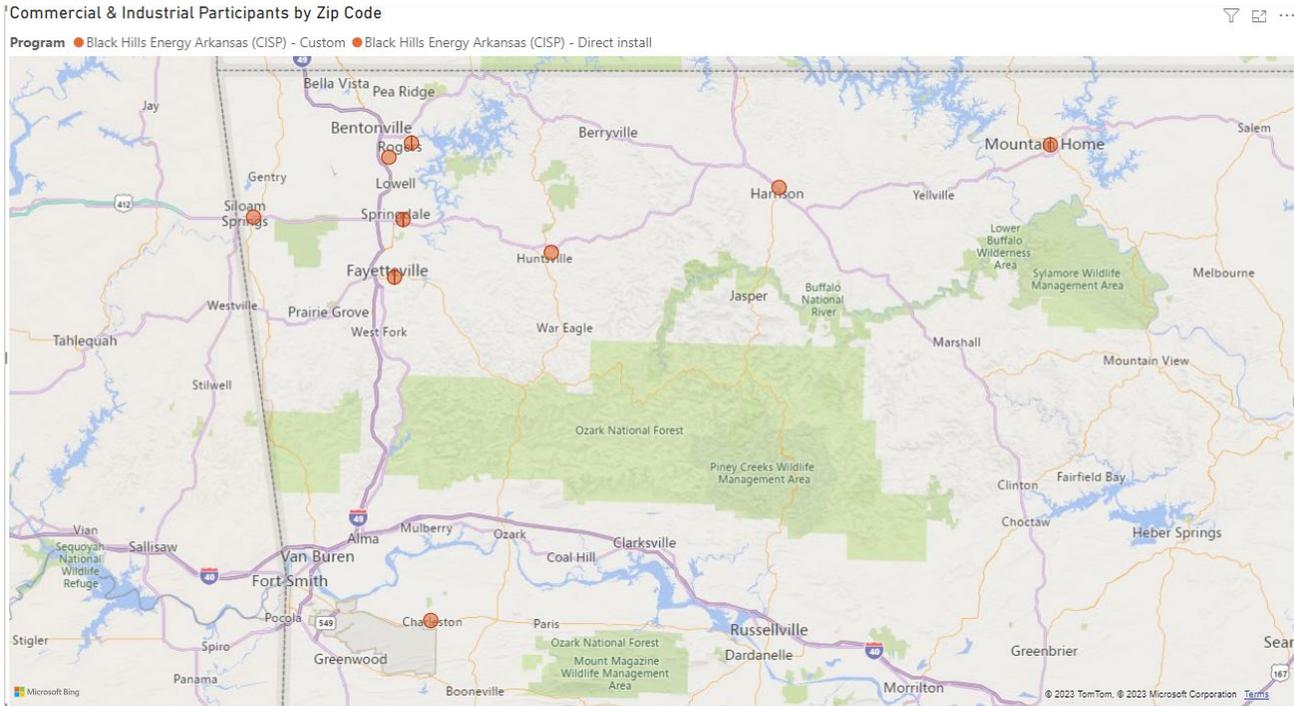


Figure 11 – 2023 Commercial & Industrial Participants by Zip Code

2.4.3 Program Budget, Savings, and Participants

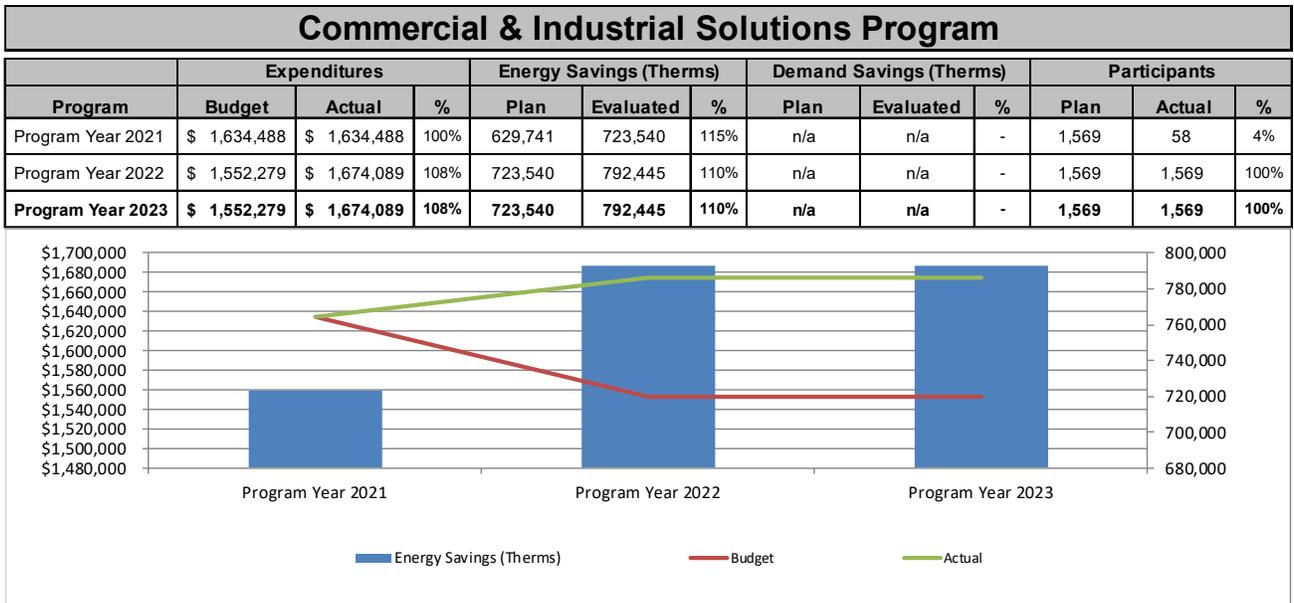


Figure 12 – 2021 Commercial & Industrial Solutions Program Trends

2.4.4 Description of Participants

- A Participant of BHEA’s CISP is defined as any measure installed.

2.4.5 Challenges & Opportunities

- BHEA’s primary challenge in this program is assisting CLEAResult in finding opportunities for custom projects. A large capital investment by customers can be required to participate in this program.
- BHEA employs a Commercial and Industrial Account Manager to promote the Company’s EE Portfolio at customer meetings and outside events. The account manager works with CLEAResult to provide contacts for follow up.

2.4.6 Planned or Proposed Changes to Program & Budget

- BHEA will continue to update and revise the program to incorporate new technology and equipment.

2.4.7 BHEA’s Response to Evaluators’ Recommendations

- Estimate water impacts in customer audit report payback calculations/ROI for relevant projects., Projects that save water can have significantly more rapid payback periods than just based solely on their gas savings. CLEAResult should factor this into audit report calculations when the opportunity presents itself (steam leak repair, condensate return, etc.).
 - BHEA will investigate and implement if feasible.

2.5 Low Income Pilot Program

2.5.1 Program Description

The Low Income Pilot Program (LIPP) is a fourth year program in PY2023 that was designed to comply with Act 1102. LIPP is an extension of the Consistent Weatherization Approach (CWA), and it is targeted to customers who meet the income eligibility requirements of the Low Income Home Energy Assistance Program (LIHEAP).

The program provides energy assessments, along with direct installation of low-cost measures and pre-qualification for building envelope improvements.

- Direct install measures include:
- Faucet aerators; and
- Low flow showerheads.
- Weatherization measures include:
- Air infiltration.
- Duct sealing; and
- Ceiling insulation.

Additionally, the program offers a maximum of \$500 per participating residence to meet the health code standards required to weatherize the residence. Health and safety funding may be used to provide carbon monoxide detectors, smoke detectors, or other required measures.

2.5.2 Program Highlights

- The program successfully completed comprehensive H&S retrofits with thorough documentation, meeting all Act 1102 requirements.
- The program met savings goals and was highly cost-effective., Though savings decreased by 24% compared to PY2022, the program still met 123% of its net savings goal.
- Survey respondents indicated high satisfaction., Respondents noted high satisfaction across all categories, including 70% reporting being “very satisfied” with the program overall.
-
- The LIPP spent \$324 per home on H&S retrofits, and thoroughly documented the equipment installed.
- 40 homes were weatherized in 2023, which were joint projects done in conjunction with SWEPCO.
- The focus on joint projects allowed the recipients to have up to a \$1,000 of Health & Safety equipment installed since the costs were split between the utilities. This was a great service to these customers as many of these homes needed extensive repairs before the weatherization measures could be installed.
-

2.5.3 Program Budget, Savings, and Participants

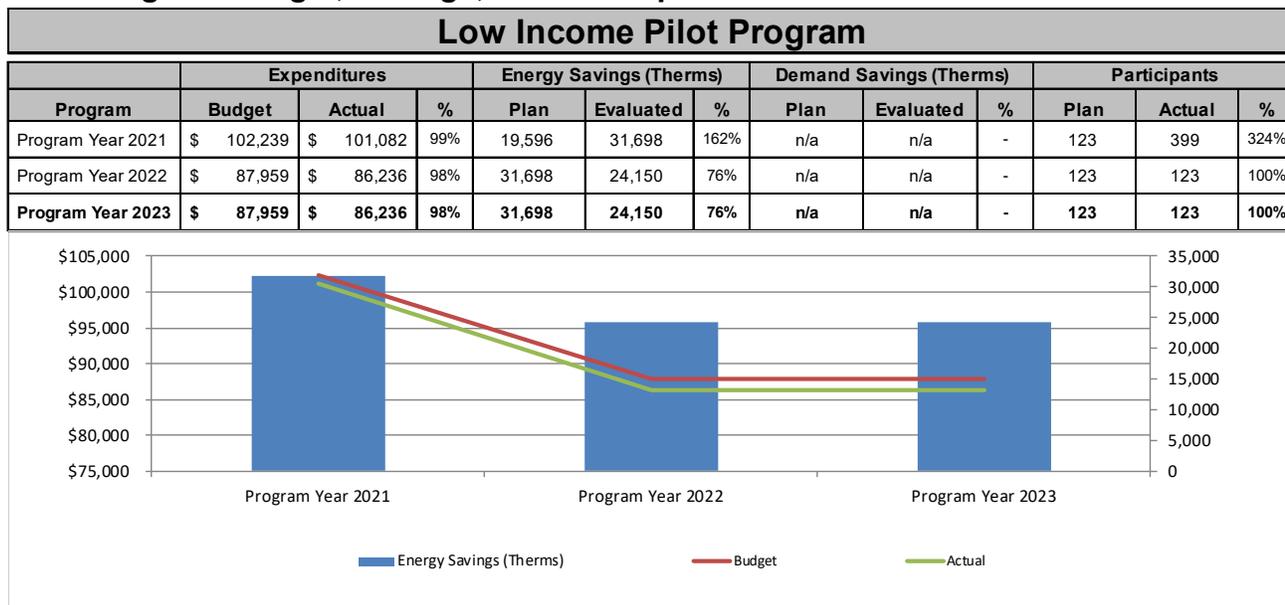


Figure 13 – 2021 Low Income Pilot Program Trends

2.5.4 Description of Participants

- A Participant of BHEA’s LIPP represents an incentivized measure, including assessments.

2.5.5 Challenges & Opportunities

- The current limit on Health & Safety measures is \$500 per project. While this meets the needs on joint projects, it falls short on BHEA only projects. Consideration will be given to increasing this limit to \$1,000 if needed.
- On the opportunity side, the program team was able to use a new CLEAResult Virtual application to remotely and in real time review the weatherization crew’s work when needed to perform quality control.

2.5.6 Planned or Proposed Changes to Program & Budget

- Currently there are no planned changes, however, BHEA will use the budget flexibility granted by the Commission if appropriate.

2.5.7 BHEA’s Response to Evaluator’s Recommendations

- **Formalize “electrician” and “AC tech” supplementary infrastructure work as H&S categories.** All instances of “Other” spending were for work from electricians or AC technicians to complete installations of H&S measures in homes where preexisting infrastructure was insufficient. This is a good strategy to meet Act 1102 requirements and complete H&S installations. As all “Other” spending fell into these readily delineable categories, establishing them as

standard H&S categories (albeit with variable incentive values) could simplify their use by program trade allies in future program years.

- ⊖ BHE has formalized this measure category.

2.6 Energy Efficiency Arkansas

2.6.1 Program Description

The Energy Efficiency Arkansas (“EEA”) program is a joint-utility program coordinated by the Arkansas Energy Office (“AEO”) to deliver cost-effective, relevant, consistent, and fuel neutral information and training that encourages people living in Arkansas to consume less energy through energy efficiency and conservation measures. This program includes the dissemination of educational material and messages through print, television, and radio advertisements, as well as training and certification programs.

Through the work done by the PWC Commercial and Industrial Collaborative, the EEA website was a springboard for national accounts and other C&I customers to gain EE information for all participating utilities.

2.6.2 Program Highlights

- EEA was available to all BHEA customers for all of 2023.
- For more detailed information, see the separate annual report being filed by the EEA Program in Docket No. 07-083-TF.

2.6.3 Program Budget, Savings, and Participants

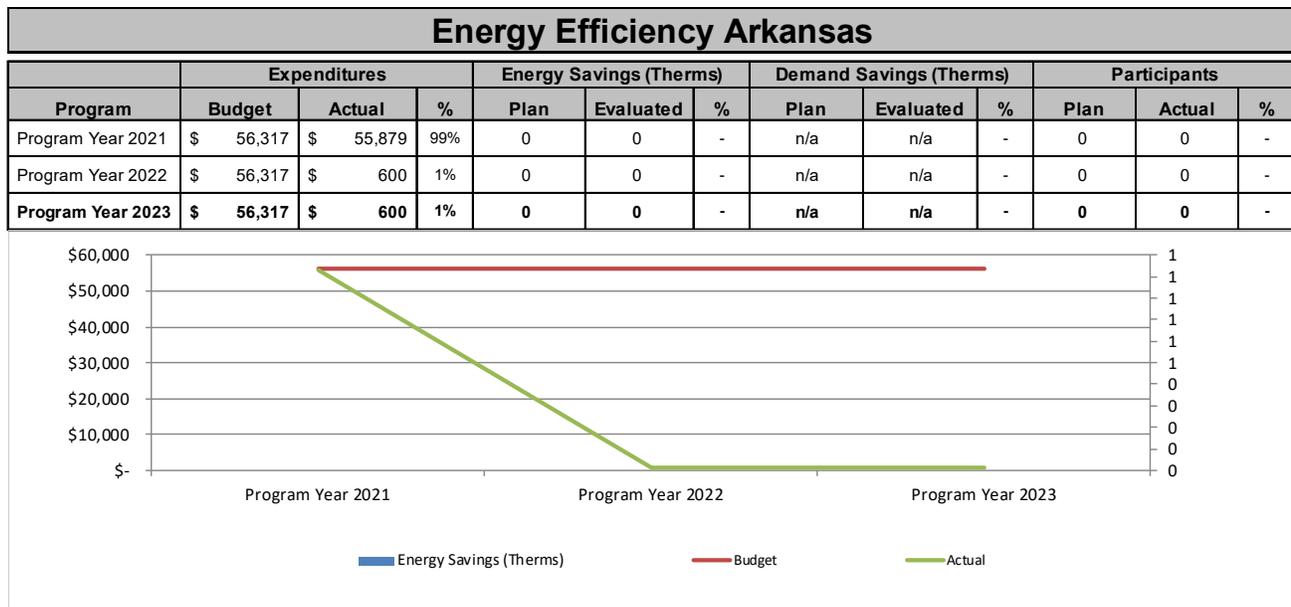


Figure 14 – 2021 Energy Efficiency Arkansas Program Trends

2.6.4 Description of Participants

- Participants in this program are difficult to quantify due to the nature of the program.

For more detailed information, see the separate annual report being filed by the EEA Program

2.6.5 Challenges & Opportunities

- For more detailed information, see the separate annual report being filed by the EEA Program in Docket No. 07-083-TF.

2.6.6 Planned or Proposed Changes to Program & Budget

- For more detailed information, see the separate annual report being filed by the EEA Program in Docket No. 07-083-TF.

3.0 Supplemental Requirements

3.1 Staffing

- Current staffing for BHEA’s EE programs is one full-time individual.
- The Company has a Commercial and Industrial Account Manager who continues to leverage any contact with customers as an opportunity to promote EE programs.
- BHEA’s implementer, CLEAResult, employs the equivalent of 6 full-time employees to work on BHEA’s programs.

3.2 Stakeholder Activities

BHEA’s EE team, including its program implementation and evaluation team members, was again very active with the PWC. The PWC held several meetings throughout the year, the majority of these discussions focused on making changes and updates to the Technical Reference Manual (TRM). The TRM discussions covered a variety of topics including accounting for the effects in the changes in the lighting market due to the roll-back of the Energy Independence and Security Act (EISA).

The PWC also addressed concerns raised in prior Commission orders regarding the clarification of the National Standard Practice Manual (NSPM), the SARP Workbooks, and the discussion of the Carbon Calculator approaches.

Program evaluators provided timely updates throughout the year regarding the status of evaluation activities and worked proactively with the IEM to develop new studies based on feedback from the PWC.

Table 1: Summary of PWC Meetings and Topics in 2023

Date	Title	Topics
3/16/2023	PWC In-person Meeting March 16	<ol style="list-style-type: none"> 1. IEM <ul style="list-style-type: none"> - Potential Study Logistics - Complimentary Study Plan - Discussion of Potential Study 2. EM&V Updates 3. Summary of DEI Metrics for Evaluation Reports
6/7/2023	TRM Update and Planning	<ol style="list-style-type: none"> 1. TRM Version 9.2 Update Plan <ul style="list-style-type: none"> - Process/Schedule for TRM Update Meetings - Guidance for TRM Updates - TRM v9.2 Update Approach 2. IEM EISA Memo Discussion <ul style="list-style-type: none"> - Memo Review and Highlights - PWC Feedback from Memorandum
6/21/2023	TRM Update and Planning	<ol style="list-style-type: none"> 1. Standards Update <ul style="list-style-type: none"> - Federal Standard Changes - SEER2/IEER2 - ENERGY STAR Updates 2. Arkansas Energy Code for Residential New Construction <ul style="list-style-type: none"> - Smart Thermostats application for baselines
7/5/2023	TRM Potential New Measures Discussion	<ol style="list-style-type: none"> 1. Potential New Measures Discussion <ul style="list-style-type: none"> - Drain Water Heat Recovery - Water Coolers - Steam Leak Repairs - Possible Measure Updates 2. HIMs Analysis Review
7/19/2023	TRM Updates - Existing Measures	<ol style="list-style-type: none"> 1. Duct Sealing & Convection Ovens 2. Commercial Lighting 3. EV Chargers & Engineered Nozzles
8/9/2023	PWC in-Person Technical Forum	<ol style="list-style-type: none"> 1. Volume 1 and Volume 3 – Minor Edits/Updates 2. Volume 2 Updates <ul style="list-style-type: none"> - HIMs Analysis Summary - Residential Standards and ENERGY STAR Updates - IEM Memo on EISA Guidance for PY2023 - Commercial Standards and ENERGY STAR Updates - Existing Measure Updates - New Measures and Future Updates for TRM v10 3. Staff IEM Discussion 4. Staff IEM Discussion 5. Potential Study Update/Next Steps 6. Key Takeaways from EM&V PY2022 Reports 7. Act 1102 Working Group Discussion
8/23/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. Review Initial Data Request <ul style="list-style-type: none"> - Discuss data elements - Timing expectations 3. Offered Items (as needed)
9/6/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. SharePoint 3. Data request

		<ul style="list-style-type: none"> - Status - Questions and discussion <p>4. Offered Items (as needed)</p>
9/19/2023	Act 1102 Working Group Meeting	<ol style="list-style-type: none"> 1. Reporting Metrics 2. Current Misalignment in Tracking 3. Discussion of Comprehensive Factors 4. Discussion Questions 5. EM&V Plans for Capturing Key Metrics
9/20/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. Data request <ul style="list-style-type: none"> - Status - Questions and discussion 3. Draft measure list <ul style="list-style-type: none"> - Screenshare & discussion - Getting feedback 4. Offered Items (as needed)
10/4/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. Data request <ul style="list-style-type: none"> - Status - Questions and discussion 3. Draft measure list feedback 4. Offered Items (as needed)
11/1/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. Invoice payment status/process 3. Data request 4. Demand Response update 5. Market Research Planning, Logistics 6. Offered Items (as needed)
11/15/2023	Potential Study Working Group Meeting	<ol style="list-style-type: none"> 1. Agenda Review 2. Market research follow-up <ul style="list-style-type: none"> - Trade ally data - Marketing guidelines 3. Demand Response <ul style="list-style-type: none"> - Review program/measure list and comments 4. Offered Items (as needed)
12/5/2023	Act 1102 Working Group Meeting	<ol style="list-style-type: none"> 1. Review Current Metrics <ul style="list-style-type: none"> - Total Audits Complete - Total Submitted Projects - Conversion Rate - Energy-savings Measures Installed - H&S Measures per Project - Total Measures per Project - Cost per Participant 2. Proposed Metrics <ul style="list-style-type: none"> - Energy Savings per Project - Adjusted Measure Count/Savings Total per Project

3.3 Information Provided to Consumers to Promote EE

BHEA's marketing plan relies on traditional marketing channels to promote the programs. Additionally, BHEA uses customer touch points such as service calls, customer newsletters, and speaking engagements at seminars, conferences, and community events to spread the word about its programs. Over the past year, marketing for BHEA's energy efficiency programs has included:

- Continued Internet presence through the www.energyready-arkansas.com website which features:
 - A website that is mobile and tablet compatible;
 - A list of energy savings tips;
 - Information on all BHEA's EE programs and instructions on how to participate in each program, with contact information for further questions;
 - Printable rebate forms;
 - Online rebate application;
 - Links to other useful resources, such as a free online energy audit tool and energy efficiency organizations;
 - Samples of marketing materials;
 - A direct email link for more information or questions regarding any BHEA EE program
- Program materials are distributed at multiple events during the year, where BHEA customers are able to learn more about the programs.

Comprehensive Energy Efficiency Plan

Program Year 2023

Annual Report

Appendix A – Evaluation, Measurement and
Verification Report For The 2023 Arkansas Energy
Efficiency Portfolio



EVALUATION, MEASUREMENT AND VERIFICATION REPORT FOR THE 2023 ARKANSAS ENERGY EFFICIENCY PORTFOLIO

SUBMITTED TO: BLACK HILLS ENERGY ARKANSAS

SUBMITTED ON: APRIL 30, 2024

SUBMITTED BY: ADM ASSOCIATES, INC.

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Black Hills Energy



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We would like to thank the staff at Black Hills Energy Arkansas for their time and effort in contributing to the EM&V of the PY2023 programs. This evaluation was conducted with regular coordination with staff at BHE, who provided quick feedback and turnaround to the requests of the evaluation team as well as open and forthright insights into the operations of their programs.

Further, we would like to acknowledge our gratitude towards BHE customers, implementation contractor staff, and trade allies. As with the staff at BHE, their active participation allowed for the evaluation team to collect all needed data for this effort.

In final, we would like to thank staff at the Independent Evaluation Monitor for their involvement in providing thorough answers and clarification to the evaluation team when higher-level questions arose over the course of the PY2023 EM&V effort.

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TABLE OF CONTENTS

1	Executive Summary.....	1-1
2	General Methodology.....	2-1
3	Portfolio-Level Summary	3-1
4	Residential Solutions.....	4-1
5	Commercial & Industrial Solutions Program (CISP)	5-1
6	Low Income Pilot Program.....	6-1
7	Appendix A: Site Reports	7-1
8	Appendix B: Deferred Replacement Cost Calculations.....	8-1
9	Appendix C: Detailed NTG Tables	9-1
10	Appendix D: Cost-Benefit Inputs.....	10-1

LIST OF TABLES

Table 1-1: BHE PY2023 Energy Efficiency Portfolio Overview	1-3
Table 1-2: BHE PY2023 Energy Efficiency Portfolio Sectors Served	1-3
Table 1-3: Gross Impact Summary	1-4
Table 1-4: Net Impact Summary	1-4
Table 1-5: BHE PY2023 EE Portfolio Performance against Goals	1-5
Table 1-6: BHE PY2023 Ex Post Electric Savings.....	1-6
Table 1-7: BHE PY2023 Ex Post Water Savings (Gallons).....	1-7
Table 1-8: BHE PY2023 Avoided/Deferred Replacement Cost	1-7
Table 2-1: PY2023 Impact Evaluation Activities by Program	2-9
Table 2-2: PY2023 NTG Approaches by Program.....	2-9
Table 3-1: Summary of Data Collection Efforts	3-1
Table 3-2: Assessment of Customer Education by Program	3-3
Table 3-3: Assessment of Trade Ally Training by Program	3-3
Table 3-4: Assessment of Marketing & Outreach by Program	3-4
Table 3-5: Assessment of Budgetary, Management, and Program Delivery Resources by Program	3-5
Table 3-6: End-Uses Addressed by Program.....	3-6
Table 3-7: Installation of Multiple Measures.....	3-8
Table 3-8: Assessment of Project Comprehensiveness by Program	3-8
Table 3-9: Assessment of Targeted Customer Sectors by Program	3-9
Table 3-10: Assessment of Cost-Effectiveness	3-11
Table 3-11: Assessment of Data & QA/QC Procedures by Program.....	3-12
Table 3-12: Cost-Effectiveness Summary	3-12

Table 3-13: Residential NEBs	3-13
Table 3-14: Commercial & Industrial NEBs.....	3-13
Table 4-1: Residential Solutions Performance against Goals	4-1
Table 4-2: RSP PY2023 Impact Evaluation Activities.....	4-2
Table 4-3: RSP Non-Energy Benefits	4-3
Table 4-4: Determining Appropriate Timing to Conduct a Process Evaluation.....	4-4
Table 4-5: Determining Appropriate Conditions to Conduct a Process Evaluation	4-4
Table 4-6: Residential Solutions Response to PY2022 Recommendations	4-4
Table 4-7: RSP Equipment Rebates Pathway Data Collection Summary.....	4-6
Table 4-8: RSOL ERP Solutions Protocol A Summary	4-6
Table 4-9: Respondent Demographics (n varies).....	4-9
Table 4-10: Equipment Rebated (n varies)	4-10
Table 4-11: Additional Equipment Purchased (n=11).....	4-11
Table 4-: Number of Employees (n=19).....	4-14
Table 4-13: RSP Home Energy Savings Pathway Data Collection Summary.....	4-21
Table 4-14: CWA Required Process Evaluation Metrics	4-24
Table 4-15: HES Pathway Alignment with CWA Requirements.....	4-24
Table 4-16 Summary of Home Participation	4-25
Table 4-17 Respondent Demographics (n=92)	4-25
Table 4-18: RSP Summary of Free-ridership, Spillover, and NTGRs	4-33
Table 4-19: Residential Furnace RUL	4-35
Table 4-20: RSP Ex Post Gross Therms Savings.....	4-38
Table 4-21: RSP Net Savings Summary	4-38
Table 4-22: RSP Ex Post Net Electric Savings	4-39

Table 4-23: RSP Ex Post Net Water Savings	4-39
Table 5-1: CISP Historical Performance against Goals	5-1
Table 5-2: Custom Project Participation Summary.....	5-4
Table 5-3: Determining Appropriate Timing to Conduct a Process Evaluation.....	5-5
Table 5-4: Determining Appropriate Conditions to Conduct a Process Evaluation	5-5
Table 5-5: BHE CISP Data Collection Summary.....	5-6
Table 5-6: C&I Solutions Protocol A Summary	5-7
Table 5-7: CISP Response to PY2020 Recommendations	5-8
Table 5-8: BHE CISP Prescriptive Project Summary	5-15
Table 5-9: BHE CISP Custom Project Summary.....	5-16
Table 5-10: BHE CISP SEM Project Summary	5-16
Table 5-11: CISP Custom Project Free-Ridership Results	5-20
Table 5-12: CISP Non-Energy Benefits	5-21
Table 5-13: CISP Ex Post Therms Savings.....	5-22
Table 5-14: CISP Net Savings Summary	5-22
Table 5-15: Total Marginal Water Rates.....	5-22
Table 5-16: Commercial & Industrial Solutions Ex Post Net Water Savings.....	5-22
Table 6-1: LIPP Historical Performance against Goals	6-1
Table 6-2: CWA Required Process Evaluation Metrics	6-4
Table 6-3: LIPP Alignment with CWA Requirements	6-4
Table 6-4: Determining Appropriate Timing to Conduct a Process Evaluation.....	6-6
Table 6-5: Determining Appropriate Conditions to Conduct a Process Evaluation	6-7
Table 6-6: BHE LIPP Data Collection Summary	6-8
Table 6-7: LIPP Protocol A Summary	6-8

Table 6-8: LIPP Response to PY2022 Recommendations	6-9
Table 6-9 Response by Utility (n=20)	6-10
Table 6-10: Respondent Characteristics	6-10
Table 6-11: LIPP Ex Ante Summary	6-16
Table 6-12: LIPP Ex Post Savings Summary.....	6-17
Table 6-13: LIPP Electric NEBs.....	6-17
Table 5. Cost, Incentive, and Payback.....	7-31
Table 4. Overall Project Savings.....	7-36
Table 3. Steam Trap Replacement Savings	7-44
Table 10-1: BHE Avoided Cost Values	10-1
Table 10-2: BHE Discount Rates.....	10-1
Table 10-3: Line & Distribution Losses.....	10-1

LIST OF FIGURES

Figure 1-1: Savings Share by Measure – Residential	1-4
Figure 1-2: Savings Share by Measure – C&I	1-5
Figure 1-3: Summary of Goal Attainment & Budget Expenditure by Program	1-6
Figure 2-1: Residential Free-ridership Designations.....	2-6
Figure 3-1: Comparison of Program Plan vs. Actual Acquisition Costs.....	3-6
Figure 3-2: Benefit Summary by Program	3-14
Figure 4-1: Program Savings Share by Measure	4-2
Figure 4-2: ERP Participation Summary	4-5
Figure 4-3: Program Awareness (n=53)	4-10
Figure 4-4: Most Important Motivator for Participation (n=39)	4-10
Figure 4-5: Status of Equipment Rebated (n=53)	4-11
Figure 4-6: Contractors' Role in Equipment Choice (n=31)	4-12
Figure 4-7: Equipment Components Emphasized by Contractor (n=31).....	4-12
Figure 4-8: Program Satisfaction (n=53, unless noted)	4-13
Figure 4-9: Satisfaction with BHE (n=53)	4-13
Figure 4-10 Business Type (n=21)	4-14
Figure 4-11: Program Marketing (n=19)	4-15
Figure 4-12: Program Satisfaction (n=21)	4-16
Figure 4-13: Preferred Communication Methods (n=19)	4-16
Figure 4-14: Interactions with Utility Staff (n=13)	4-17
Figure 4-15: HES Pathway - Per-Home Therms Savings: Assessment vs. Install-Only.....	4-18
Figure 4-16: HES Pathway - % Houses with Each Measure	4-18

Figure 4-17: HES Pathway Trade Ally Participation Summary 4-19

Figure 4-18: HES Pathway Home Efficiency Graphic (source: <https://energy-readyarkansas.com/home-energy-savings-evaluation.html>)..... 4-22

Figure 4-19 Program Awareness (n=92) 4-27

Figure 4-20 Program Enrollment Motivation (n=92) 4-27

Figure 4-21 Motivation for Assessment (n=83) 4-28

Figure 4-22 Home Energy Assessment Satisfaction (n=varies)..... 4-29

Figure 4-23 Utility of Information Provided (n=78) 4-29

Figure 4-24 Program Satisfaction (n=varies)..... 4-30

Figure 4-25 Satisfaction with BHE (n=88) 4-30

Figure 4-26 Change in Energy Bill (n=92) 4-30

Figure 4-27: RSP FR Diagram 4-32

Figure 4-28: Air Infiltration Field Data Collection Results (n=33) 4-33

Figure 4-29: Duct Sealing Field Data Collection Results (n=34)..... 4-34

Figure 4-30: Residential Furnace Early Retirement Flowchart 4-36

Figure 5-1: Total Net Therms by Program Pathway 5-2

Figure 5-2: Direct Install Participation Summary..... 5-3

Figure 5-3: CISP Prescriptive Participation Summary 5-3

Figure 5-4: C&I Solutions Process Flow..... 5-12

Figure 5-5: CISP Custom Project Free-Ridership Diagram 5-19

Figure 6-1: Program Savings Share by Measure 6-2

Figure 6-2: LIPP Spending Per-Home 6-5

Figure 6-3: BHE LIPP Act 1102 Eligibility Summary..... 6-5

Figure 6-4: Summary of H&S Measure Spending 6-6

Figure 6-5 Program Awareness..... 6-12

Figure 6-6: Program Enrollment Motivation 6-12

Figure 6-7: Motivation for Assessment..... 6-13

Figure 6-8: Home Energy Assessment Satisfaction (n=14) 6-14

Figure 6-9: Usefulness of Information Provided (n=14) 6-14

Figure 6-10: Contractor Connection 6-14

Figure 6-11: Program Satisfaction 6-15

Figure 6-12: Change in Energy Bill (n=20)..... 6-15

Figure 6-13: Change in Energy Bill (n=20)..... 6-15

Figure 8-1: Residential Tankless WH Avoided Replacement Cost Calculation 8-1

Figure 8-2: C&I Tankless WH Avoided Replacement Cost Calculation..... 8-2

Figure 8-3: Furnace Early Retirement Deferred Replacement Cost Calculation 8-2

1 Executive Summary

In March of 2019, Black Hills Energy Arkansas (BHE) filed its 2020–2022 Energy Efficiency Plan (EE Plan) in response to Commission Order No. 25 in Docket No. 13-002-U. The Arkansas Public Service Commission (APSC) approved the 2020–2022 programs, which builds upon BHE’s Quick Start Energy Efficiency programs that were implemented from late 2007 through early 2011 and the Comprehensive programs that have been implemented in Arkansas since mid-2011. The EE Plan was filed in compliance with Order No. 43 of Docket No. 13-002-U, which required investor-owned natural gas utilities in Arkansas to capture energy savings equivalent to 0.5% of their 2018 energy sales reduced by those customers choosing to self-direct their energy efficiency efforts.

This report presents the Evaluation, Measurement, & Verification (EM&V) results for BHE’s energy efficiency programs implemented in Program Year (PY) 2023. In accordance with APSC Conservation & Energy Efficiency (C&EE) Rules, BHE selected an independent, third-party EM&V contractor. The selected EM&V contractor is ADM Associates. The ADM staff, collectively referred to as the Evaluators, evaluated the BHE portfolio.

The PY2023 BHE evaluation included impact and process analyses that are specified in the APSC rules and follow the Arkansas TRM Version 9.1 (TRM V9.1) protocols and savings algorithms. In addition, ADM developed the program evaluation activities based upon discussions with BHE staff and its implementation contractors, reviews of program tracking and program documentation, a review of prior years’ EM&V efforts and BHE annual reports, and input from the Independent Evaluation Monitor (IEM).

BHE’s Plan includes a portfolio of energy efficiency programs designed to facilitate energy savings in every customer class. BHE services approximately 169,000 customers in Arkansas. BHE’s service area is primarily comprised of communities in Northwest Arkansas, including Fayetteville, Springdale, and Rogers, as well as North-central (Mountain Home) and Northeast (Blytheville, Manila, Osceola) communities.

1.1 Summary of BHE Energy Efficiency Programs

In PY2023, BHE offered a portfolio of three energy efficiency programs, which provided a comprehensive range of customer options for natural gas efficiency. BHE designed its programs to achieve the following objectives:

- Program plan net therm savings target of 1,330,541, exceeding the APSC target;
- Significant energy-savings opportunities for all customers and market segments;
- Broad ratepayer benefits; and

- Comprehensiveness in seven areas (comprehensiveness factors) defined by the APSC.¹

The Evaluators calculated the results for PY2023 for one commercial and industrial (C&I) and two residential programs. Those programs and pathways are described below:

- **Commercial & Industrial Solutions Program (CISP):**

- **Custom:** CISP offers technical assistance to support C&I customers in identifying and implementing energy savings opportunities. In its custom program offering, the CISP offers on-site technical assistance, trade ally incentives for steam system surveys, and incentives based on verified performance of custom measures that are outside of the scope of the TRM V9.1.
- **Prescriptive:** CISP offers prescriptive incentives for measures that have deemed savings established in the TRM, including commercial furnaces, water heaters, boilers, boiler controls, and food service equipment.
- **Direct Install:** The direct install component provides installation of high-saving, low-cost measures at no cost to the participant. Direct install measures include low flow showerheads, faucet aerators, pre-rinse spray valves, and weather stripping for exterior doors.

- **Residential Solutions Program (RSP)**

- **Equipment Rebates Pathway:** The Equipment Rebates Pathway offers residential customers rebates for purchasing energy efficient furnaces, tankless water heaters, and smart thermostats. The Equipment Rebates Pathway is designed to help provide customers assistance in identifying potential measures that are eligible for rebate and installation in qualifying residential homes.
- **Home Energy Solutions Pathway (HES Pathway):** The HES Pathway offers residential customers no cost assessments and energy efficient improvements. The Consistent Weatherization Approach (CWA) is delivered through this program. The HES Pathway is designed to help customers achieve savings by consulting with a qualified contractor who will analyze their energy use, identify, and install core energy efficiency improvements at no cost to the customer.

- **Low Income Pilot Program (LIPP):** The LIPP offers qualifying residential customers no cost assessments and energy efficient improvements. The low income carveout for the Consistent Weatherization Approach (CWA) is delivered through this program.

¹ As defined by the APSC in the C&EE Rules of Order No. 17 in Docket 08-144-U.

Through its energy efficiency portfolio, BHE seeks to provide customers with easy program entry points, flexible options for saving energy and ongoing support for those who want to pursue deeper energy savings. Table 1-1 shows a list of the BHE programs, Pathways, and sectors served.

Table 1-1: BHE PY2023 Energy Efficiency Portfolio Overview

Program	Pathway	Sector
Residential Solutions	Equipment Rebates	Residential
	Home Energy Savings	Residential
CISP	Custom	Commercial, Industrial
	Prescriptive	Commercial, Industrial
	Direct Install	Commercial, Industrial
Low Income Pilot	N/A	Residential

Table 1-2: BHE PY2023 Energy Efficiency Portfolio Sectors Served

Program	Single Family	Multifamily	Small Business	Large C&I	Municipal	Agricultural
Residential Solutions	✓	✓				
CISP		✓	✓	✓	✓	✓
Low Income Pilot	✓	✓				

1.2 Evaluation Objectives

The goals of the PY2023 EM&V effort are as follows:

- Develop sampling plans that allow for attaining 90% confidence and ±10% precision for each of the (3) programs in the BHE portfolio.
- For prescriptive measures, verify that savings are being calculated according to appropriate Technical Resource Manual (TRM) V9.1 guidelines.
- For custom measures, this effort comprises the calculation of savings according to accepted protocols (such as International Performance Measurement and Verification Protocol). This is to ensure that custom measures are cost-effective and provide reliable savings.
- Assign net-to-gross (NTG) values for each pathway in the BHE portfolio.
- Conduct process evaluation of all BHE programs and of the portfolio overall. This is to provide a comprehensive review of program operations, marketing and outreach, quality control procedures, and program successes relative to goals. From this, the Evaluators provide program and portfolio-level recommendations for BHE. Process evaluation activities include interviews of key program actors, surveys of participants and non-participants, literature reviews and best-practices assessments, and documentation of program activities, successes, and shortcomings.

1.3 Impact Findings

Table 1-3 and 1-4 present the gross and net impact by program.

Table 1-3: Gross Impact Summary

Program	Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		Gross Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post	
Residential Solutions	752,543	763,390	13,020,099	12,792,023	101.4%
Commercial & Industrial Solutions	762,204	816,628	6,517,848	6,718,273	107.1%
Low Income Pilot	24,055	24,150	520,438	411,742	100.4%
Total	1,538,802	1,604,168	20,058,385	19,922,038	104.2%

Table 1-4: Net Impact Summary

Program	Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		NTGR	Net Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Residential Solutions	686,347	726,434	11,556,323	12,231,281	95.2%	105.8%
Commercial & Industrial Solutions	751,351	792,445	5,953,993	6,279,634	97.0%	105.5%
Low Income Pilot	24,055	24,150	410,136	411,742	100.0%	100.4%
Total	1,461,753	1,543,028	17,925,961	18,922,657	96.2%	105.6%

Figure 1-1 and Figure 1-2 summarize the share of savings by measure category for residential and non-residential segments, respectively.

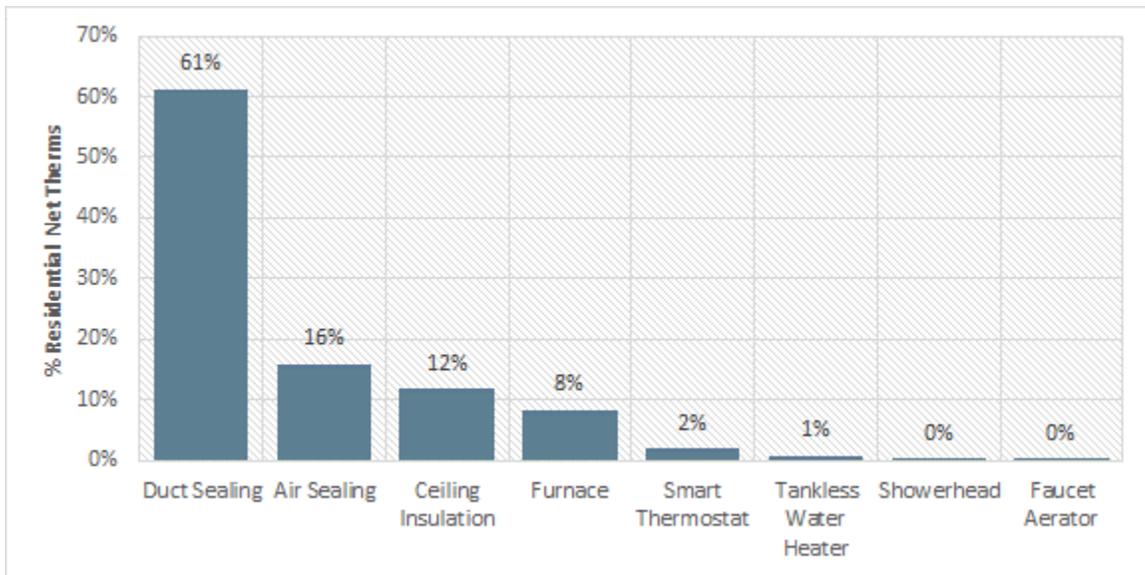


Figure 1-1: Savings Share by Measure – Residential

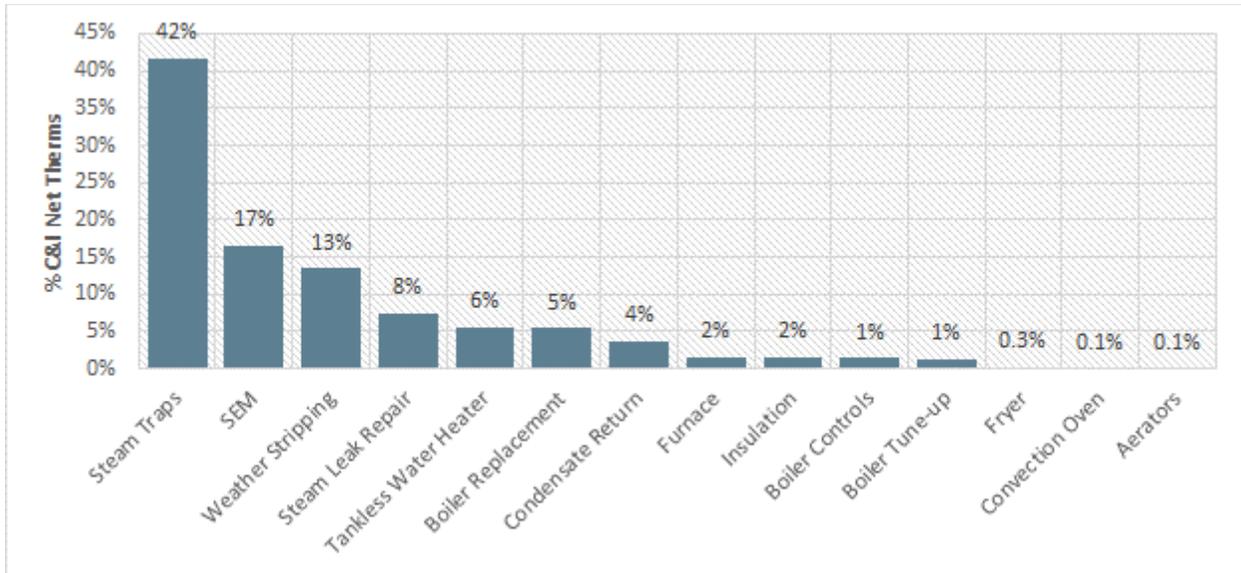


Figure 1-2: Savings Share by Measure – C&I

From this, the Evaluators have identified the following High Impact Measure (HIMs):

- Residential
 - Duct sealing
 - Air sealing
 - Ceiling insulation
 - Furnace replacement
- Non-residential
 - Steam trap replacement
 - SEM
 - Weather stripping
 - Steam leak repair
 - Tankless water heaters
 - Boiler replacement

Further, the Evaluators put the net savings into the context of BHE’s filed PY2023 goal. BEH’s filed goal exceeds the requirements established by the APSC. Table 1-5 summarizes the performance against filed goals of programs evaluated in this report.

Table 1-5: BHE PY2023 EE Portfolio Performance against Goals

Program	PY2023 Ex Post Net Therms	PY2023 Net Therms Goal	% Goal Reached
RSP	726,434	755,139	96.2%
CISP	792,445	723,540	109.5%
LIPP	24,150	31,698	76.2%
Total	1,543,028	1,510,377	102.2%

The BHE portfolio overall met 102.2% of the filed savings goal. Percent of goal attained, and budget spent by program is summarized in Figure 1-3. This was achieved while spending 105.3% of the program budget, compared to 94.1% in PY2022.

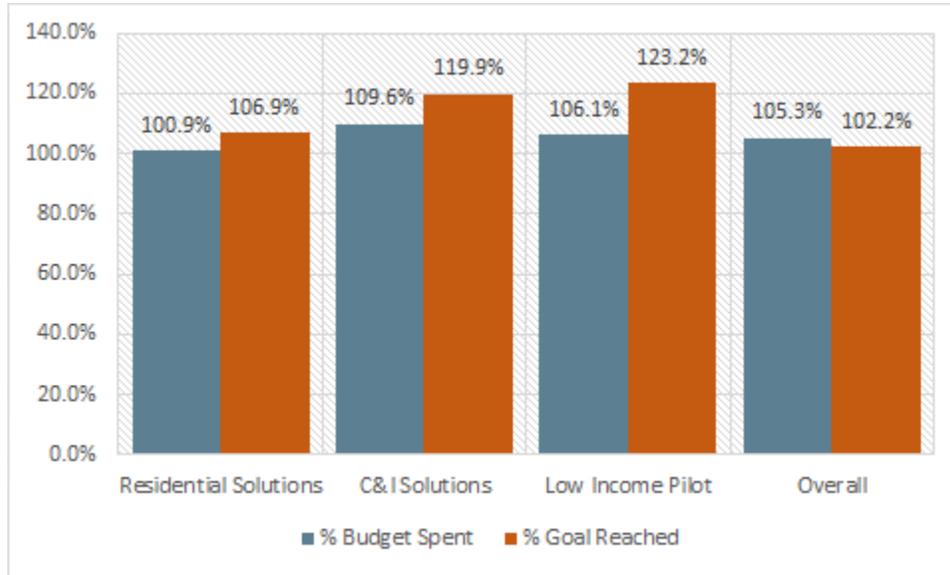


Figure 1-3: Summary of Goal Attainment & Budget Expenditure by Program

The non-energy benefits (NEBs) attained by the BHE portfolio in PY2023 are detailed below.

Table 1-6: BHE PY2023 Ex Post Electric Savings

Program	Measure	Net Annual kWh	Net Peak kW	Lifetime Net kWh
RSP	Smart Thermostats	150,446	0	1,654,908
	Air Infiltration	99,451	61.09	1,093,966
	Ceiling Insulation	280,376	231.05	5,607,521
	Duct Sealing	935,524	438.90	16,839,427
LIPP	Smart Thermostats	1,507	0	16,753
	Air Infiltration	1,572	.93	17,293
	Ceiling Insulation	2,087	1.82	41,731
	Duct Sealing	12,058	5.62	217,047
CISP	Weather Stripping	3,128	2.68	34,405
Total		1,486,149	742.08	25,522,871

Table 1-7: BHE PY2023 Ex Post Water Savings (Gallons)

Program	Measure	Net Annual Water	Net Lifetime Water
RSP	Faucet Aerators	34,627	346,274
	Showerheads		
CISP ²	Custom	1,070,420	10,704,200
	Direct Install	120,000	1,200,000
Total		1,225,047	12,250,474

Table 1-8: BHE PY2023 Avoided/Deferred Replacement Cost

Program	Measure	Net ARC/DRC per Unit	Total DRC
RSP	Res Furnace Early Retirement	\$710.32	\$184,283
	Res Tankless WH	\$355.33	\$35,724
CISP	C&I Tankless WH	\$109.48	\$1,642
Total			\$221,649

1.4 Program Findings

1.4.1 Residential Solutions

The program exceeded program goal.	The program met 106.9% of its filed net savings goal.
Realization rates were high across most measure categories.	The overall realization rate was 101.4%. Realization was high for all measure groups.
Many trade allies are not aware of the Equipment Rebate Pathway.	About two-thirds responding trade allies did not know about the Equipment Rebates pathway until their customer mentioned it to them. Among those trade allies who previously knew about the pathway, the vast majority actively promote it to their customers.

² Direct Install included showerheads. Custom was comprised of steam leak repair, condensate return improvement, and low flow devices.

<p>Some trade allies indicated difficulties with the Equipment Rebate Program application.</p>	<p>Some trade allies indicated their customers do not apply for rebates, even when purchasing efficient equipment, due to perceived difficulties with the application process.</p>
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1.4.2 C&I Solutions

<p>The program met savings goals and was highly cost-effective.</p>	<p>Savings increased by 3.8% compared to PY2022, and the program met 119.7% of its net savings goal</p> <p>Participation increased significantly in the Prescriptive Pathway for the second straight year. Savings by year from this pathway for the program cycle were:</p> <ul style="list-style-type: none"> • PY2020: 24,400 • PY2021: 36,398 • PY2022: 48,397
<p>NEBs have increased significantly.</p>	<p>Water savings decreased significantly compared to PY2022. Savings by year from this pathway for the program cycle were:</p> <ul style="list-style-type: none"> • PY2020: 435,401 • PY2021: 16,312,350 • PY2022: 41,015,414 • PY2023: 1,190,120 <p>This is a volatile value year-over-year as it is heavily driven by the relative prevalence of custom projects that save water.</p>
<p>SEM is growing in prevalence in the Custom Pathway.</p>	<p>SEM constituted 21% of CISP Custom Pathway savings in PY2023, up from 15% in PY2022.</p>

1.4.3 Low Income Pilot

<p>The program met savings goals and was highly cost-effective.</p>	<p>Though savings decreased by 24% compared to PY2022, the program still met 123% of its net savings goal.</p>
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Survey respondents indicated high satisfaction.

Respondents noted high satisfaction across all categories, including 70% reporting being “very satisfied” with the program overall.

1.5 Response to Program Recommendations

In PY2022, three program or portfolio level recommendations were provided to BHE as part of the EM&V of their portfolio. The Evaluators reviewed BHE’s response to recommendations from the PY2022 EM&V report and categorized them as follows:

- 1) **Completed.** Recommendation fully implemented.
- 2) **Continuing.** Recommendation fully implemented. However, due to the nature of the recommendation, this will be an area monitored throughout the next program year.
- 3) **Rejected.** This applies to recommendations which are reviewed by BHE and rejected.
- 4) **In progress.** Recommendation accepted and will be adopted before next program year.
- 5) **Under consideration.** Recommendation still under review by program staff or implementers and no decision yet made.
- 6) **Reviewed and rejected.** Recommendation considered and subsequently rejected or no longer applicable due to changes in program design or operations.

The Evaluators found the disposition of the recommendations as follows:

- (1) recommendation complete (33% of total)
- (2) recommendations in progress 967% of total)

1.6 Report Organization

This report is organized with one chapter providing the full impact and process summary of a specified program. The report is organized as follows:

- Chapter 2 provides general methodologies;
- Chapter 3 provides a summary of portfolio-level issues;
- Chapter 4 provides results for the Residential Solutions Program;
- Chapter 5 provides results for the C&I Solutions Program;
- Chapter 6 provides results for the Low Income Pilot Program;
- Appendix A provides the site-level custom reports for the CISP;

- Appendix B provides Deferred Replacement Cost Calculations;
- Appendix C presents NTG survey tabulations; and
- Appendix D summarizes cost-benefit inputs.

2 General Methodology

This section details general impact evaluation methodologies by program-type as well as data collection methods applied. This section will present full descriptions of:

- Gross Savings Estimation;
- Sampling Methodologies;
- Free-Ridership Determination;
- Process Evaluation Methodologies; and
- Data Collection Procedures.

2.1 Glossary of Terminology

As a first step to detailing the evaluation methodologies, the Evaluators provide a glossary of terms to follow³:

- *Ex Ante* – Forecasted savings used for program and portfolio planning purposes (from the Latin for “beforehand”)
- *Ex Post* – Savings estimates reported by the Evaluators after the energy impact evaluation has been completed (From the Latin for “From something done afterward”)
- *Deemed Savings* – An estimate of an energy savings or demand savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) is applicable to the situation being evaluated (e.g., assuming 17.36 Therms savings for a low-flow showerhead)
- *Gross Savings* – The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated
- *Gross Realization Rate* – Ratio of Ex Post Savings / Ex Ante Savings (e.g., if ADM verifies 15 Therms per showerhead, Gross Realization Rate = $15/17.36 = 86\%$)
- *Free-Rider* – A program participant who *would have* implemented the program measure or practice in the absence of the program. Free riders can be total, partial, or deferred

³ Arkansas TRM V9.1, Volume 1, Pg. 89-95

- *Spillover* – Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program that exceed the program-related gross savings of the participants. There can be participant and/or non-participant spillover rates depending on the rate at which participants (and non-participants) adopt energy efficiency measures or take other types of efficiency actions on their own (i.e., without an incentive being offered).
- *Net Savings* – The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of free drivers, free riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand (e.g., if Free-Ridership for low-flow showerheads = 50%, net savings = 15 Therms x 50% = 7.5 Therms).
- *Net-to-Gross-Ratio (NTGR)* = (1 – Free-Ridership % + Spillover %), also defined as Net Savings / Gross Savings
- *Ex Ante Net Savings* = Ex Ante Gross Savings x Ex Ante Free-Ridership Rate
- *Ex Post Net Savings* = Ex Post Gross Savings x Ex Post Free-Ridership Rate
- *Net Realization Rate* = Ex Post Net Savings / Ex Ante Net Savings
- *Effective Useful Life (EUL)* – An estimate of the median number of years that the efficiency measures installed under a program are still in place and operable
- *Gross Lifetime Therms* = Ex Post Gross Savings x EUL

2.2 Overview of Methodology

The proposed methodology for the evaluation of the PY2023 BHE portfolio is intended to provide:

- Net impact results at the 90% confidence and +/-10% precision at the program-level; and
- Program feedback and recommendations via process evaluation

In doing so, this evaluation will provide the verified net savings results, provide the recommendations for program improvement, and ensure cost-effective use of ratepayer funds.

2.3 Sampling

Sampling is necessary to evaluate savings for the BHE EE portfolio insomuch as verification of a census of program participants is typically cost-prohibitive. As per evaluation requirements set forth by the IEM, samples are drawn in order to ensure 90% confidence at the +/- 10% precision level. Programs are evaluated on one of three bases:

- Census of all participants
- Simple Random Sample
- Stratified Random Sample

2.3.1.1 Census of Participants

A census of participant data was used for programs where such review is feasible. Programs that received analysis of a census of participants include:

- Commercial & Industrial Solutions – Custom Component

2.3.1.2 Simple Random Sampling

For programs with relatively homogenous measures (largely in the residential portfolio), ADM conducted a simple random sample of participants. The sample size for verification surveys is calculated to meet 90% confidence and ±10% precision (90/10). The sample size to meet 90/10 requirements is calculated based on the coefficient of variation (CV) of savings for program participants. CV is defined as:

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

Where x is the average Therms savings per participant. Without data to use as a basis for a higher value, it is typical to apply a CV of 0.5 in residential program evaluations. The resulting sample size is estimated at:

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

Where,

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

CV = Coefficient of Variation

RP = Required Precision, 10% in this evaluation

With 10% required precision (RP), this calls for a sample of 68 for programs with a sufficiently large population. However, in some instances, programs did not have sufficient participation to make a sample of this size cost-effective. In instances of low participation, ADM then applied a finite population correction factor, defined as:

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

Where

n_0 = Sample Required for Large Population

N = Size of Population

n = Corrected Sample

For example, if a program were to have only 100 participants, the finite population correction would result in a final required sample size of 41. The Evaluators applied finite population correction factors in instances of low participation in determining samples required for surveying or onsite verification.

Programs subject to Simple Random Sampling included pathways of the Residential Solutions Program.

2.3.1.3 Stratified Random Sampling

For the BHE Commercial & Industrial Solutions program, Simple Random Sampling is not an effective sampling methodology as the CV values observed in business programs are typically very high because the distributions of savings are generally positively skewed. Often, a relatively small number of projects account for a high percentage of the estimated savings for the program.

To address this situation, we use a sample design for selecting projects for the M&V sample that takes such skewness into account. With this approach, we select a number of sites with large savings for the sample with certainty and take a random sample of the remaining sites. To further improve the precision, non-certainty sites are selected for the sample through systematic random sampling. That is, a random sample of sites remaining after the certainty sites have been selected is selected by ordering them according to the magnitude of their savings and using systematic random sampling. Sampling systematically from a list that is ordered according to the magnitude of savings ensures that any sample selected will have some units with high savings, some with moderate savings, and some with low savings. Samples cannot result that have concentrations of sites with atypically high savings or atypically low savings. Programs that were evaluated using stratified random sampling include:

- Commercial & Industrial Solutions – Direct Install (DI).

2.4 Free-Ridership

In determining ex post net savings for the BHE EE portfolio, the Evaluators provide estimates of free ridership for individual programs. Free riders are program participants that would have implemented the same energy efficiency measures at nearly the same time absent the program. As per TRM V9.1 guidelines, free riders are defined as:

“...program participants who received an incentive but would have installed the same efficiency measure on their own had the program not been offered. This includes partial free-riders, defined as customers who, at some point, would have installed the measure anyway, but the program

persuaded them to install it *sooner* or customers who would have installed the measure anyway, but the program persuaded them to install more efficient equipment and/or more equipment. For the purposes of EM&V activities, participants who would have installed the equipment within one year will be considered full free-riders; whereas participants who would have installed the equipment later than one year will not be considered to be free-riders (thus no partial free-riders will be allowed).”⁴

Given this definition, participants are defined as free riders through a binary scoring mechanism, in being either 0% or 100% free riders. Models of free ridership utilized in these EM&V efforts were aimed at providing a probability of free ridership; this probability value was then rounded to a whole-number free ridership value.

2.4.1.1 Residential Free-Ridership

The Evaluators determine free ridership by measure type and installation type for BHE programs. Free-ridership study groups are delineated by technology, delivery mechanism and target market. The taxonomy of residential free-ridership designations is summarized in Figure

⁴ Arkansas TRM V9.1, Pg. 450.

2-1. Blocks marked in light blue indicate a final free-ridership category.

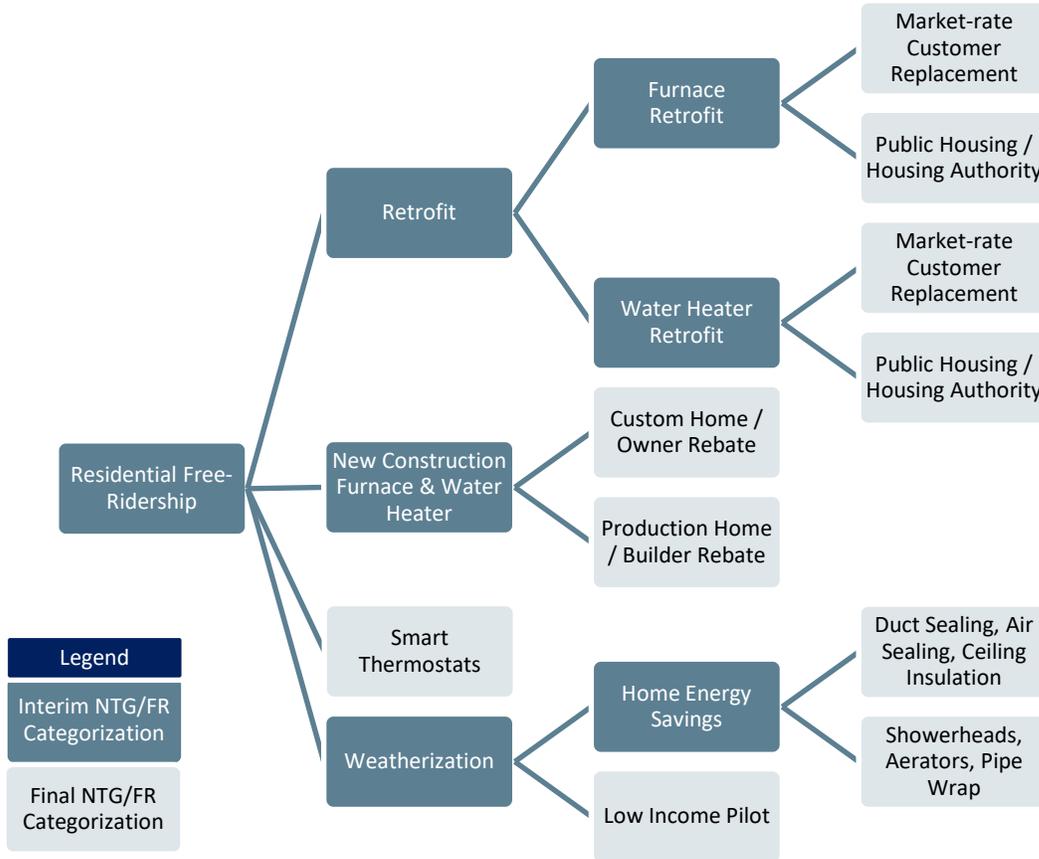


Figure 2-1: Residential Free-ridership Designations

Certain measures were selected to have NTG evaluated by different market segments, as these segments can demonstrate markedly different decision-making processes and cost sensitivities. For example, installation of a high efficiency furnace or tankless water heater is a simpler process in new construction than in retrofit, and the decision is often made by a home builder rather than a homeowner. In instances such as this, the Evaluators segmented participation into key subgroups to better-differentiate the impact of BHE program interventions on various customer segments’ decision-making.

The general methodology for evaluating free ridership among residential participants involved examination of four factors:

- (1) Demonstrated financial ability to purchase high-efficiency equipment absent the rebate
- (2) Importance of the rebate in the decision-making process
- (3) Prior planning to purchase high-efficiency equipment
- (4) Demonstrated behavior in purchasing similar equipment absent a rebate

In this methodology, Part (1) is essentially a gateway value, in that if a participant does not have the financial ability to purchase energy efficient equipment absent a rebate, the other components of free ridership become moot. As such, if they could not have afforded the high-efficiency equipment absent the rebate, free ridership is scored at 0%. If they did have the financial capability, the Evaluators then examine the other three components. The respondent is determined to be a free rider based upon a preponderance of evidence of these three factors; that is, if the respondent's answers indicate free ridership in two or more of these three components, they are considered free riders. Specific questions and modifications to this general methodology are presented in the appropriate program chapters.

For residential programs, free ridership is calculated as the average score determined for the sample of participants surveyed. For programs that are contractor-driven, the free rider score of a survey respondent incorporates the relative importance of advice from their contractor, provided that the contractor is a program trade ally that received training from the appropriate program. This value is then applied to the program-level savings to discount savings attributable to free ridership.

2.4.1.2 Prescriptive Non-Residential Free-Ridership

The general methodology for evaluating free ridership among prescriptive program participants involved examination of four factors:

- (1) Demonstrated financial ability to purchase high-efficiency equipment in the absence of the rebate
- (2) Importance of the rebate in the decision-making process
- (3) Prior planning to purchase high-efficiency equipment
- (4) Importance of the contractor in influencing the decision-making process⁵

In this methodology, Part (1) is essentially a gateway value, in that if a participant does not have the financial ability to purchase energy efficient equipment absent a rebate, the other components of free ridership become moot. As such, if they could not have afforded the high-efficiency equipment absent the rebate, free ridership is scored at 0%. If they did have the financial capability, the Evaluators then examine the other three components. The respondent is determined to be a free rider based upon a preponderance of evidence of these three

⁵ Contractor recommendations were considered to be program-inducement in instances where findings from vendor interviews showed that the program changed the mix of products sold by the vendor and that the vendor responsible for the customers' installation was a program trade ally.

factors; that is, if the respondent's answers indicate free ridership in two or more of these three components, they are considered free riders. Specific questions and modifications to this general methodology are presented in the appropriate program chapters.

For non-residential programs, free ridership is calculated as the average score determined for the sample of participants surveyed. This value is then applied to the program-level savings to discount savings attributable to free ridership.

2.4.1.3 Custom Free-Ridership

For custom projects from the CISP, free ridership is assessed on a case-study basis, through which the Evaluators conduct an in-depth interview that includes a battery of questions addressing:

- The timing of learning of the program relative to the timing of the planning of the retrofit;
- The impact the program incentive has on measure payback relative to the stated payback requirements by the respondent;
- Whether the respondent learned of the energy efficiency measure from a program-funded audit; and
- Whether any influence the program had in modifying the project affected savings by greater than 50%.

In the CISP chapter, the free rider "case studies" are provided for every custom project.

2.5 Impact Evaluation Activities by Program

The Evaluators used established, industry-standard approaches to estimate energy savings at the measure, program, and portfolio levels. We followed all applicable measure- and program-level guidelines and protocols from the AR TRM V9.1.

To evaluate program impacts, the Evaluators adjusted program-reported gross savings using the results of our research, relying primarily on engineering desk reviews, TRM deemed savings calculation, and onsite verification and metering for applicable programs. To calculate deemed savings, we verified the appropriateness of savings algorithms and values in program tracking data as compared to guidelines in the TRM V9.1. Where sampling was used (for surveys and site visits), we designed a sampling plan to achieve a minimum precision of $\pm 10\%$ of the gross realized savings estimate with 90% confidence at the program-level.

Impact evaluation activities by program are summarized in Table 2-1.

Table 2-1: PY2023 Impact Evaluation Activities by Program

Program	Residential Solutions	CISP	Low Income Pilot
Database & Document Review	✓	✓	✓
Engineering Desk Review		✓	
TRM Deemed Savings Review	✓	✓	✓
On-site Verification / Metering	✓	✓	
Simulation Modeling		✓	
Billing Analysis		✓	

2.5.1.1 Net-to-Gross Approach by Program

For the PY2023 evaluation, the evaluation team conducted data collection and analysis to support NTG calculations. Table 2-2: shows the NTG approach the Evaluators followed for each program based on our assessment of specific program needs and the availability of accurate, existing information. These data collection and analysis activities are in compliance with one of the five accepted approaches listed in the TRM V9.1, Protocol F.

Table 2-2: PY2023 NTG Approaches by Program

Program	Assigned PY2022 Value	Literature Review	BHE-specific Survey	Multi-utility Survey
Residential Solutions				
■ Residential furnace retrofit				✓
■ Residential DHW retrofit				✓
■ Residential smart thermostats				✓
■ Housing authority furnace & DHW	✓			
■ New construction – builders	✓			
■ New construction – homeowner / custom				✓
■ Commercial furnace & DHW				✓
■ Home Energy Savings			✓	
CISP				
■ Direct install	✓			
■ Custom			✓	
■ Prescriptive boilers	✓			
■ Prescriptive food service	✓			
Low Income Pilot		✓		

2.6 Process Evaluation

The Evaluators’ general approach to process evaluation begins with a review of the tests for timing and appropriateness of process evaluation as defined in Protocol C of the TRM V9.1. In this review, the Evaluators determine what aspects of the program warrant a process evaluation.

The PY2023 process overviews began with interviews of program staff. These interviews, along with guidance from IEM protocols, inform the establishment of goals for the process evaluation, provide background history of programs, and give an introduction to portfolio-level

issues. From these interviews, the Evaluators then develop a list of data collection activities. The data collection procedures for process evaluations typically included:

- *Participant Surveying.* The Evaluators surveyed statistically significant samples of participants in each program in order to provide feedback for the program and provide an assessment of participant satisfaction.
- *In-Depth Interviews.* The Evaluators conducted in-depth interviews with high-level program actors, including BHE program staff, third-party implementation staff, and program trade allies. These interviews are semi-structured, in having general topics to be covered, without fully prescribed question and answer frameworks.

3 Portfolio-Level Summary

This chapter provides a summary of the portfolio-level findings and any cross-cutting evaluation activities that occurred over the course of the PY2023 EM&V effort. Specifically, this chapter includes:

- A summary of program and portfolio performance in PY2023;
- A summary of EM&V activities and expenditures in PY2023; and
- High-level findings that cut across programs.

3.1 Summary of EM&V Effort

Table 3-1 summarizes the data collection efforts for the PY2023 EM&V effort. “Interviews” should be distinguished from “Surveys” in that “Interviews” reflect semi-structured, in-depth discussions with high-level program actors (such as utility staff and third-party implementation staff) whereas surveys are fully structured and typically conducted with program participants.

Table 3-1: Summary of Data Collection Efforts

Program	# Site Visits	# Surveys	# Interviews
Residential Solutions	37	145	7
CISP	2	0	3
Low Income Pilot	0	20	5
Total	39	145	15

3.2 Tests of Portfolio Comprehensiveness

The APSC has in place a set of criteria in order to determine whether an EE portfolio qualifies as “Comprehensive”. These criteria are:

- **Factor 1:** *Whether the programs and/or portfolio provide, either directly or through identification and coordination, the education, **training**, marketing, or outreach needed to address market barriers to the adoption of cost-effective energy efficiency measures;*
- **Factor 2:** *Whether the programs and/or portfolio, have adequate **budgetary**, management, and program delivery resources to plan, design, implement, oversee, and evaluate energy efficiency programs;*
- **Factor 3:** *Whether the programs and/or portfolio, reasonably address all major **end-uses** of electricity or natural gas, or electricity and natural gas, as appropriate;*
- **Factor 4:** *Whether the programs and/or portfolio, to the maximum extent reasonable, comprehensively address the needs of customers at one time, in order to avoid **cream-skimming** and lost opportunities;*

- **Factor 5:** *Whether such programs take advantage of opportunities to address the comprehensive needs of **targeted customer sectors** (for example, schools, large retail stores, agricultural users, or restaurants) or to leverage non-utility program resources (for example, state or federal tax incentive, rebate, or lending programs);*
- **Factor 6:** *Whether the programs and/or portfolio enables the delivery of all achievable, **cost-effective** energy efficiency within a reasonable period of time and maximizes net benefits to customers and to the utility system;*
- **Factor 7:** *Whether the programs and/or portfolio, have evaluation, measurement, and verification "EM&V") procedures **adequate** to support program management and improvement, calculation of energy, demand and revenue impacts, and resource planning decisions.*

The Evaluators reviewed the BHE programs and portfolio in order to assess whether it complied with the APSC Comprehensiveness Goals. In assessing these metrics, the Evaluators score them on numerous subcomponents. The scoring methodology is as follows:

- : Meets all requirements and is in full compliance with this performance indicator
- ◐: Meets some requirements and is in partial compliance with this performance indicator
- : Is not in compliance with this performance indicator.
- NA: Performance indicator is not applicable to this program.

3.2.1 Factor 1: Education, Training, Marketing, and Outreach

3.2.1.1 Assessment of Education

The Evaluators assessed the educational components of the BHE programs, in order to identify whether the programs were providing potential participants with the needed information to guide their decision-making, and whether the channels used to reach the target markets are appropriate. The Evaluators found that:

- BHE’s programs used a range of channels to provide educational materials to their programs’ target markets. The educational materials included brochures, case studies, and presentations to trade & industry groups.
- BHE program staff conducts outreach and education through a wide range of potential program partners, including contractors, retailers, home builders, and local governments.

The breadth of educational materials by program is summarized in Table 3-2.

Table 3-2: Assessment of Customer Education by Program

<i>Program</i>	<i>Provides Educational Materials</i>	<i>Outreach Through Multiple Channels</i>	<i>Education Targeted to Specific Market Barriers</i>	<i>Coordination of Education by Multiple Entities</i>
Residential Solutions	●	●	●	●
CISP	●	●	●	●
Low Income Pilot	●	●	●	●

- Educational materials broadly provided
- ◐ Program budgeting includes educational materials, but materials not broadly provided
- Educational materials not offered

3.2.2 Assessment of Training

The Evaluators reviewed each BHE program to assess whether:

- 1) The program is trade ally-driven;
- 2) If not, could or should the program be trade ally-driven;
- 3) The program provides training classes to support their program offerings; and
- 4) The program needs trade ally certification.

A summary of the Evaluators’ assessment of training for each BHE program is presented in Table 3-3.

Table 3-3: Assessment of Trade Ally Training by Program

<i>Program</i>	<i>Trade Ally Training Offered</i>	<i>Training Requirements Adhere to Best Practices</i>	<i>Trade Allies Participate in Training</i>
Residential Solutions	●	●	●
CISP	●	●	●
Low Income Pilot	●	●	●

- Category fulfilled in most instances (deviations are an exception)
- ◐ Category fulfilled in some instances (deviations occur regularly)
- Category not offered not offered/not fulfilled at all

BHE does not require trade ally registration to participate for most program pathways. Their approach has been to allow all licensed dealers or contractors to apply for the appropriate equipment rebates. Trade ally training and registration is required for the Home Energy Savings Pathway and for the Low Income Pilot, however. Staff at BHE and CLEAResult came to this conclusion given the extent of service provided by the program, thus requiring trade ally training and registration as warranted.

3.2.3 Marketing & Outreach

The Evaluators reviewed the marketing and outreach strategies associated with each of the BHE programs. These strategies were reviewed to assess whether they adequately addressed the relevant participant barriers, the extent to which trade allies were actively marketing the program (where appropriate), and whether the materials were correctly targeted in marketing a comprehensive approach to energy efficiency.

A summary of the Evaluators’ assessment of BHE marketing and outreach is presented in Table 3-4.

Table 3-4: Assessment of Marketing & Outreach by Program

<i>Program</i>	<i>Marketing Addresses Specific Barriers</i>	<i>Trade Allies Promote Program</i>	<i>Marketing Support Provided to Trade Allies</i>	<i>Marketing Performed Through Diverse Channels</i>
Residential Solutions	●	●	●	●
CISP	●	●	●	●
Low Income Pilot	●	●	●	NA

● Category fulfilled in most instances (deviations are an exception)
 ◐ Category fulfilled in some instances (deviations occur regularly)
 ○ Category not offered not offered/not fulfilled at all

After reviewing the marketing and outreach materials, the Evaluators concluded that:

- Most programs have marketing materials that address specific barriers associated with the targeted segments or technologies.
- The BHE programs are marketed through a diverse range of channels, including mass-media advertising, online advertising, meetings and training sessions with professional organizations and trade groups, and partnered marketing with municipal governments.
- The BHE programs for the non-residential sector all apply past participant case studies in their marketing.
- The Low Income Pilot is not presently intended to be broadly marketed and has been assigned “N/A”.

3.2.4 Factor 2: Budgetary, Management, and Program Delivery Resources

Several performance indicators were assessed in reviewing the adequacy of budgetary, management, and program delivery resources presented in Table 3-5. This included:

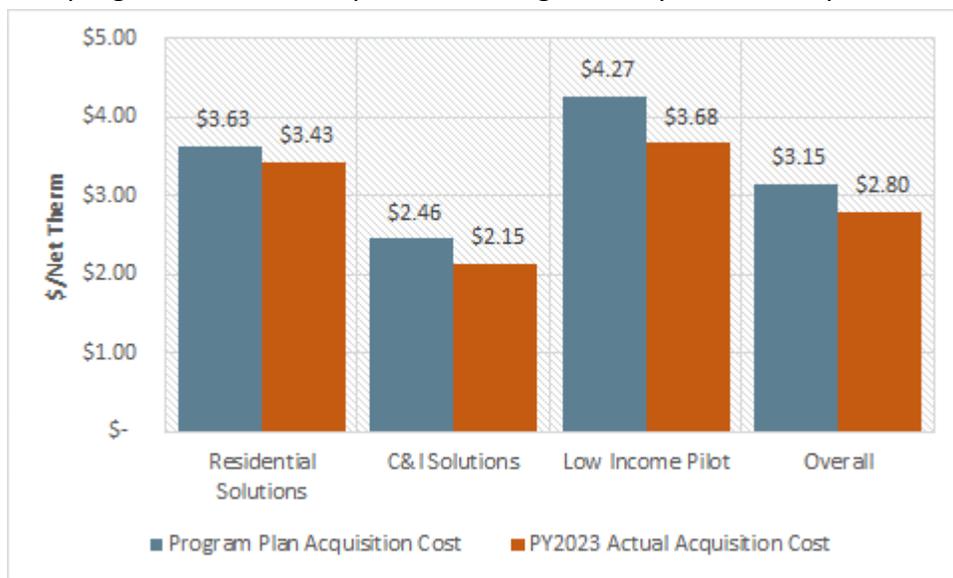
- Self-reports from program management staff
- Cost per Therm saved
- Review of trade ally resources dedicated to program promotion

Table 3-5: Assessment of Budgetary, Management, and Program Delivery Resources by Program

Program	Budget is Sufficient to Support Program Goals	Cost per-Therm Aligns with Program Plan	Program Has Sufficient Staffing	Program Has Sufficient Trade Ally Support
Residential Solutions	●	●	●	●
CISP	●	●	●	●
Low Income Pilot	●	●	●	●

● Quantitative: meets of expectation/requirement
 Qualitative: Category fulfilled in most instances (deviations are an exception)
 ◐ Quantitative: value no lower than 90% of expectation/requirement
 Qualitative: Category fulfilled in some instances (deviations occur regularly)
 ○ Quantitative: value is lower than 90% of expectation/requirement
 Qualitative: Category not offered not offered/not fulfilled at all

Aggregated across all programs, actual cost per therm is significantly lower than planned. As



demonstrated in

Figure 3-1, in PY2023 the BHE portfolio had an acquisition cost of \$2.80 per net therm, lower than the program plan value of \$3.15. At the individual program level, the LIPP significantly outperformed relative to its planned acquisition cost, with acquisition costs at 86% of the program plan value.

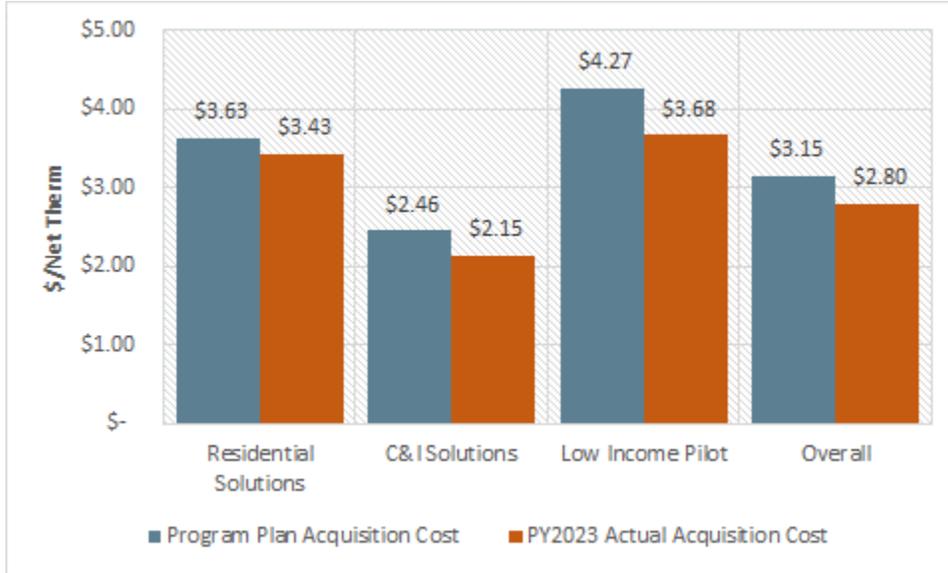


Figure 3-1: Comparison of Program Plan vs. Actual Acquisition Costs

Overall, the BHE portfolio had acquisition costs that were 11% lower than PY2023 plan values.

3.2.5 Factor 3: Addressing Major End-Uses

The Evaluators identified the end-uses served by each of the BHE programs. Most BHE programs are designed around a specific technology or end-use. Table 3-6 summarizes the end-uses addressed by each program.

Table 3-6: End-Uses Addressed by Program

Program	HVAC	Hot Water	Appliances	Food Service	Building Envelope	Industrial Process	Behavioral
Residential Solutions	●	●	○	○	●	○	○
CISP	●	●	●	●	●	●	●
Low Income Pilot	●	●	○	○	●	○	○

● Measure targeted ◐ Measure offered ○ Measure not offered

Presently, the BHE portfolio covers most end-uses. The Evaluators found that sectors where the program offerings were not providing sufficient outreach and market transformation included:

- **Behavioral savings.** BHE cancelled their Home Energy Reports program to allow for the development of the Home Energy Savings weatherization program. This has had the tradeoff of filling residential building envelope but leaving a gap in behavioral savings. Given the program budget allotment, the Evaluators concluded that BHE was correct in prioritizing weatherization over behavioral savings.
- **Residential appliances.** The TRM V9.1 includes deemed savings for residential appliances, including dishwashers and clothes washers. These are not presently offered in any BHE programs. However, given the low unit energy savings of these measures,

any offering for this end-use would need to be an upstream, multi-utility effort to be cost-effective.

Table 3-7 summarizes the percent of projects that are single- versus multiple-measure installations by program. The Evaluators define “multiple measures” as follows:

- **Residential Solutions:** Completing more than one of the following four categories:
 - Furnace
 - Water Heater
 - Smart Thermostat
 - Duct Sealing
 - Air Sealing
 - Ceiling Insulation
 - Faucet Aerators
 - Showerheads
- **CISP:** Completing more than one of the following measures:
 - Custom
 - Prescriptive Boiler
 - Prescriptive Food Service
 - DrySmart Controls
 - Water Pump Controls
 - Direct Install Aerators
 - Direct Install Showerheads
 - Direct Install PRSVs
 - Direct Install Weather Stripping

Or having completed more than one custom measure, either as part of one application or multiple applications.

- **Low Income Pilot:** Completing more than of the energy-saving improvements as part of weatherization, excluding the Assessment and Health & Safety:
 - Duct Sealing
 - Air Sealing
 - Ceiling Insulation
 - Faucet Aerators
 - Showerheads
 - Smart Thermostats
 - Pipe Wrap

Table 3-7: Installation of Multiple Measures

Program	% Single-Measure	% Multi-Measure
Residential Solutions	93%	7%
CISP	84%	16%
Low Income Pilot	0%	100%

3.2.6 Factor 4: Comprehensively Addressing Customer Needs

To assess Factor 4, the Evaluators reviewed BHE programs to discern the extent of:

- Program-provided technical assistance;
- Incentives of comprehensive projects/measure suites; and
- Tiered incentives for higher efficiency levels.

The BHE portfolio has no specific requirements for installation of multiple measures. Customers are able to participate to an extent of their choice. This is a program best-practice in enabling customers to engage in energy efficiency in a manner in accordance with their budget constraints.

Table 3-8 summarizes the comprehensiveness of offerings for each program.

Table 3-8: Assessment of Project Comprehensiveness by Program

Program	Technical Assistance and/or Audits	Information Provided for Comprehensive Efficiency	Bundled Incentives for Multiple Measures	Tiered Incentives for Premium Efficiency	Trade Ally Incentives for Premium Efficiency
Residential Solutions	●	●	●	N/A	■
CISP	●	●	●	●	●
Low Income Pilot	●	●	NA	NA	NA

● Broadly provided ◐ Available ○ Not offered

Findings from the assessment of this factor included:

- Most BHE prescriptive programs offer incentives to trade allies for installation of top-tier efficiency measures. This has included incentives for condensing furnaces, and tankless water heaters.
- The BHE portfolio formerly offered tiered incentives for premium efficiency across all of their rebate programs. In some cases, this tiering has been removed in lieu of only including premium efficiency. Examples include:
 - The incentives for furnaces in the former Equipment Rebates Program used to increase from \$400 for units with 90-94.99 AFUE to \$600 for units with 95 AFUE or greater. The program now only offers incentives for 95 or greater AFUE (\$400 per unit). This decision was made due to low participation in this group; most

program participants historically elected for the 95% AFUE model. BHE has by necessity reduced rebates for furnaces as avoided costs have declined since program inception.

- BHE has removed incentives for storage tank water heaters, opting to incentivize tankless units exclusively.
- Retained tiered incentives include:
 - High efficiency boiler incentives are \$1,400/million BTUs per hour (MMBTUh) input rating for units < 94% efficient and \$2,000/MMBTUh for units with 94% efficiency or greater.
 - The CISP pays an incentive per verified therm, and as a result projects with higher savings are by design paid a higher incentive.
- The BHE portfolio has programs that bundle on-site technical assistance with direct installation.
- The range of technical assistance varies by program. The Residential Solutions Equipment Rebates Pathway offers technical assistance through participating HVAC and plumbing contractors, while the Home Energy Savings Pathway and LIPP offer technical assistance through program-registered trade allies. CISP provides on-site technical assistance that is directly funded by the program.
- The programs have procedures for following up with customers after their participation (including thank-you calls or emails) and verification inspection.
- Marketing materials typically make attempts at cross-promotion of programs.
- The Low Income Pilot was assigned “N/A” for Tiered Incentives, Bundled Incentives, and Trade Ally Incentives categories as all measures are provided without a customer co-pay as part of an enhanced weatherization package under Act 1102 requirements.

3.2.7 Factor 5: Targeting Market Sectors & Leveraging Opportunities

The Evaluators reviewed whether the BHE portfolio offered a comprehensive range of energy efficiency opportunities to all major customer sectors. Table 3-9 summarizes the market sectors and what programs target or allow each sector.

Table 3-9: Assessment of Targeted Customer Sectors by Program

<i>Program</i>	Residential	Multifamily	Mobile Home	Small Commercial	Large Commercial	Industrial	Agricultural	Public Sector
Residential Solutions	●	◐	◐	○	○	○	○	●
CISP	○	◐	○	●	●	●	●	■
Low Income Pilot	●	◐	◐	○	○	○	○	◐

● Program targets this sector
 ◐ Sector is eligible for this program
 ○ Sector is ineligible for this program

Each sector has several programs for which they are eligible, and at least one program that targets them. Segment-specific findings include:

- Public Sector facilities are targeted with a wide range of programs. This has included residential programs that reach out to public housing authorities.
- Rebates for commercial furnaces and water heaters formerly offered through the Equipment Rebates Program are now offered under the CISP.
- Multifamily and mobile homes are technically eligible for BHE residential programs (including the LIPP). In practice, however, these market segments rarely participate in BHE programs as they have a high share of all-electric space heating and water heating equipment.

In addition, the Evaluators reviewed the extent of collaboration and leveraging of available partnership opportunities by BHE.

Examples of cross-utility coordination included:

- BHE has brought on a third-party implementer (CLEARResult) for their CISP. This implementer uses the same program design and similar incentive levels for Summit Utilities Arkansas and AOG. This has allowed for reduced program costs for CISP, which is the largest program in each of the three gas utility portfolios. Further, dual-fuel projects are coordinated with SWEPCO and EAI.
- The Home Energy Savings channel in the Residential Solutions program has program partnering agreements with multiple electric utilities to leverage the effectiveness of program funds.
- BHE has developed the Low Income Pilot in accordance with Act 1102, and this also manifests with a similar program design across utilities.

Examples of coordination with non-utility partners included marketing through industry partners such as professional organizations, trade groups, universities, and homeowners' associations.

3.2.8 Factor 6: Cost-Effectiveness of Energy Efficiency

To assess this factor, the Evaluators reviewed whether:

- Programs met net savings goals;
- The NTG ratios were in line with industry norms; and
- Programs passed cost-effectiveness (TRC) testing.

A summary of Factor 6 findings is provided in Table 3-10.

Table 3-10: Assessment of Cost-Effectiveness

<i>Program</i>	<i>NTGR</i>	<i>NTGR Within Industry Norms</i>	<i>Met Net Savings Goal</i>	<i>Program TRC</i>
Residential Solutions	95.2%	Yes	Yes	2.11
CISP	97.0%	Yes	Yes	1.25
Low Income Pilot	100.0%	Yes	Yes	1.75

All programs and the portfolio overall had a TRC benefit-cost ratio of 1.0 or greater in PY2023.

3.2.9 Factor 7: Adequacy of EM&V Procedures

The Evaluators conducted a review of EM&V procedures by program as implemented by several parties:

- Quality assurance and quality control (QA/QC) and EM&V procedures by BHE program staff;
- QA/QC and EM&V procedures by third-party implementation staff (where applicable)
- QA/QC and EM&V procedures by the Evaluators.

The EM&V of the BHE programs incorporated industry best practices and was conducted in an iterative process that incorporated feedback from BHE and implementation contractors as well as the IEM.

Further, the Evaluators found that BHE has QA/QC procedures that align with industry best-practices, including randomized post-inspection to their programs and targeting of new trade allies for early feedback.

Finally, the Evaluators reviewed the quality of program tracking data in order to assess whether the data allowed for complete evaluation. Further, the Evaluators reviewed the extent to which individual savings calculations were performed using facility-specific inputs into the TRM V9.1

algorithms versus the use of simplifying assumptions⁶. The results of the review are summarized in Table 3-11.

Table 3-11: Assessment of Data & QA/QC Procedures by Program

Program	Tracking Contains Necessary Fields	Savings Calculations Performed and Reported	Savings Calculations Based on Facility Data	QA/QC Inspections by Program Staff
Residential Solutions	●	●	●	●
CISP	●	●	●	●
Low Income Pilot	●	●	●	●

● Process fully developed ◐ Process partially developed ○ No process in place

Findings of this review included:

- QA/QC inspections are in place for all programs.
- CLEAResult conducts inspections of an adequate percent of projects annually and align with industry best practices.

3.3 Cost-Effectiveness Results

Table 3-12 summarizes the cost-effectiveness results by program. Tests performed include:

- **Total Resource Cost (TRC):** Evaluating benefits and costs simultaneously from the perspective of BHE and program participants.
- **Utility Cost Test (UCT):** Evaluating benefits and costs from the perspective of BHE.
- **Ratepayer Impact Measure (RIM):** Evaluating benefits and costs from the perspective of all BHE customers (including participants and non-participants).
- **Participant Cost Test (PCT):** Evaluation benefits and costs from the perspective of program participants.

Table 3-12: Cost-Effectiveness Summary

Program	TRC	UCT	PCT	RIM	TRC Net Benefits
Residential Solutions	2.11	1.59	4.24	0.36	\$3,225,274
CISP	1.25	1.31	5.26	0.44	\$473,836
Low Income Pilot	1.75	1.50	5.13	0.35	\$66,809
EEA	.00	.00	.00	.00	\$0
Regulatory	.00	.00	.00	.00	(\$41,863)
Total	1.76	1.46	4.50	0.38	\$3,724,056

⁶ Examples of this could include assuming average facility square footage for commercial water heating and using that as an input to the savings calculation, as opposed to collecting facility-specific square footage.

3.3.1.1 NEBs Summary

NEBs claimed by-program are as follows:

- **RSP:** avoided replacement costs, deferred replacement costs, kWh, kW, and water;
- **CISP:** avoided replacement costs, kWh, kW, and water; and
- **LIPP:** kWh and kW..

Table 3-13: Residential NEBs

Measure	Water	kWh / kW	Avoided Replacement Cost	Deferred Replacement Cost	AR TRM V9.1 Section
Furnace (early retirement only)				✓	2.1.3
Duct sealing		✓			2.1.11
Smart thermostats		✓			2.1.12
Ceiling insulation		✓			2.2.2
Air infiltration		✓			2.2.9
Tankless water heater			✓		2.3.1
Faucet aerators	✓				2.3.4
Low-flow showerheads	✓				2.3.5

Table 3-14: Commercial & Industrial NEBs

Measure	Water	kWh / kW	Avoided Replacement Cost	Deferred Replacement Cost	AR TRM V9.1 Section
Weather stripping		✓			3.2.11
Tankless water heater			✓		3.3.1
Aerator	✓				3.3.2
Steam leak repair	✓				N/A - Custom
Condensate Return	✓				N/A - Custom

NEBs were a significant contributor to program benefits in PY2023, accounting for 29% of total TRC benefits across the portfolio. Figure 3-2 summarizes the percent of total TRC benefits derived from NEBs.

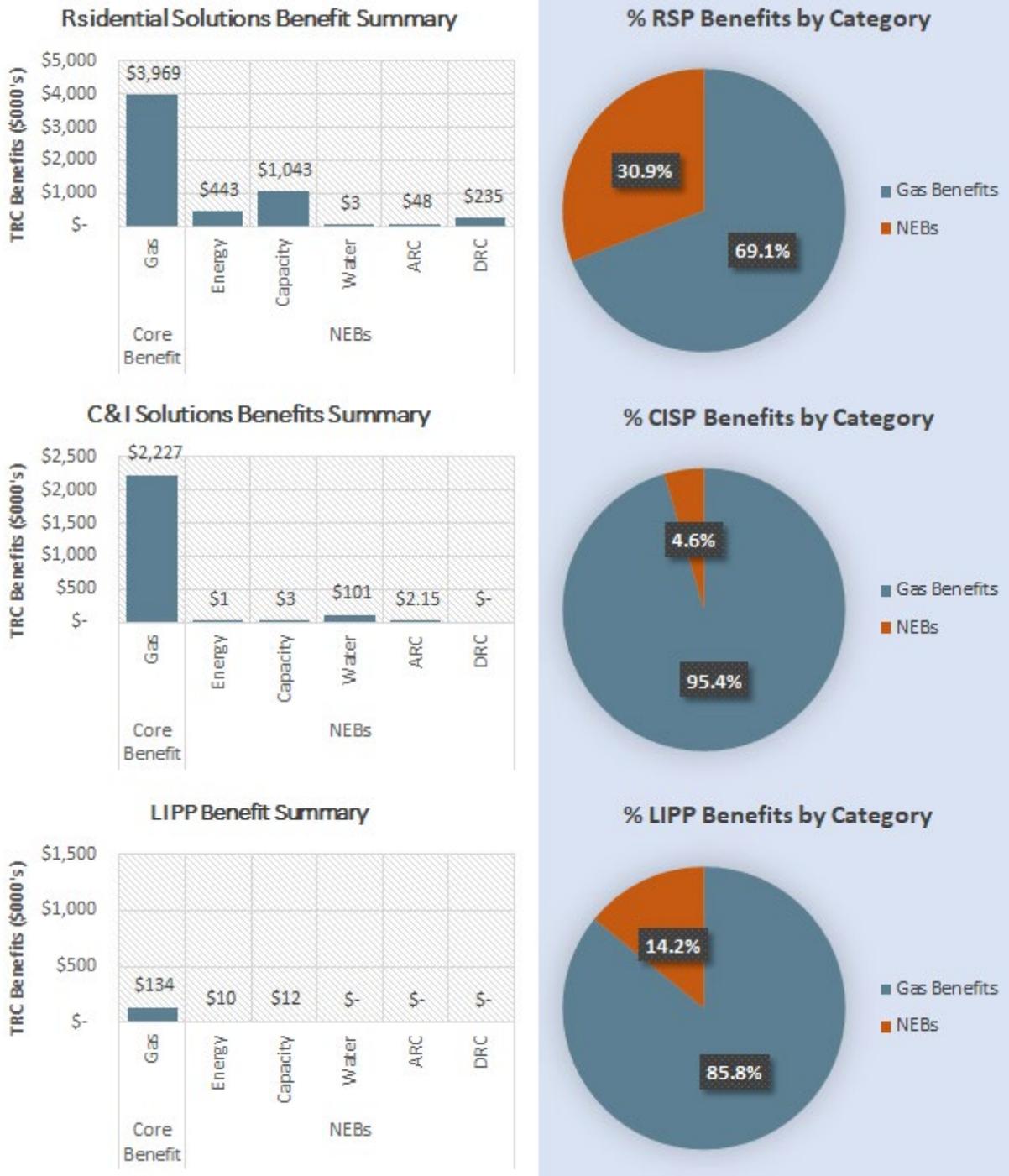


Figure 3-2: Benefit Summary by Program

4 Residential Solutions

The Residential Solutions Program is comprised of two previously separate programs: the Equipment Rebate Program and the Home Energy Savings Program.

The Equipment Rebate Pathway provides incentives to residential customers for high-efficiency space heating, water heating equipment and smart thermostats. Further, a \$50 trade ally incentive is provided for all qualifying furnace and water heating equipment.

Eligible measures for this pathway include:

- \$400 for furnaces with 95% or higher AFUE;
- \$300 for tankless water heaters with an EF of 0.90 or greater; and
- \$50 for a smart thermostat.

The Home Energy Savings Pathway is a weatherization program launched by BHE in late PY2013. The program is designed to train contractors and home energy consultants to analyze the energy use for single and multifamily homes and identify specific energy efficiency improvements which may be undertaken by the customer.

The Home Energy Savings Pathway provides energy assessments, direct installation of low-cost measures and weatherization improvements for qualifying homes.

The HES pathway provides the following measures:

- Faucet aerators;
- Low flow showerheads;
- Air sealing;
- Duct sealing; and
- Ceiling insulation.

The program is implemented by CLEARResult.

4.1 Program Overview

The history of program performance and expenditures is presented in Table 4-1.

Table 4-1: Residential Solutions Performance against Goals

Program Year	# Participants		Budget			Net Therms		
	Actual	Goal	Spent	Allocated	%	Achieved	Goal	%
2020	4,909	4,834	\$2,183,409	\$2,421,798	90.2%	647,495	681,204	95.0%
2021	6,867	4,834	\$2,256,751	\$2,421,798	93.2%	791,836	681,204	116.2%
2022	4,982	4,834	\$2,688,648	\$2,470,073	108.8%	784,542	681,204	115.2%
2023	5,280	4,834	\$2,493,479	\$2,470,073	100.9%	726,434	681,204	106.9%

4.2 Participation Summary

Figure 4-1 summarizes verified net therms savings by measure for PY2023 compared to PY2021-PY2022.

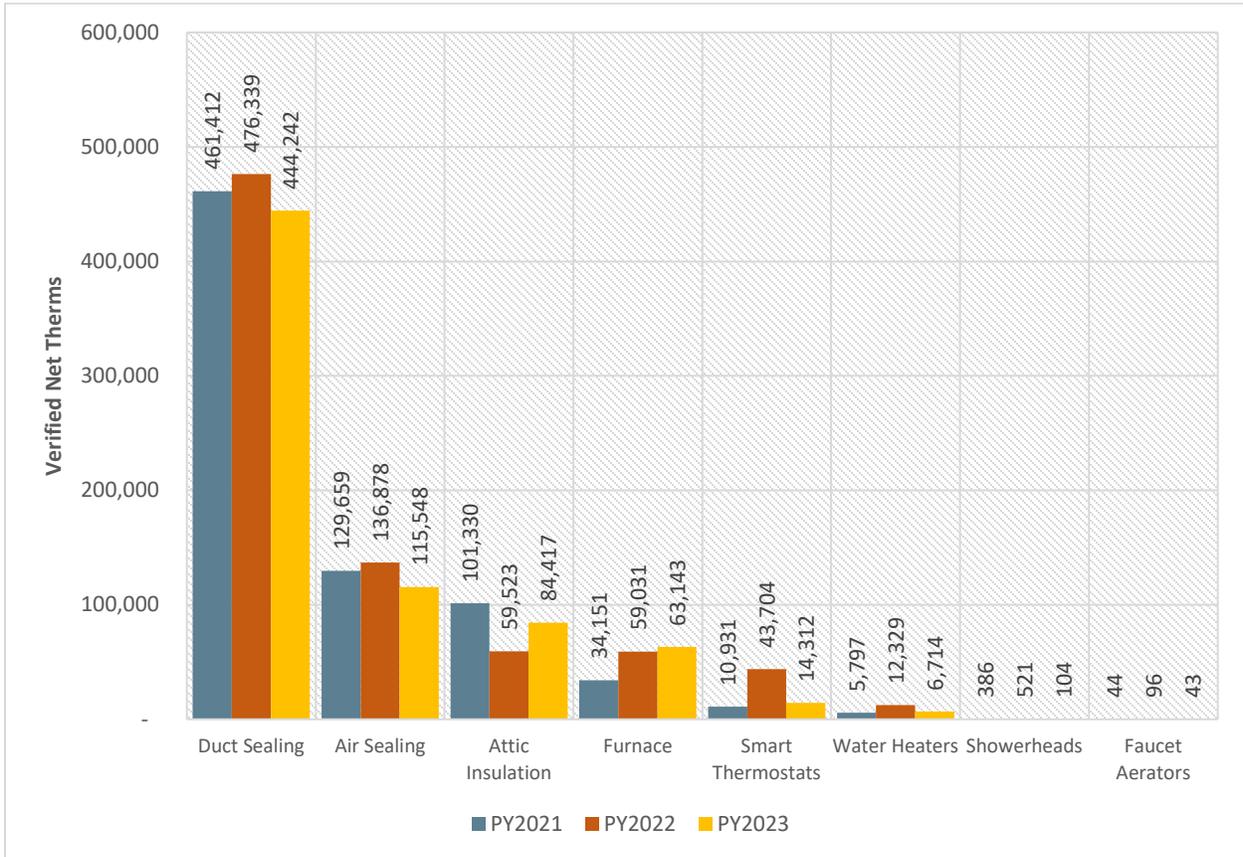


Figure 4-1: Program Savings Share by Measure

4.3 Residential Solutions Program Impact Evaluation

This section provides a brief overview of the data collection activities, gross and net impact calculation methodologies, and process evaluation activities that the Evaluators employed in the evaluation of RSP. The evaluation activities conducted are summarized in Table 4-2.

Table 4-2: RSP PY2023 Impact Evaluation Activities

Gross Impact Evaluation	Net-to-Gross
<ul style="list-style-type: none"> Database review TRM deemed savings calculation review 	<ul style="list-style-type: none"> Phone survey with participating customers Citing prior NTG studies for non-sampled measure groups

4.3.1.1 Gross Impact Evaluation

The evaluation of gross therm savings from projects incentivized through the RSP can be broken down into the following steps:

- First, the program tracking database was reviewed to determine the scope of the program and to ensure there were no duplicate project entries.
- Next, a detailed desk review was conducted for a census of projects in the tracking system. The desk review process entails recalculation of therms and non-energy benefits for each measure and for each participant.
- For the HES Pathway, the Evaluators scheduled on-site inspections with program participants subsequent to completion of documentation reviews. The visits were used to collect data for savings calculations, to verify measure installation, and to determine measure operating parameters.
- After determining the ex-post savings impacts for each sampled project, the ex post savings were combined with the ex-ante savings from the projects not included in the sample to determine a program level savings.

4.3.1.2 Summary of Non-Energy Benefits

Table 4-3 summarizes the non-energy benefits by measure that were credited to the Residential Solutions Program.

Table 4-3: RSP Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	Avoided Replacement Cost	Deferred Replacement Cost
Equipment Rebates Pathway					
■ Furnace Early Retirement					✓
■ Tankless Water Heater				✓	
■ Smart Thermostat	✓				
HES Pathway					
■ Duct Sealing	✓				
■ Ceiling Insulation	✓				
■ Air Infiltration	✓				
■ Low Flow Showerhead	✓	✓			
■ Faucet Aerator	✓	✓			

4.4 Residential Solutions Process Evaluation

Table 4-4: and Table 4-5 summarize the Evaluators’ review of the Residential Solutions Program in comparison to TRM V9.1 Protocol C for timing and conditions of conducting a process evaluation. The Residential Solutions Program is itself a new program but is the combination of two preexisting programs. When assessing the Residential Solutions Program per Protocol C,

the Evaluators did so via a combined examination of past program performance for the formerly separate Equipment Rebates Program and Home Energy Savings Program.

Table 4-4: Determining Appropriate Timing to Conduct a Process Evaluation

<i>Component</i>	<i>Determination</i>
New and Innovative Components	No. The program is unchanged from PY2022.
No Previous Process Evaluation	No. A limited process evaluation was conducted in PY2021 and PY2022.
New Vendor or Contractor	No. The restructured program continues to be implemented by CLEAResult.

Table 4-5: Determining Appropriate Conditions to Conduct a Process Evaluation

<i>Component</i>	<i>Determination</i>
Are program impacts lower or slower than expected?	No. The program met 115% of goal in PY2022.
Are the educational or informational goals not meeting program goals?	No. The program has an established trade ally network.
Are the participation rates lower or slower than expected?	No. The program met exceeded participation goals in PY2022.
Are the program’s operational or management structure slow to get up and running or not meeting program administrative needs?	No. The PY2021 and PY2022 process evaluations found that the operational and management structure for the Equipment Rebates Program and Home Energy Savings Program to be up to speed and efficient in administering the program.
Is the program’s cost-effectiveness less than expected?	No. The program was cost-effective.
Do participants report problems with the programs or low rates of satisfaction?	No. Participant surveys found high satisfaction levels.
Is the program producing the intended market effects?	Yes. Interviews with participants and trade allies have shown market transformation is occurring.

Based on these findings, a limited process evaluation was conducted in PY2023 to address response to PY2022 recommendations.

4.4.1 Residential Solutions - Response to Program Recommendations

In PY2022, the Evaluators provided one program recommendation for the residential solutions program.

Table 4-6: Residential Solutions Response to PY2022 Recommendations

Residential Equipment Rebate Program		
Conduct an audit of deemed inputs in DSMT for measures that differed significantly after the migration. This audit should focus on furnaces, water heaters, and attic insulation calculations.	CLEAResult conducted greater QA and made calculation corrections where needed.	Complete

4.4.2 Equipment Rebates Pathway

PY2023 participation in the Equipment Rebates Pathway is as follows:

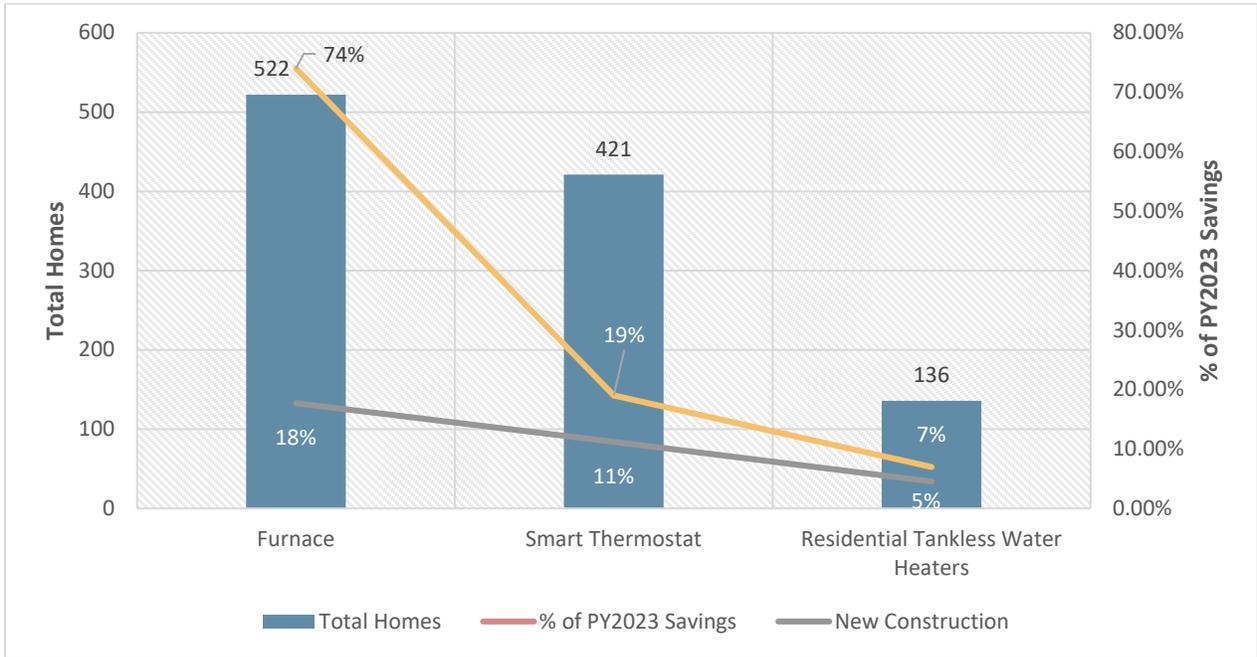


Figure 4-2: ERP Participation Summary

4.4.2.1 Equipment Rebates Pathway Process Evaluation Results

This section includes the process evaluation findings for the Equipment Rebates Pathway.

4.4.2.1.1 Equipment Rebates Pathway - Data Collection Activities

The process evaluation of Equipment Rebates Pathway included the following activities:

- Program Actor In-Depth Interviews.** The Evaluators conducted in-depth interviews with a series of program actors. These interviews covered a range of topics, including marketing efforts, feedback on program delivery, an assessment of barriers to program implementation and success, and recommendations for program improvement. Program Actors interviewed include:
 - BHE Program Staff.* The Evaluators interviewed staff at BHE involved in the administration of the Equipment Rebates Pathway.
 - Third Party Implementation Staff Interviews.* The Evaluators conducted interviews with CLEAResult involved with the Equipment Rebates Pathway.
- Program Participant Surveys.** Evaluators conducted surveys with a series of program participants. These surveys covered a range of topics, including program awareness, participation, and satisfaction. Program participants interviewed include:

- *Customers.* The Evaluators surveyed customers who participated in the Equipment Rebates Pathway.

Table 4-7 summarizes the data collection for this process evaluation effort. This includes the titles, role, and sample sizes for data collection.

Table 4-7: RSP Equipment Rebates Pathway Data Collection Summary

Target	Component	Activity	n	Precision Met	Role
BHE Program Staff	Manager of Energy Efficiency; 3 Program Coordinators	Interview	4	NA	Overall administration of BHE EE programs. This manager is involved in the larger strategic decisions associated with the EE portfolio and is involved with the HES Pathway and in the overall coordination of utility resources.
CLEAR Result Staff	Program Manager	Interview	1	NA	Handles day-to-day operations, including mass market outreach, application review, billing, and logistics
Customers	Participants	Survey	53	±11.5%	Received at least one rebate through the Equipment Rebates pathway.

4.4.2.1.2 Equipment Rebates Pathway - Protocol A Database Review

Table 4-8: RSOL ERP Solutions Protocol A Summary

Category	Field	Status	Description of Issue(s)
Participating Customer Information	Unique customer identifier, such as account number	✓	
	Customer contact information – name, mailing address, telephone number	-	Data was fully present for 75% of ERP projects.
	Date/s of major customer milestones such as rebate application date, approval date, rebate processing date, etc.	✓	
Measure-Specific Information	Measure Group (Equipment Type)	✓	
	Equipment Fuel/Energy Source	✓	
	Equipment Quantity	✓	
	Efficiency Level	✓	
	Estimated Savings	✓	
	Estimated incremental measure cost	✓	
	Equipment Useful Life	✓	
	Measure Name – Text Description	✓	
	Measure Name – Numerical Code	N/A	
	Serial Number	N/A	
	Reported age of equipment replaced	N/A	
	Reported measure type of equipment replaced	✓	
Other inputs necessary for the use and compliance with the TRM	✓		
Vendor-Specific Information	Name and Contact Information for Contractor	✓	
	Contractor Type	✓	
	Date of Installation	✓	
	Cost of the installed equipment	✓	

	Efficiency level of the installed equipment	✓	
Program Tracking Information	Date of the initial program contact/rebate information	✓	
	Date of rebate/incentive paid	✓	
	Incentive amount paid to-date	✓	
	Incentive amounts remaining	✓	
	Application Status (i.e., number of applications approved, pending, or denied)	✓	
	Reason and reason code for application denial	✓	
Program Costs	Overall program budgets	✓	
	Program expenditures to-date	✓	
	Incentive Costs	✓	
	Administrative Costs	✓	
	Marketing/Outreach Costs	✓	
	Evaluation Costs	✓	
Marketing and Outreach Activities	Advertising and marketing spending levels	-	Not itemized from total marketing costs in data provided to the Evaluators.
	Media schedules	N/A	
	Summary of number of community events/outreach activities	✓	
	Other media activities – estimated impressions via mailings, television/radio; print ads.	✓	

4.4.2.1.3 Equipment Rebates Pathway - Program Theory & Design

The Equipment Rebates Pathway is designed to provide straightforward prescriptive incentives for high efficiency furnaces, water heaters, and smart thermostats. The program is designed to engage both the retrofit and new construction markets. Contractors may participate as long as they have the appropriate licensing.

4.4.2.1.4 Equipment Rebates Pathway - Program Administration

The Equipment Rebates Pathway is overseen by the Manager of Energy Efficiency at BHE. This manager’s responsibilities primarily included interfacing with CLEAResult, who directly implements the program. Other activities by this manager included providing updated customer lists to CLEAResult to better facilitate their implementation, participation in outreach events, and at times assisting CLEAResult in customer interactions. Three program coordinators also assist with the program; these staff split their time across the different portfolio programs focusing on specific tasks for each program and pathway including 1) trade ally connections, 2) data administrations, and 3) quality control.

For CLEAResult, the roles and responsibilities of program staff are as follows:

- **Program Manager.** The Program Manager oversees day-to-day activities, supervises program staff, and handles complaints from customers or contractors.

- **Program Coordinator/Specialist.** This staff member coordinates tracking data, develops samples for quality assurance inspection, and supports reporting and invoicing requirements.

4.4.2.1.5 Equipment Rebates Pathway - Program Implementation & Delivery

The Equipment Rebates Pathway promotes high efficiency natural gas equipment in new and existing homes. It will drive participation in the program by developing relationships with participating partners and educating consumers to influence their purchasing behavior.

This offering promotes the purchase of energy efficient products by providing the benefits of downstream incentives. Mail in/online rebates are available for installation of qualified equipment to BHE residential customers. All eligible measures have deemed savings values in the TRM. Participating contractors and implementation staff will provide customers with assistance in identifying potential measures. Monetary incentives are paid to eligible customers for the installation of eligible measures in qualifying residential homes.

4.4.2.1.6 Equipment Rebates Pathway – Measures

The only change to the measures offered through the residential equipment rebate pathway was the introduction of a new construction bundle; the bundle includes a smart thermostat, furnace, and tankless water heater rebates. Staff have not heavily marketed this new bundle, but rather are observing its status to determine if they should move forward with it in the future. The main purpose of the bundle is to increase interest in tankless water heater rebates.

4.4.2.1.7 Equipment Rebates Pathway – Trade Allies

Equipment rebate customers can use any trade ally they like for the rebates program as long as they are licensed plumbers, HVAC installers, or contractors.

4.4.2.1.8 Equipment Rebates Pathway - Marketing

CLEAResult is the implementer for the Equipment Rebates Pathway and oversees marketing efforts. The program is directly marketed by participating HVAC and plumbing contractors, who use program incentives as part of their business' customer outreach. Other marketing efforts include encouragement of program referral among participants and promotion of the program on the BHE website. All marketing materials are BHE branded.

4.4.2.1.9 Equipment Rebates Pathway – Participant Survey

Evaluators conducted a survey of customers who participated in the BHE's equipment rebate program to gather feedback about customers' engagement with and experience of the programs. Customers were contacted via email three times and invited to complete the survey. Fifty-three participants responded to the survey for a response rate of 24.0%.

4.4.2.1.9.1.1 Respondent Demographics

Table 4-9 summarizes respondent demographics.

Table 4-9: Respondent Demographics (n varies)

Answer	%	Count
Homeownership status (n=53)		
Rent	1.9%	1
Own	96.2%	51
Own but rent to someone else	0.0%	0
Prefer not to answer	1.9%	1
Household size (n=53)		
1 person	7.6%	4
2 people	37.7%	20
3 people	17.0%	9
4 people	28.3%	15
5 people	7.6%	4
6 people	0.0%	0
7 people	0.0%	0
8 people or more	0.0%	0
Prefer not to answer	1.9%	1
Age (n=53)		
18 - 24	0.0%	0
25 - 34	9.4%	5
35 - 44	32.1%	17
45 - 54	11.3%	6
55 - 64	20.8%	11
65 - 74	11.3%	6
75+	13.2%	7
Prefer not to answer	1.9%	1
Household includes 65 + year old (n=53)		
Yes	26.4%	14
No	66.0%	35
Don't know	3.8%	2
Prefer not to answer	1.9%	1

4.4.2.1.9.1.2 Program Awareness and Engagement

Respondents learned about the program a variety of ways, most commonly through the Black Hills Energy website (Figure 4-3). **Respondents were most interested in the program to save money on energy bills** (64.2%, n=34), followed by improving the comfort of their home (24.5%, n=13) and getting a rebate (11.3%, n=6) (Figure 4-4).

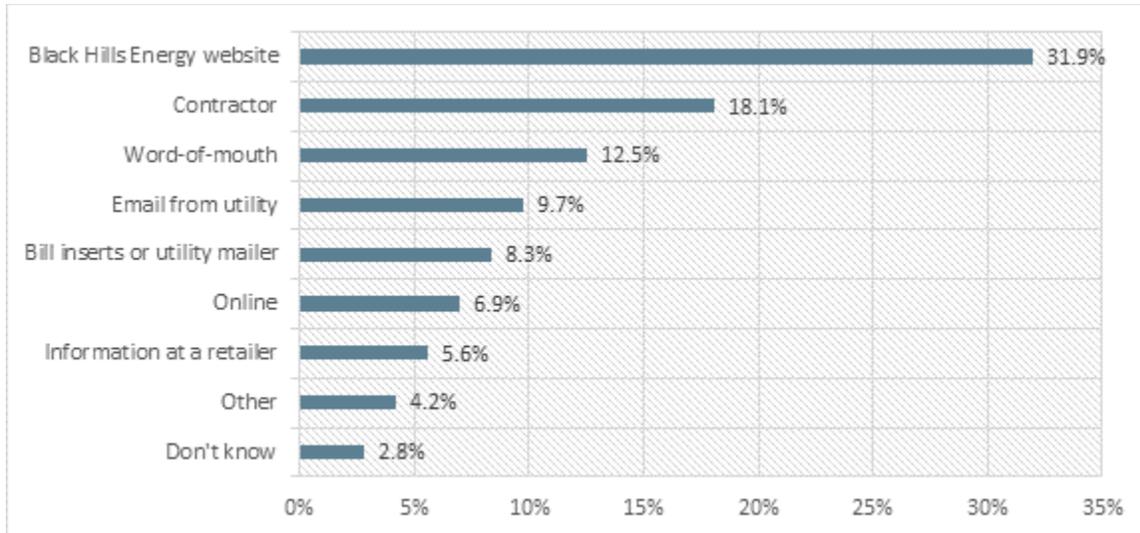


Figure 4-3: Program Awareness (n=53)

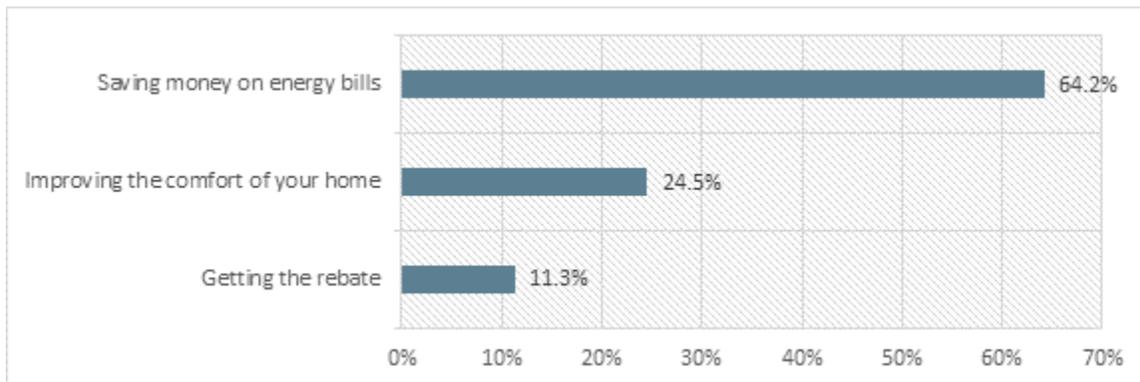


Figure 4-4: Most Important Motivator for Participation (n=39)

Respondents received rebates for water heaters, smart thermostats, and furnaces (Table 4-10). Fifty-seven rebates were distributed to 53 respondents. **Few respondents replaced fully broken equipment (5.7%, n=3)**; instead, respondents mostly replaced of fully working equipment (67.9%, n=36), equipment needing some repair (18.9%, n=10), or new installations (7.5%, n=4) (Figure 4-5).

Table 4-10: Equipment Rebated (n varies)

	Broken	Working			New install
		Major repairs needed	Minor repairs needed	No repairs needed	
Water heater (n=4)	1	0	0	0	3
Smart thermostat (n=38)	1	0	2	33	2
Furnace (n=14)	1	5	3	4	1
Total	3	5	5	37	7

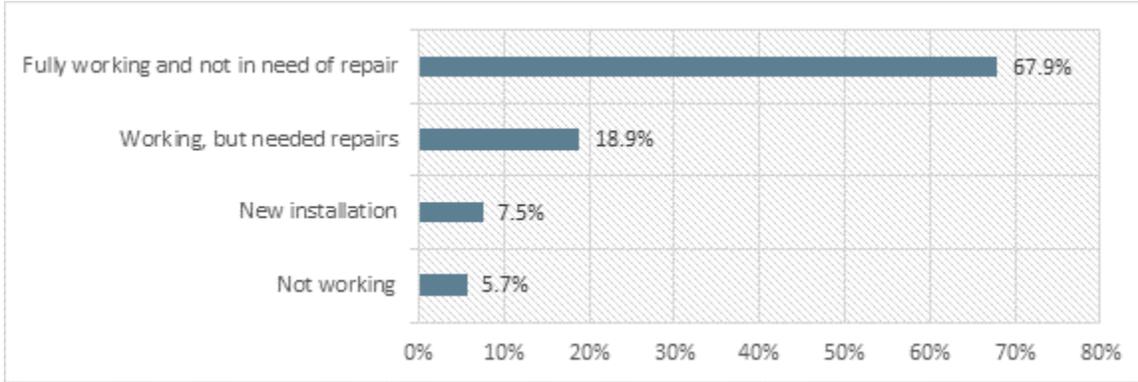


Figure 4-5: Status of Equipment Rebated (n=53)

Most respondents had to pay some money for the equipment they received a rebate for (92.5%, n=49); most respondents were also planning on buying new equipment before they learned about the rebates (58.5%, n=31). More than half of respondents indicated they would have bought the same piece of equipment even if the incentive was not available (54.7%, n=29), however one-fifth noted they would have bought something different (20.8%, n=11). Many of these respondents indicated they would have bought less efficient equipment (45.5%, n=5).

Some respondents have installed additional energy efficient equipment because of their experience with the program (21.2%, n=11). These respondents purchased ENERGY STAR appliances, low flow showerheads, low flow faucet aerators, water heater insulation, and other equipment (Table 4-11).

Table 4-11: Additional Equipment Purchased (n=11)

Answer	%	Count
ENERGY STAR appliance	40.0%	16
Low flow showerheads	20.0%	8
Water heater pipe insulation	10.0%	4
Low flow faucet aerators	5.0%	2
Other energy efficient equipment	25.0%	10

Less than two-thirds of the respondents hired a contractor to install their equipment (61.1%, n=22). Contractors helped respondents decide what equipment to buy over half the time (Figure 4-6). More than a third of the respondents were referred to the contractor by a friend or relative (35.5%, n=11) and a fifth had worked with their contractor in the past (19.4%, n=6). In general, contractors emphasized the energy efficiency of the equipment when providing recommendations.

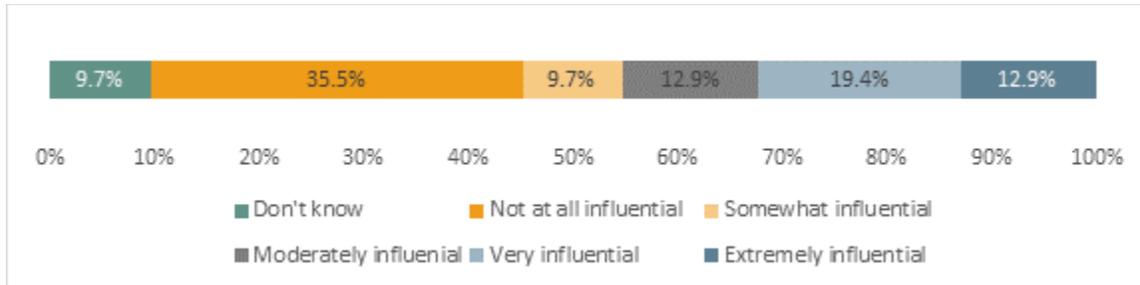


Figure 4-6: Contractors' Role in Equipment Choice (n=31)

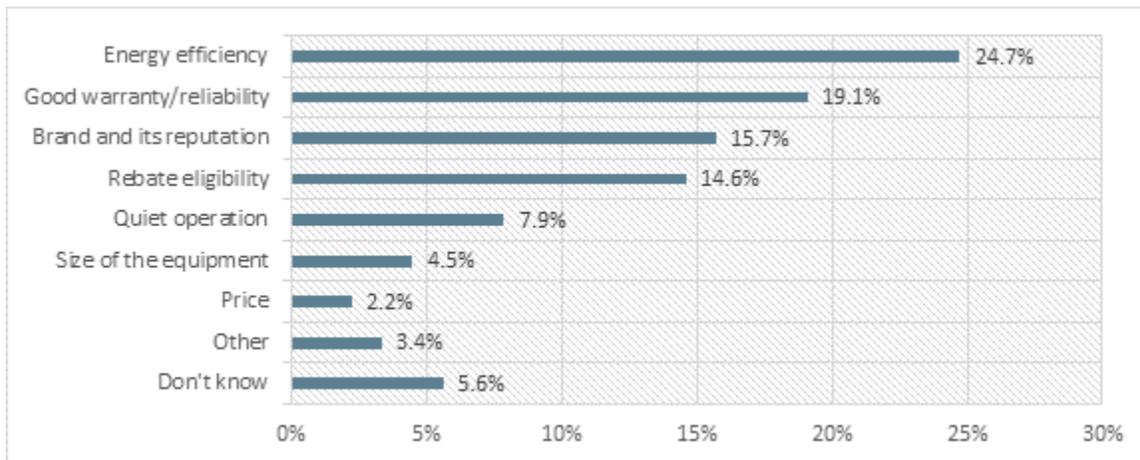


Figure 4-7: Equipment Components Emphasized by Contractor (n=31)

4.4.2.1.9.1.3 Program Satisfaction

In general, respondents were satisfied with the program (Figure 4-8) and BHE as their service provider (Figure 4-9). Six respondents expressed dissatisfaction with the program; reasons for dissatisfaction included the quality of the installed thermostat (n=1), the number of thermostats covered by the program (n=1), the amount of rebate received (n=1), the required documentation (n=1), follow-up after installation (n=1). The overwhelming majority of respondents indicated they are likely to recommend the program to their friends and family (92.5%, n=49).

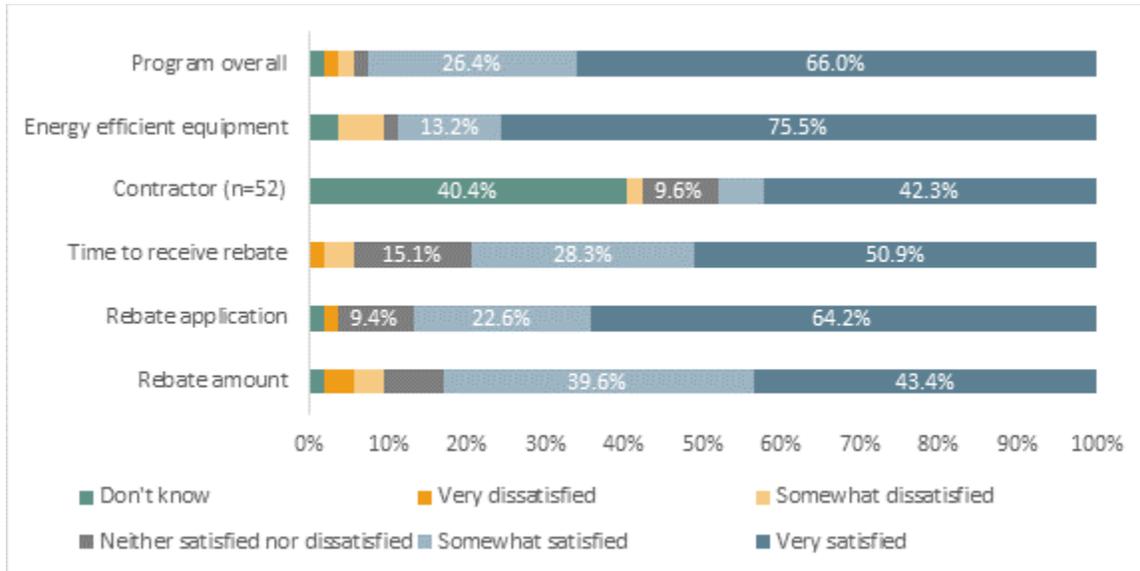


Figure 4-8: Program Satisfaction (n=53, unless noted)

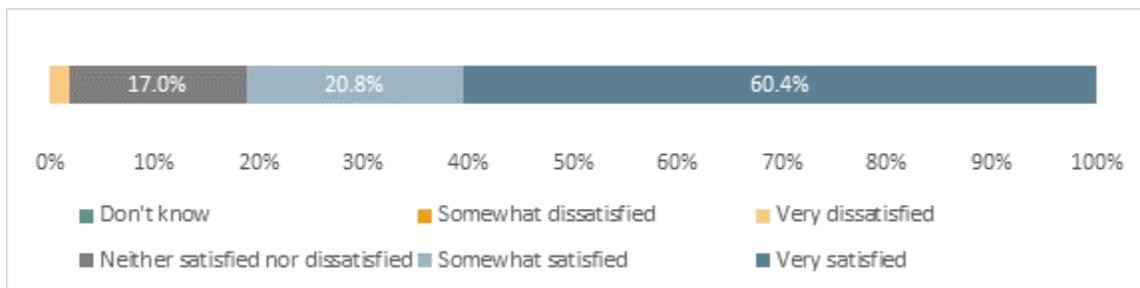


Figure 4-9: Satisfaction with BHE (n=53)

4.4.2.1.10 Equipment Rebates Pathway Trade Ally Survey Results

Evaluators conducted a survey of trade allies who participated in the Arkansas gas utilities' equipment rebate programs to gather feedback about trade allies' engagement with and experience of the programs. Tracking data included 299 unique trade ally contacts across the three utilities. Of these participants, 153 had valid email addresses. Trade allies were contacted via email three times and invited to complete the survey. 19 participants responded to the survey for a response rate of 12.4%.

Because trade allies participated across all three equipment rebate programs and all three programs are structured similarly, results are combined for all three programs.

4.4.2.1.10.1.1 Program Awareness and Engagement

The majority of responding trade allies were HVAC or water heater contractors (Figure 4-10). About half of the survey respondents represented businesses with one to four employees (90.4%, n=2) (Figure 4-10). All but two of the respondents had previously participated in the program (89.5%, n=19); the remaining respondents learned about the programs through trade associations.

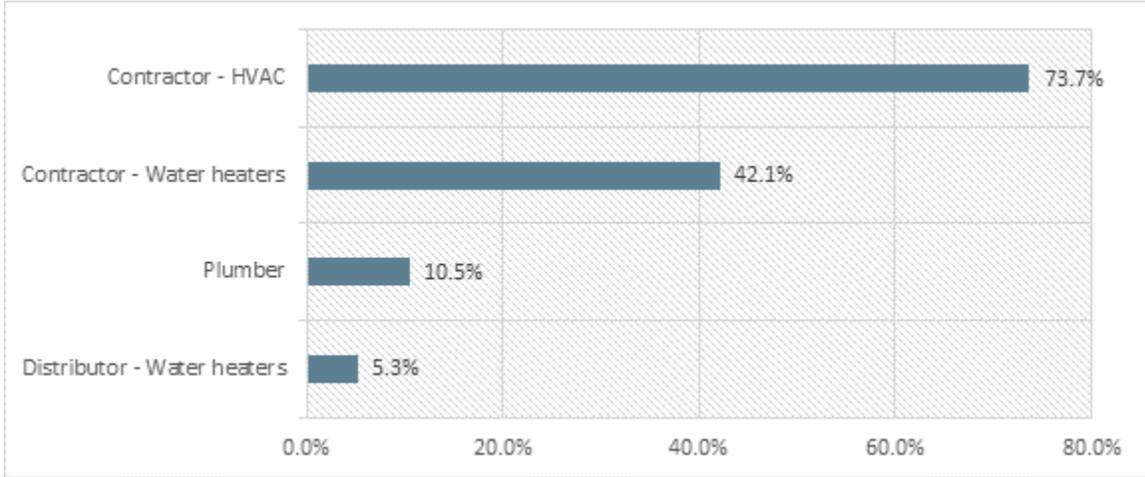


Figure 4-10 Business Type (n=21)

Table 4-12: Number of Employees (n=19)

Employees	%	n
1 to 4	47.4%	9
5 to 9	10.5%	2
10 to 19	21.1%	4
20 to 99	15.8%	3
Prefer not to answer	5.3%	1

On average, about one-third of survey respondents' customers were aware of the incentives available through the equipment rebate programs prior to their mentioning it. Respondents noted that the utilities can increase program awareness through simplified application process (n=2), bill inserts (n=1), expanding marketing materials (n=1), and increased promotion of the benefits of efficient equipment (n=1). The majority of respondents actively promote the rebate programs to their customers (90.4%, n=19); popular marketing techniques include mentioning it during home visits, posting on company website, mentioning it in cost estimates, and including information in sent materials (Figure 4-11).

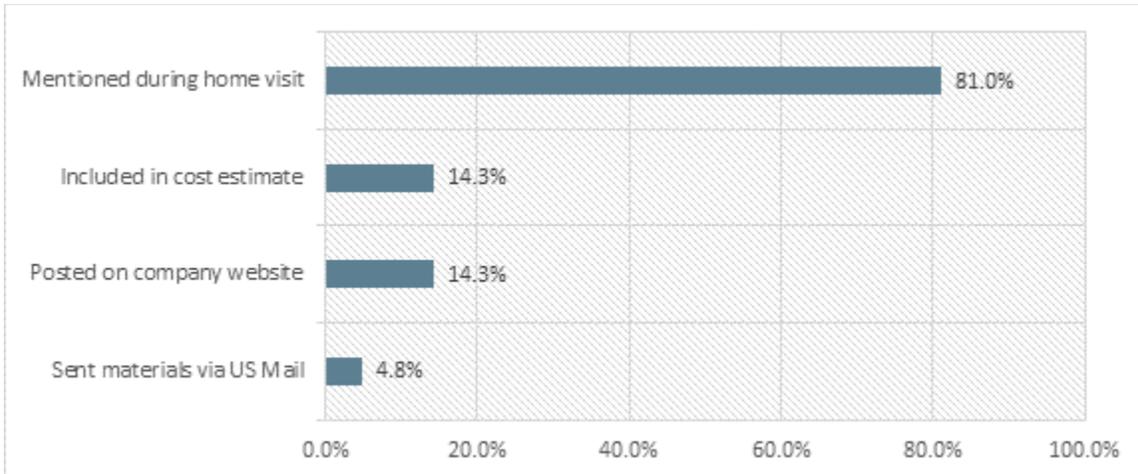


Figure 4-11: Program Marketing (n=19)

Most survey respondents noted they promote some equipment more than other equipment (84.2%, n=16), specifically tankless water heaters (n=6); eight respondents also had preferred brands. In general, survey respondents rely on price (n=8), customer service support (n=6), equipment quality (n=4), and energy savings (n=3) when choosing which equipment to promote. Half of the survey respondents noted that involvement in the program has affected the types of equipment they promote (52.6%, n=10), with all ten respondents indicating they are more likely to promote efficient equipment because of the rebates.

Across all 21 respondents, upfront equipment cost was the main reason their customers do not purchase efficient equipment.

More than half of the respondents complete the entire program application for their customers (57.1%, n=12) and one-quarter assist their customers in completing the application (26.3%, n=5). Seven (36.8%) of respondents noted that some of their customers did not apply for a rebate even though they purchased efficient equipment; these customers did not apply for a rebate due to issues with the application. In open-ended interviews, both trade allies also identified challenges with the application including discrepancies in the amount of the rebate applied for versus what is approved (n=1), and issues with AHRI numbers being recognized in the submission portal (n=1).

4.4.2.1.10.1.2 Program Satisfaction

In general, respondents were satisfied with the equipment rebate programs (Figure 4-12). More respondents expressed dissatisfaction with the “steps taken to get through the program” than any other category (23.8%, n=5), citing the difficult to use rebate portal and application process. Most respondents believe the incentive levels provided by the programs are appropriate (80.9%, n=17).

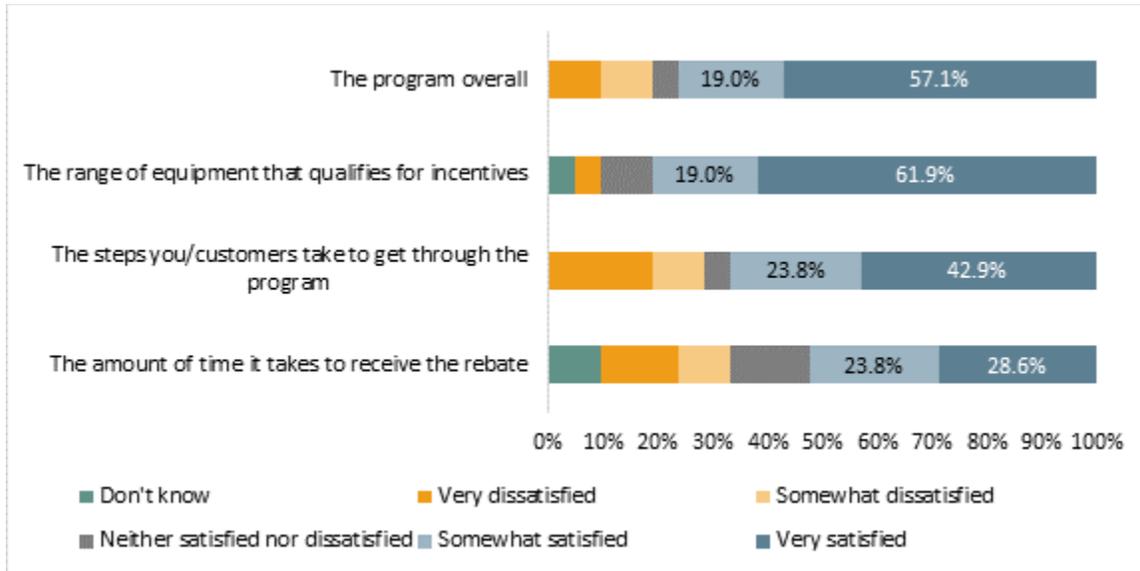


Figure 4-12: Program Satisfaction (n=21)

Survey respondents indicated that email is the most effective ways for utilities to keep them updated about programs (Figure 4-13). Among the two-thirds of survey respondents who interacted with program staff during the program year (68.4%, n=13), all but three were satisfied with all aspects of their communication with program staff (Figure 4-14). Dissatisfied survey respondents cited application issues (n=2), staff’s professionalism (n=2), and confusion over program components (n=1). Moreover, across all respondents, eleven highlighted issues with the portal and application process, noting the system is frustrating and not user friendly.

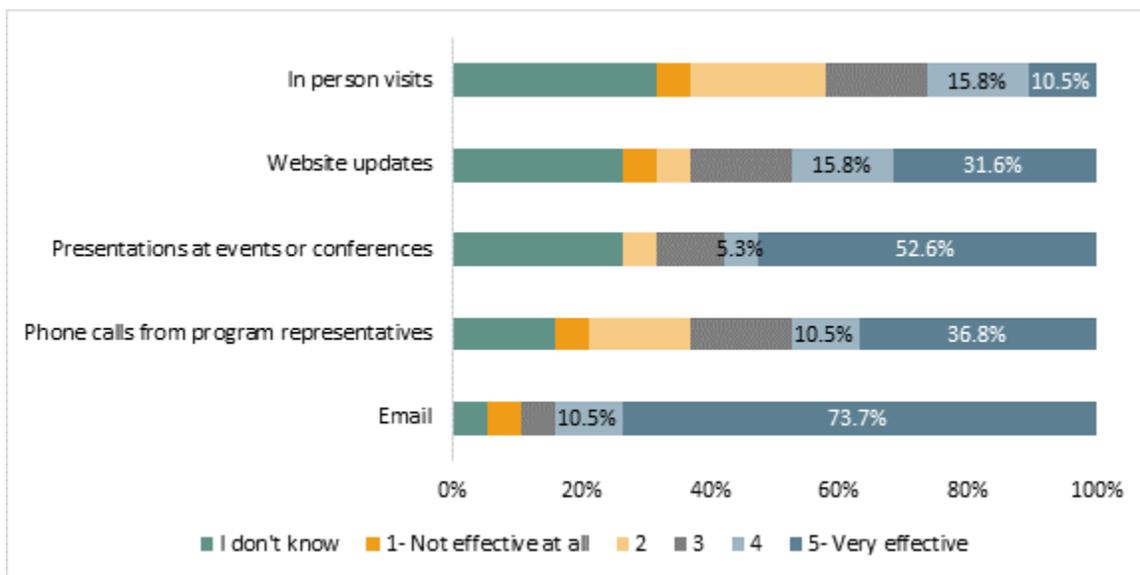


Figure 4-13: Preferred Communication Methods (n=19)

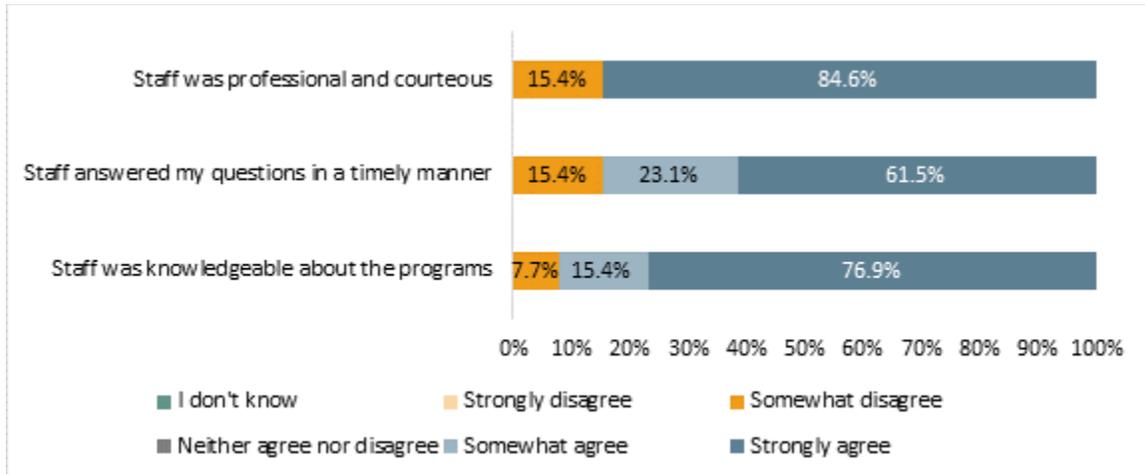


Figure 4-14: Interactions with Utility Staff (n=13)

4.4.3 Home Energy Savings Pathway

4.4.3.1 Home Energy Savings Participation Summary

The HES Pathway had 1,565 participants in PY2023. This includes:

- 1,201 customers that received one assessment;
- 363 customers received duct sealing, air sealing, or ceiling insulation but no assessment in PY2023.

4.4.3.1.1 Home Energy Savings Pathway Impact of Home Assessments

The Evaluators reviewed the measure installations energy savings for participants in the HES Pathway. The Evaluators key findings from this review were:

- 76.7% of participating homes received an assessment.
- Similar to prior program years, assessment homes had significantly higher savings than homes that install-only.

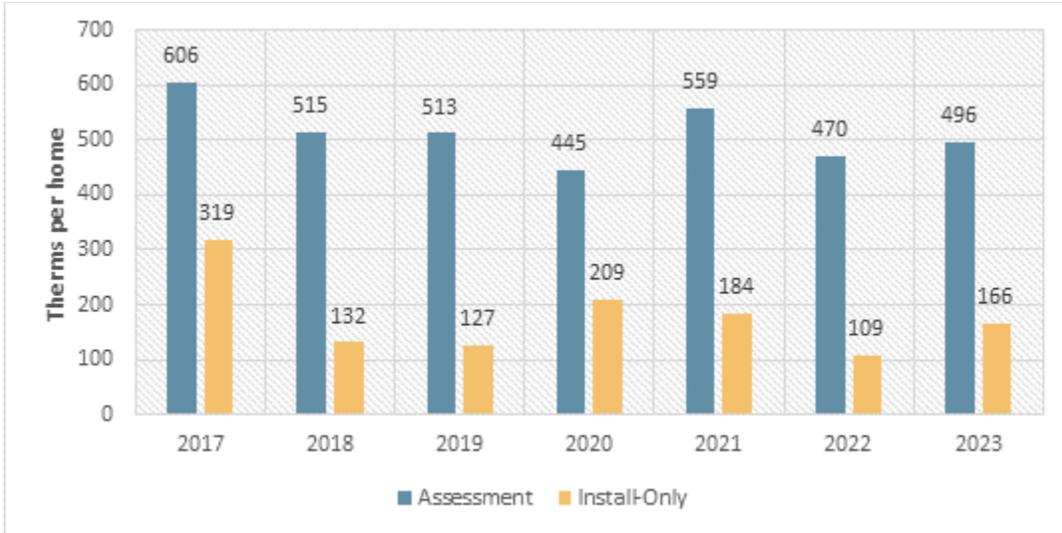


Figure 4-15: HES Pathway - Per-Home Therms Savings: Assessment vs. Install-Only

As shown in Figure 4-16, the measure mixes largely remained the same between 2020 and 2023.

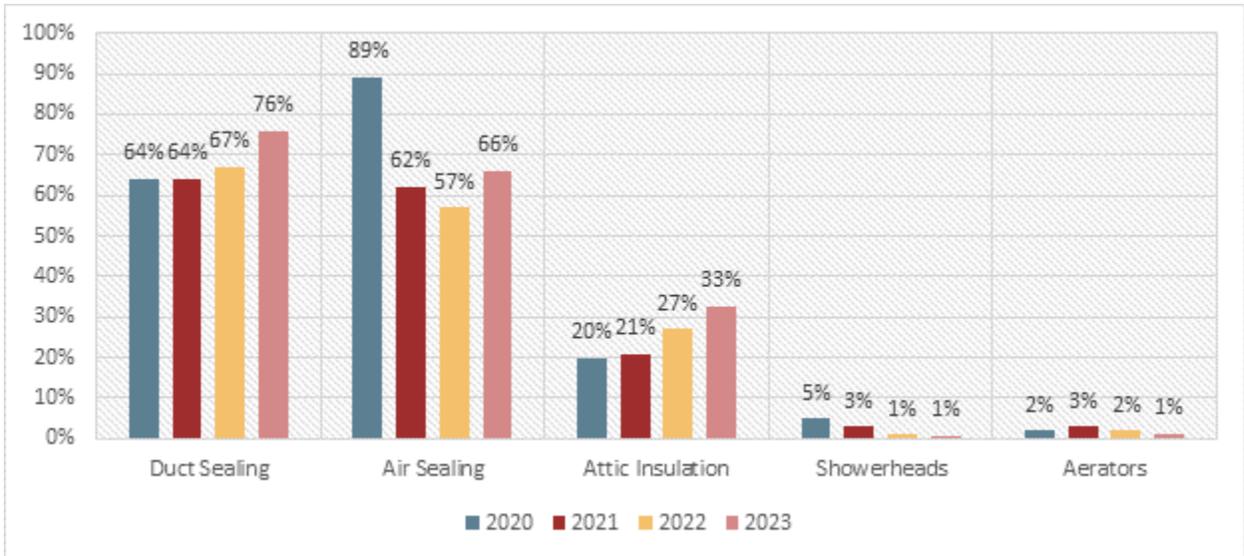


Figure 4-16: HES Pathway - % Houses with Each Measure

4.4.3.1.2 Home Energy Savings Pathway Contractor Participation

In PY2023, the Home Energy Solutions pathway had six registered trade allies. All registered allies were active in the program in PY2023. As shown in Figure 4-17, most trade allies installed duct sealing and air sealing improvements at a large majority of their projects. In PY2023, one trade ally completed 41% of total projects. Other trade allies completed between 0.1% and 36% of total projects.

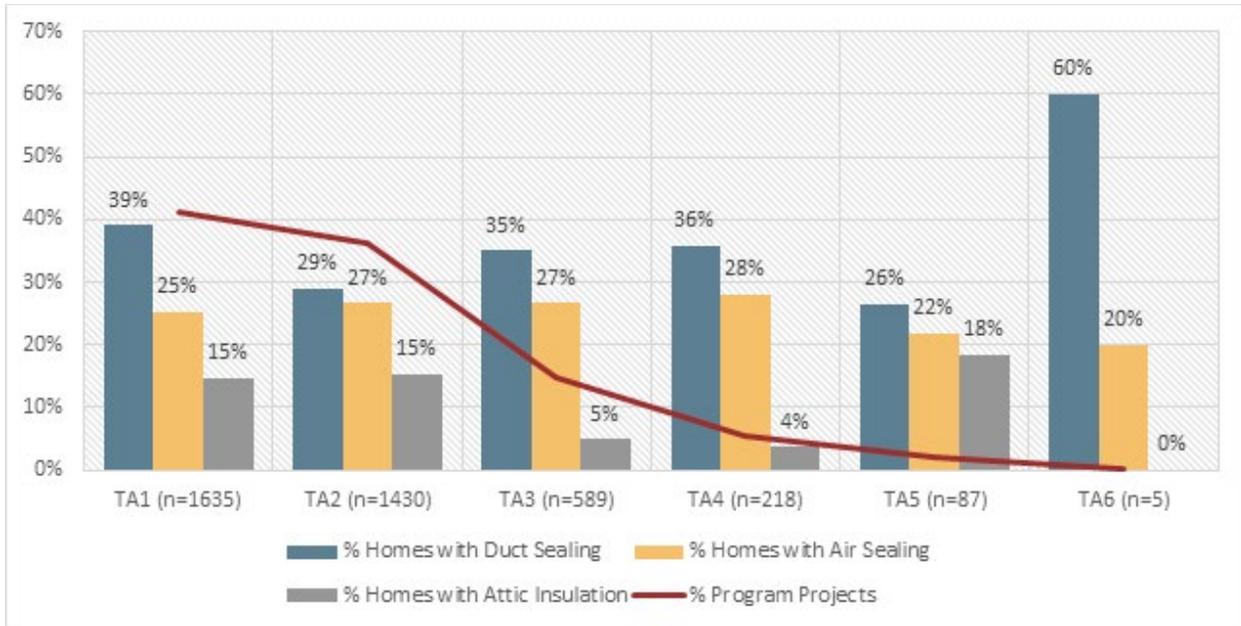


Figure 4-17: HES Pathway Trade Ally Participation Summary

4.4.3.2 Home Energy Savings Pathway Process Evaluation Results

This section includes the process evaluation findings for the HES Pathway.

4.4.3.2.1 Home Energy Savings Pathway - Protocol A Database Review

The CLEAResult tracking system contained full detail with project addresses, contact information, and measure inputs. Further, the tracking system provided the therm savings for each line item.

During PY2023, the Evaluators received quarterly tracking data updates as well as final tracking exports. The tracking system was updated to include necessary inputs as per TRM V9.1. Other than these updates, there were no major changes to the structure or content of program tracking data. The Evaluators reviewed program tracking to assess its compliance with Protocol A of the TRM which specifies that tracking data should be checked for:

- Participating Customer Information;
- Measure Specific Information;
- Vendor Specific Information;
- Program Tracking Information;
- Program Costs; and
- Marketing & Outreach Activities.

The Evaluators reviewed each of the above factors within PY2023 tracking data except for marketing and outreach activities as these are outside the scope of the tracking system's reporting.

4.4.3.2.2 Home Energy Savings Pathway Customer, Premise, Cost, and Vendor Information

Each of these factors was assessed individually based on the guidelines stated in TRM V9.1.

Overall, the Evaluators conclude the following regarding tracking data completeness:

- Participating customer information was complete for all participants. This included Job IDs, telephone numbers, addresses, full names, and utility account numbers for BHE and participating electric utility. In PY2023, 100.0% of all projects had complete name, address, phone number, and account information.
- All participant records included the name of the installation contractor who performed the implementation as well as the invoice date and weatherization date.
- Tracking data included the measure and project costs for each home.
- Tracking data included the weather zone for each home.
- As with the prior program year, premise characteristics such as home heating type, cooling type, and ceiling square footage were present for all participants where appropriate and needed.

4.4.3.2.3 Home Energy Savings Pathway Measure Specific Information

The content of tracking data was found to include sufficient information for all measures in PY2023. There were no large issues with measure specific information in the PY2023 program tracking data.

4.4.3.2.4 Home Energy Savings Pathway - Data Collection Activities

The process evaluation of Home Energy Savings Pathway included the following activities:

- *Program Actor In-Depth Interviews.* The Evaluators conducted in-depth interviews with a series of program actors. These interviews covered a range of topics, including marketing efforts, feedback on program delivery, an assessment of barriers to program implementation and success, and recommendations for program improvement. Program Actors interviewed include:
 - *BHE Program Staff.* The Evaluators interviewed staff at BHE involved in the administration of the Home Energy Savings Pathway.
 - *Third Party Implementation Staff Interviews.* The Evaluators interviewed staff at CLEAResult involved in the administration of the Home Energy Savings Pathway.
 - *Trade Allies.* The Evaluators interviewed trade allies engaged in the Home Energy Savings Pathway.

- *Field Data Collection.* The Evaluators conducted field data collection to verify impacts from duct sealing, air sealing, and ceiling insulation measures.
- *Participant Surveying.* The Evaluators conducted surveys with HES Pathway participants, collecting feedback on the participant experience as well as collecting data for NTG estimation

Table 4-13 summarizes the data collection for this process evaluation effort. This includes the titles, role, and sample sizes for data collection.

Table 4-13: RSP Home Energy Savings Pathway Data Collection Summary

Target	Component	Activity	n	Precision Met	Role
BHE Program Staff	Manager of Energy Efficiency; 3 Program Coordinators	Interview	4	NA	Overall administration of BHE EE programs. This manager is involved in the larger strategic decisions associated with the EE portfolio and is involved with the HES Pathway and in the overall coordination of utility resources.
CLEAResult Staff	Program Manager	Interview	1	NA	Handles day-to-day operations, including mass market outreach, application review, billing, and logistics
Program Participants	RSP: HES Pathway	Field Data Collection	37 homes, 119 measures	±7.8%	Field data collection was performed to verify duct sealing, air sealing, and ceiling insulation projects.
		Surveys	92	±8.6%	This survey was conducted on a sample of residents who participated in the consistent weatherization approach program.
Trade allies	RSP: HES Pathway	Interview	2	NA	Interviews were conducted with two of the five trade allies who participate in the consistent weatherization approach program.

4.4.3.2.5 Home Energy Savings Pathway - Program Theory & Design

The HES Pathway is designed to follow Department of Energy’s Home Performance with ENERGY STAR® (HPwES) Program guidelines. The HES Pathway offers a comprehensive, whole-home approach to improving energy efficiency of existing homes. The HES Pathway also is consistent with the approved APSC-mandated Consistent Weatherization Approach. The program maintains a closed contractor network, emphasizing training and quality control for a small group of providers who are allocated a share of total weatherization projects to complete for the program year.

4.4.3.2.6 Home Energy Savings Pathway - Program Administration

The HES Pathway is overseen by the Manager of Energy Efficiency at BHE. This manager’s responsibilities primarily include interfacing with CLEAResult, who directly implements the program. Other activities by this manager include providing updated customer lists to CLEAResult to better facilitate their implementation, participation in outreach events, and at times assisting CLEAResult in customer interactions.

For CLEAResult, the roles and responsibilities of program staff are as follows:

- **Program Manager.** The Program Manager oversees day-to-day activities, supervises program staff, and handles complaints from customers or contractors.
- **Program Coordinator/Specialist.** This staff member coordinates tracking data, develops samples for quality assurance inspection, and supports reporting and invoicing requirements.
- **QA Verification Specialist.** The QA Verification Specialist conducts post inspections and communicates inspection results to contractors.

4.4.3.2.7 Home Energy Savings Pathway - Program Implementation & Delivery

For the HES Pathway, homes must be at least 10 years old or have gas costs that are at \$.05 per square foot based on the customers’ highest bill in the past 12 months. Eligible homes must have been occupied for the previous 12 months and have not received weatherization services in the past five years.



Figure 4-18: HES Pathway Home Efficiency Graphic (source: <https://energy-readyarkansas.com/home-energy-savings-evaluation.html>)

The key delivery aspects specific to this outreach channel include the follow elements:

- **Customer verification:** Potential customers interested in the program will be confirmed as a qualified BHE customer by program staff.

- **A comprehensive assessment of the customer’s home:** Once the customer is prequalified, the contractor will schedule a comprehensive audit of the home and develop a recommended action plan of weatherization upgrades for the homeowner.
- **Direct installation of immediate energy savings measures:** While performing the comprehensive audit, the contractor will also install energy efficient measures throughout the home, including low-flow aerators and showerheads, at no cost to the customer.
- **Installation of a set of weatherization measures:** The contractor and customer will decide on what upgrades will be undertaken for the home. Based on review of the plan, the customer and contractor will develop an installation plan, and upgrades will be installed by the contractor.

4.4.3.2.8 Home Energy Savings Pathway - Marketing

CLEAResult is the implementer for the HES Pathway and oversees marketing efforts. The program is directly marketed by the five registered trade allies. Other marketing efforts include encouragement of program referral among participants and promotion of the program on the BHE website.

4.4.3.2.9 Home Energy Savings - Measures

The program did not offer any new measures in PY2023.

4.4.3.2.10 Home Energy Savings - Trade Ally Network

Both weatherization programs continue to utilize a trade ally network. The trade ally network currently has five members; four focus on standard homes and one focuses on income qualified home. Staff noted that they are looking to add another trade ally focused on income qualified homes but want to limit the network in general to ensure all participating trade allies can get work through the program. Two of the trade allies were new to the program this year; they replaced two other trade allies who disengaged for personal reasons. Program staff assign trade allies leads based on their performance and capacity. Although trade allies generate some of their own leads through advertising and word-of-mouth, most participants are assigned a trade ally through Black Hills Energy.

4.4.3.2.11 Home Energy Savings Pathway Required Participant Demographics and Consistent Weatherization Approach (CWA) Metrics

This section presents the required metrics for BHE’s CWA program (the Home Energy Savings Pathway).

Table 4-14: CWA Required Process Evaluation Metrics

Metric	Value
Program Name	Residential Solutions Program - HES Pathway
CWA Implementation	Yes
Total Audits Completed	1,201
Total Submitted Measures	4,201 at 1,565 homes
Conversion Rate	89.7%
Measures installed per-project	1.01 (excluding Assessment)
Cost per participant	\$864.50 (including Assessment)
Percent of contractors promoting program	100% (5 contractors)

Table 4-15: HES Pathway Alignment with CWA Requirements

Requirement	Alignment with Requirement	Percent of Participants Receiving
Includes Applicable DI Measures	Yes	2.0%
Aerators	Yes	1.3%
Showerheads	Yes	0.6%
Efficient lighting	Yes	N/A
Smart strips	Yes	N/A
Prequalifies homes based on year of construction or energy costs	Yes, the customer must have had a bill in the last twelve months that exceeded five cents per square foot or the home’s age is 10 years or greater.	Not in tracking data
TRC is used to assess program cost-effectiveness	Yes	N/A
Measures screened using SIR or comparable metric	Program uses TRC	N/A
Includes Core No Cost Measures	Yes	23.2%
Audit (walk through)	Yes	76.7%
Attic insulation	Yes	32.7%
Duct sealing	Yes	75.8%
Air infiltration reduction	Yes	66.0%
Safety testing and/or measures	Yes	0.1%
Offers other utility measures	Yes	N/A
Contractors are certified BPI Building Analyst or RESNET HERS Rater	Yes, for duct sealing, air infiltration, and assessments. Insulation requires Arkansas Home Improvement Specialty License.	N/A

On average, HES Pathway participants received measures that resulted in 418 therm savings and incentives that averaged \$864.50 (Table 4-16).

Table 4-16 Summary of Home Participation

Average Ex ante Therm Savings	Average Incentive Amount	Average Number of Measures Implemented
418.4	\$864.50	1.01

4.4.3.2.12 HES Pathway – Consistent Weatherization Approach Participant Survey Results

Evaluators conducted a survey of Weatherization Program participants to gather feedback about customers engagement with and experience of the program. Tracking data included 751 weatherization program participants, including income qualified participants, with valid mailing addresses. Participants were sent a letter inviting them to take the survey; 453 participants also received up to two emails or phone calls requesting their survey response. One-hundred participants – 61 via letter, 33 via email, and 6 via phone – responded to the survey; 92 of these respondents were standard weatherization program participants and eight were income qualified participants.

4.4.3.2.12.1.1 Respondent Characteristics

Table 4-17 presents respondents’ demographic characteristics.

Table 4-17 Respondent Demographics (n=92)

Characteristic	%
Housing Type	
Single-family home	94.6%
Duplex or townhome	3.3%
Apartment	2.2%
Manufactured home	0%
Prefer not to say	0%
Housing Age	
Before 1960	9.8%
1960-1969	5.4%
1970-1979	13.0%
1980-1989	10.9%
1990-199	15.2%
2000-2009	26.1%
2010 or later	15.2%
Not sure	4.4%
Housing Status	
Own	90.2%
Rent	5.4%
Prefer not to say	1.1%

Home Size (sq ft)	
Less than 1,000 square feet	2.2%
1,000 to 1,999 square feet	52.8%
2,000 to 2,999 square feet	23.1%
3,000 to 3,999 square feet	13.2%
4,000 square feet or more	5.5%
Not sure	2.2%
Prefer not to say	1.1%
Number of people in home	
1 person	10.9%
2 people	40.2%
3 people	18.5%
4 people	14.1%
5 or more people	14.1%
Prefer not to say	2.2%
Age (years)	
18 - 24	2.2%
25 - 34	15.2%
35 - 44	23.9%
45 - 54	16.3%
55 - 64	18.5%
65 - 74	10.9%
75+	8.7%
Prefer not to answer	4.4%
Work Status	
Working or attending school outside of the home	60.9%
Working or attending school from home	25.0%
Retired	23.9%
Unemployed	0.0%
On medical, disability or maternity leave	4.3%
Stay-at-home parent or care provider	15.2%
Prefer not to answer	6.5%

4.4.3.2.12.1.2 Program Awareness

Respondents most commonly learned about the program through word of mouth (Figure 4-19), and most were motivated to participate to save money on their energy bills (Figure 4-20).

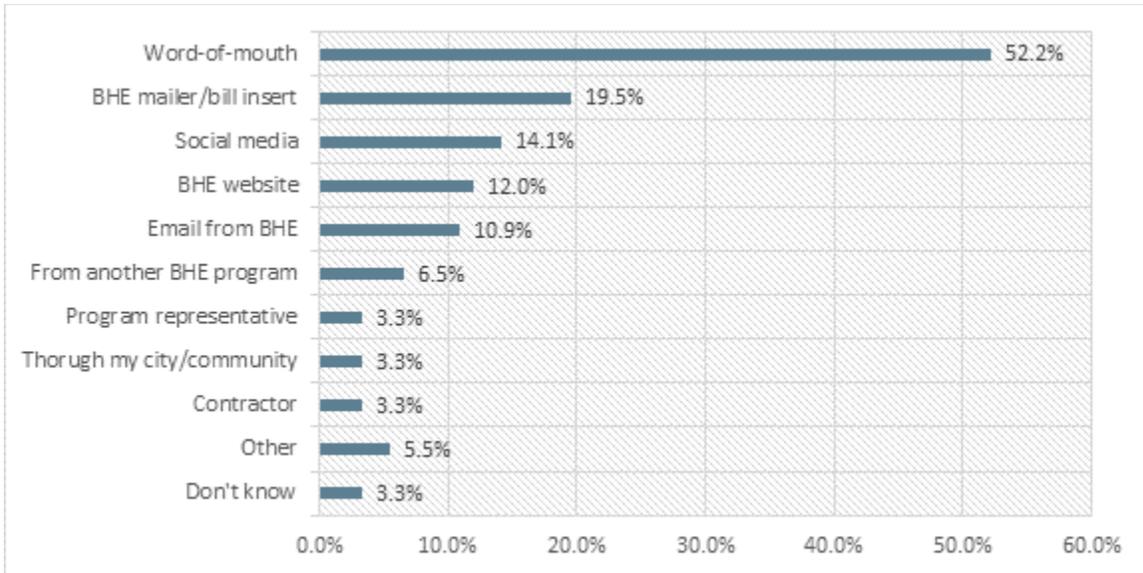


Figure 4-19 Program Awareness (n=92)

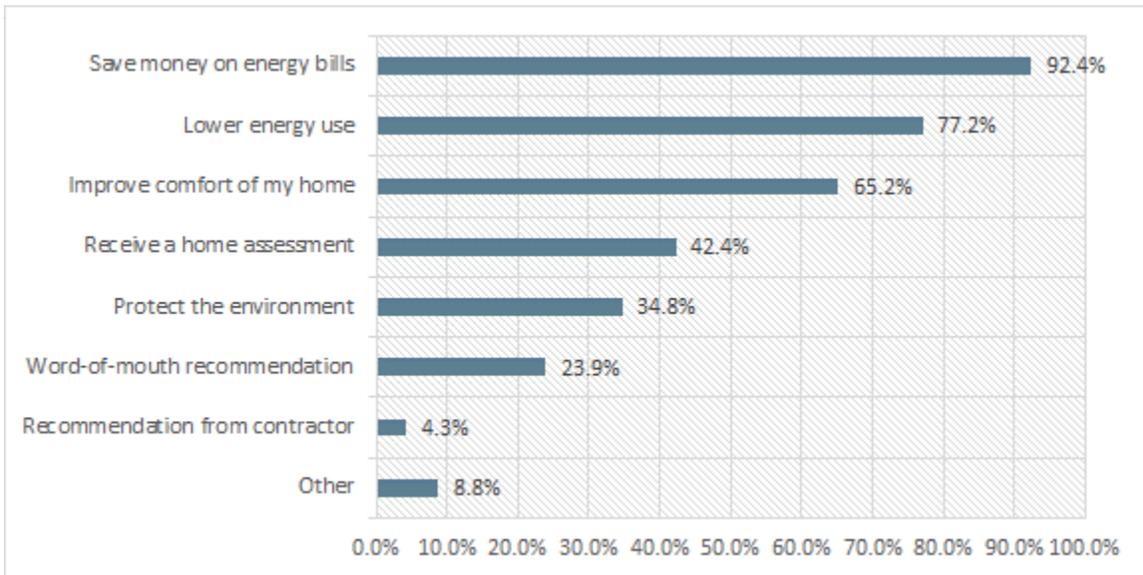


Figure 4-20 Program Enrollment Motivation (n=92)

4.4.3.2.12.1.3 Home Energy Assessment

Most respondents recalled receiving an energy assessment through the program (97.7%, n=83). Of these respondents, most wanted the assessment to learn how to save energy to save money (Figure 4-21).

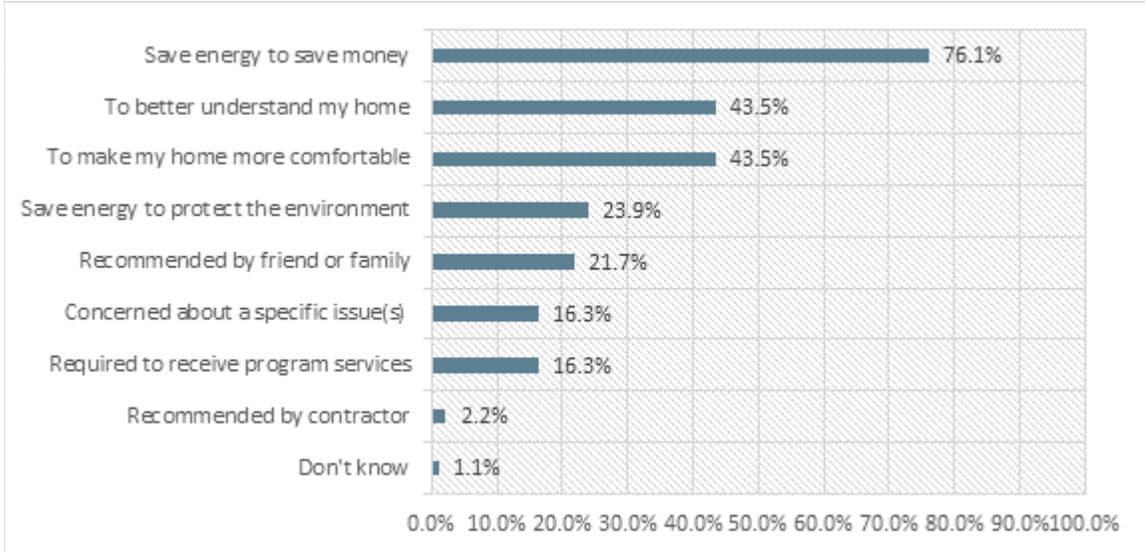


Figure 4-21 Motivation for Assessment (n=83)

Almost all the respondents who received a home energy assessment were the person at home when the assessment took place (94.0%, n=77). Almost all the in-person assessors went over the findings with the respondents (97.4%, n=76). A majority of respondents received a written report or list of recommendations for making their home more energy efficient (78.2%, n=61).

More than half of the respondents implemented all of the recommendations from their assessment (68.8%, n=53). Thirteen respondents did not implement all of the recommendations, despite a majority of respondents (n=12) who indicated they felt they had enough information to do so. Recommendations not implemented included attic insulation (n=5), replace showerheads (n=1), replace windows (n=1), insulate basement end joists (n=1), install a smart thermostat (n=1). Three respondents did not specify what recommendations they did not implement.

In general, respondents who received a home energy assessment and were home during the assessment were satisfied with all aspects of the home energy assessment (Figure 4-22); three-fourths of the respondents also found the information provided by the assessment to very or extremely useful (Figure 4-23).

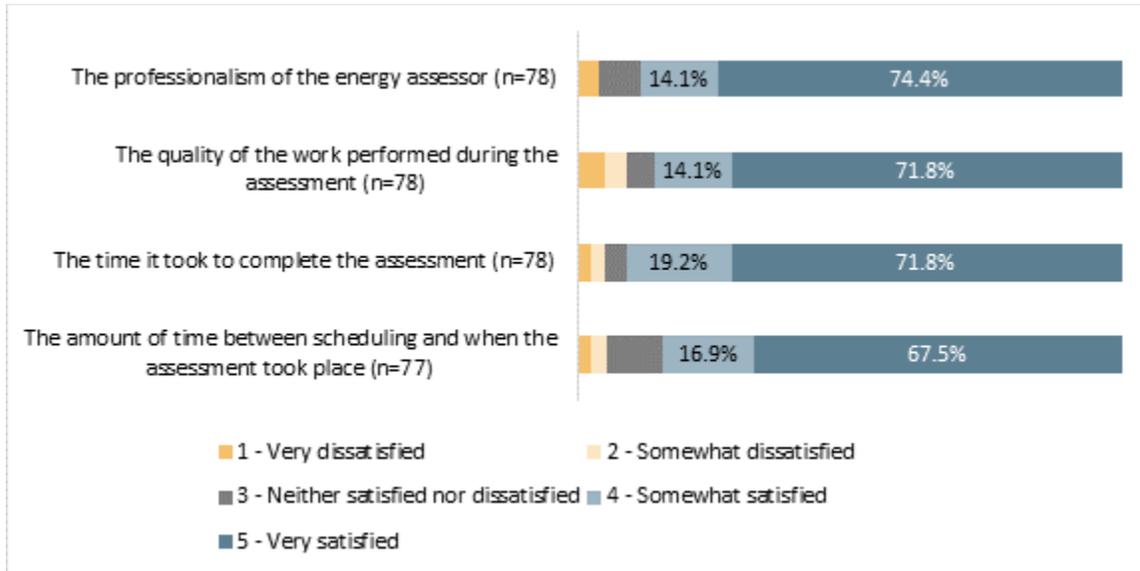


Figure 4-22 Home Energy Assessment Satisfaction (n=varies)

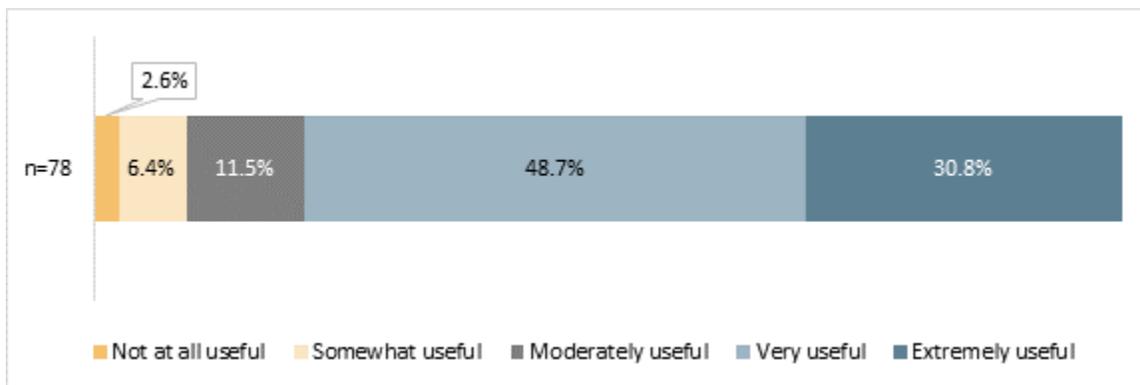


Figure 4-23 Utility of Information Provided (n=78)

4.4.3.2.12.1.4 Satisfaction

Respondents were generally satisfied with the Weatherization Program (Figure 4-24) and with BHE as their natural gas service provider (Figure 4-25). Respondents who expressed dissatisfaction noted sloppy or incomplete work (n=6); contractor caused extensive damage to their home (n=1); and not learning any new information about their home (n=1). Most respondents have recommended the program to others (80.4%, n=74).

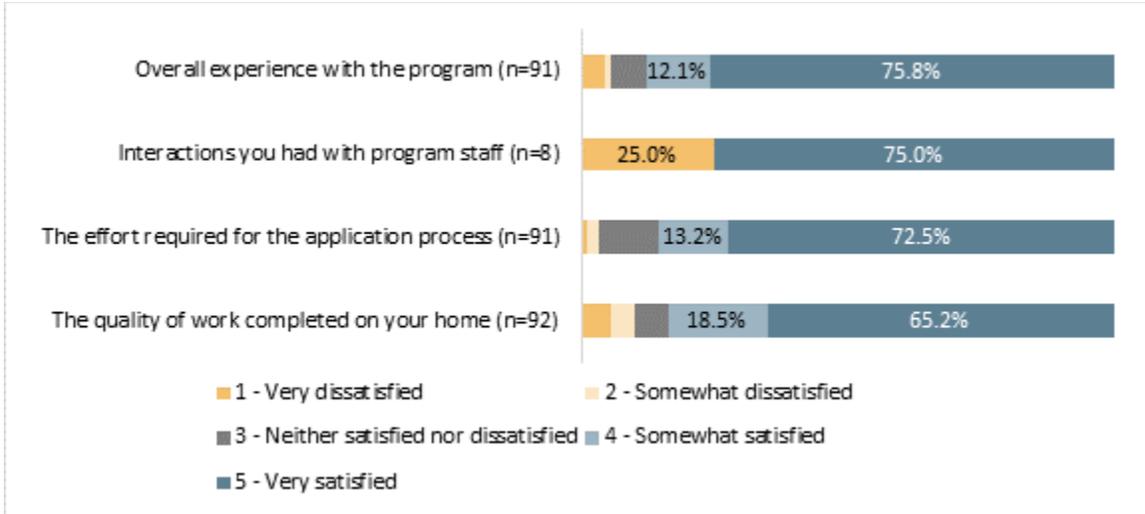


Figure 4-24 Program Satisfaction (n=varies)

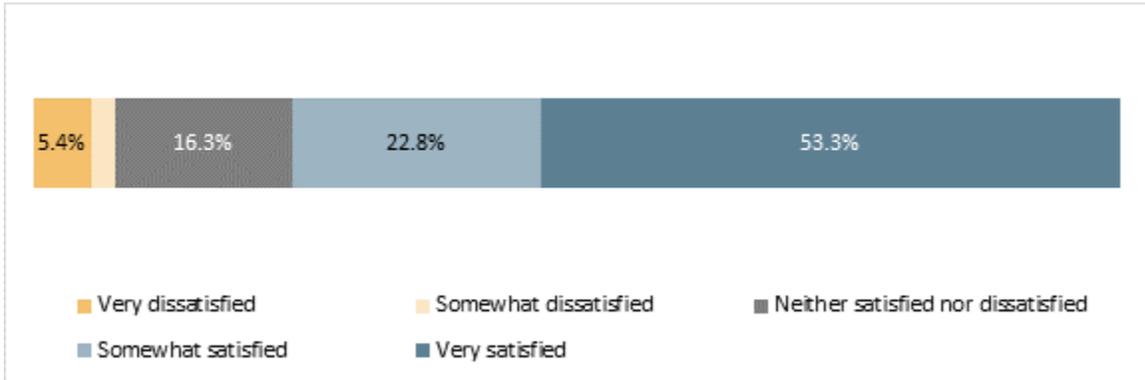


Figure 4-25 Satisfaction with BHE (n=88)

More than half of the respondents indicated that participating in the program improved their satisfaction with BHE (66.3%, n=61) and 48.9% (n=45) have seen a decrease in their energy bill since participating in the program (Figure 4-26).

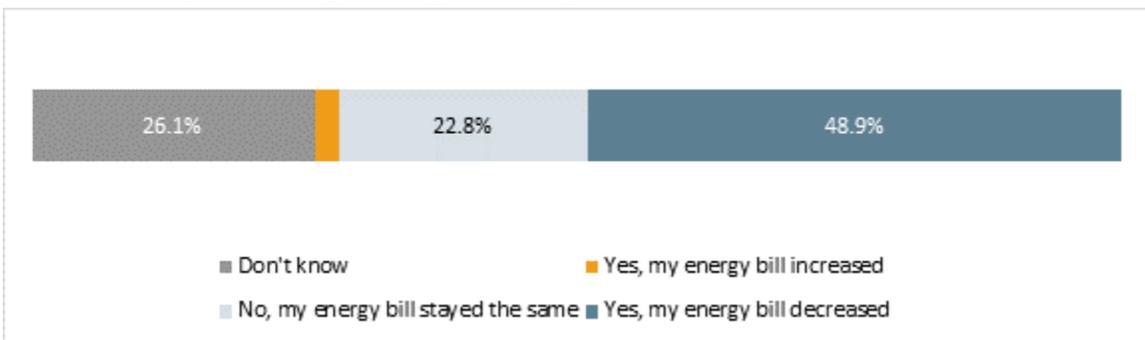


Figure 4-26 Change in Energy Bill (n=92)

4.4.4 Free-Ridership and Spillover Findings

The survey battery to address residential program free-ridership was as follows:

- Were you planning to complete the same [MEASURE] project in 2023 before learning about the program?
 - **IF PLANNING = “YES”:** Would your budget for the planned project have accommodated the project's full cost if you had not completed the project through the program?
 - If the incentive was not available from the program, would you have completed the same project or would you have done something different?
 - **IF RESPONSE = “SOMETHING DIFFERENT”:** Would it have been the same level of energy efficiency, higher energy efficiency, or lower energy efficiency?
- Would you have completed the same project or one that made your home even more energy efficient within one year if the program was not available?

A respondent is a free rider if they indicate all the following:

1. They had plans to complete the same measure in 2023;
2. Had a budget that could accommodate the full project cost without the program;
3. Would have done the same project or a more efficient version of the project in the absence of the program; and
4. Would have completed the same or more efficient version of the project within a year.

Figure 4-27 details the scoring mechanism for residential free ridership in the Residential Solutions Program.

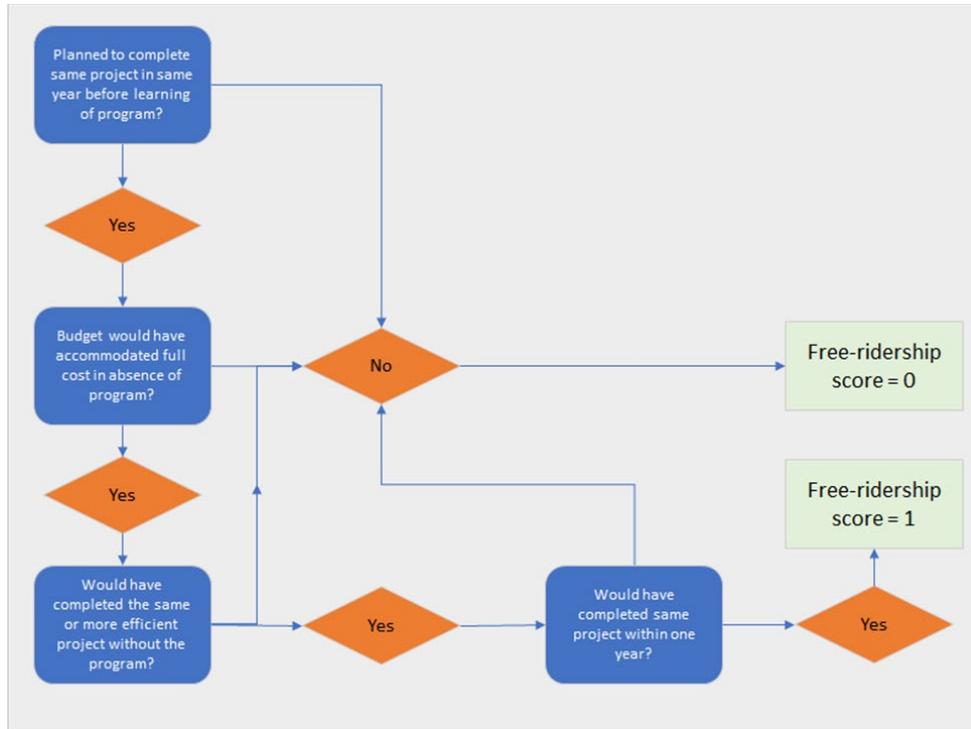


Figure 4-27: RSP FR Diagram

The resulting NTGRs were as follows:

- Residential Furnace Retrofit: 78.4%
- Residential Water Heating Retrofit: 71.7%
- Smart Thermostat: 61.2%

Table 4-18 summarizes the estimated free-ridership, spillover, and net-to-gross ratios for the estimates developed through self-report.

Table 4-18: RSP Summary of Free-ridership, Spillover, and NTGRs

Pathway & Measure	Free Ridership	Spillover	NTG Ratio
Equipment Rebates Pathway			
■ Furnace - Retrofit	21.6%	0.0%	78.4%
■ Furnace – NC - Builder	9.0%	0.0%	91.0%
■ Furnace – NC - Owner	21.6%	0.0%	78.4%
■ Smart Thermostat	35.0%	0.0%	65.0%
■ Water Heater - Retrofit	28.3%	0.0%	71.7%
■ Water Heater – Housing Authority	0.0%	0.0%	100.0%
■ Water Heater - NC – Builder	9.0%	0.0%	91.0%
■ Water Heater – NC - Owner	28.3%	0.0%	71.7%
HES Pathway			
■ Duct sealing, air sealing, ceiling insulation	1.7%	0.0%	98.3%
■ Aerators, showerheads, pipe wrap, tank wrap	1.7%	0.0%	98.3%

4.4.4.1 HES Pathway – Gross Savings Analysis

The Evaluators conducted field verification at 70 homes in the HES Pathway. Measures included in this sample were as follows:

- Air Infiltration: 33 homes
- Ceiling Insulation: 17 homes
- Duct Sealing: 31 homes, 34 HVAC systems

The Evaluators conducted duct blaster and blower door tests at all homes that received duct sealing and air sealing (respectively).

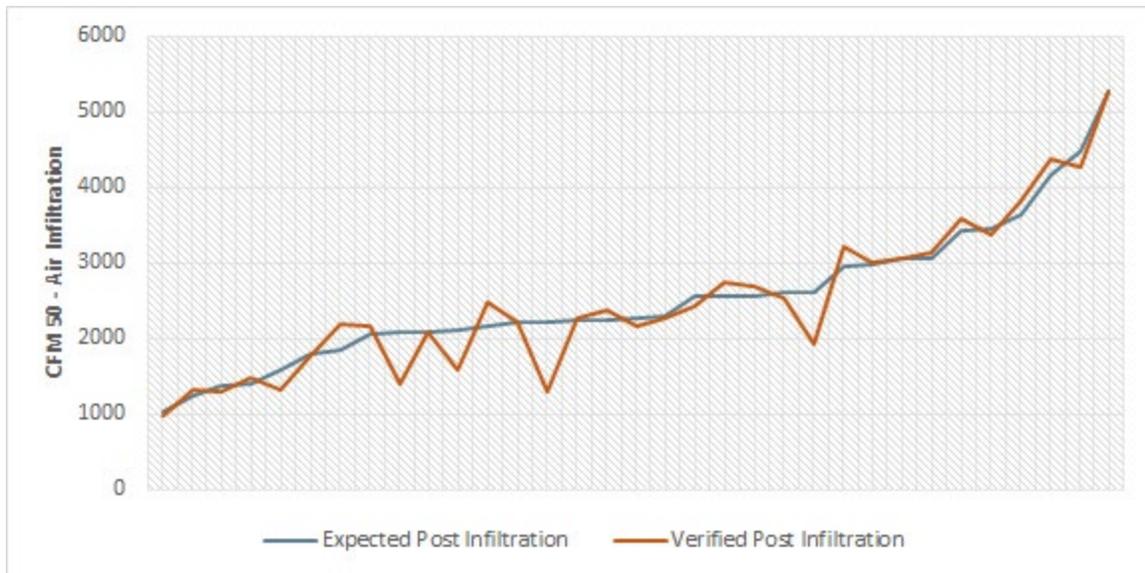


Figure 4-28: Air Infiltration Field Data Collection Results (n=33)

The Evaluators lower infiltration than shown in ex ante estimates. This resulted in an overall in-service rate (ISR) of 104.3%.



Figure 4-29: Duct Sealing Field Data Collection Results (n=34)

The Evaluators higher leakage than shown in ex ante estimates. This resulted in an overall in-service rate (ISR) of 99.9%.

Ceiling insulation projects inspected showed no deviations from project tracking and had a 100.0% ISR.

4.4.4.2 Energy Savings Calculations - Furnaces

Gross savings for furnaces applied TRM V9.1 protocols. The Evaluators verified heat load estimates based on home age and square footage, all of which was provided in BHE program tracking data.

One key parameter addressed in the PY2020 gross impact analysis was verification of early retirement. Early retirement is estimated based off survey findings with BHE participants. Surveys were not completed in PY2023 so values from the PY2020 survey were applied to PY2023 projects. The survey findings addressed:

- Extent to which furnaces that are in working condition have been replaced; and
- Age of the preexisting furnace in instances of qualifying early retirement.

As per the TRM V9.1, and the procedures for calculating the impact of early replacement for residential furnaces, early retirement AFUE is calculated by a degradation factor of a 78 AFUE unit. This is calculated as: ⁷

$$AFUE_{base_early} = (Base\ AFUE) \times (1 - M)^{age}$$

Where:

Base AFUE = efficiency of the existing equipment when new, 78% AFUE.

*M*⁸ = maintenance factor, 0.01.

age = the age of the existing equipment, in years.

Following this, lifetime savings are determined based on the Remaining Useful Life (RUL) of the old equipment. The RUL table is presented in Table 4-19. ⁹

Table 4-19: Residential Furnace RUL

Unit Age	RUL	Unit Age	RUL
5	14.7	19	3.6
6	13.7	20	3.2
7	12.7	21	2.9
8	11.8	22	2.6
9	10.9	23	2.4
10	10.0	24	2.1
11	9.1	25+	0.0
12	8.3		
13	7.5		
14	6.8		
15	6.2		
16	5.5		
17	4.5		
18	4.0		

To assess whether a unit qualified for early retirement, the Evaluators examined the following survey questions:

7. Was the replaced [BASELINE]....(READ LIST)?

1. Fully functional and not in need of repair?

⁷ Arkansas TRM V9.1 Volume 2, Pg. 44

⁸ Maintenance factor of 0.01 is the average maintenance factor for gas furnaces taken from the October 2010 National Renewable Energy publication "Building America House Simulation Protocols", table 30.

⁹ AR TRM V9.1, Volume 2, Pg. 46

- 2. Functional, but needed minor repairs?
- 3. Functional, but needed major repairs?
- 4. Not functional?
- 98. DON'T KNOW
- 99. REFUSED

8. How old was the [BASELINE] at the time you replaced it?

- 1. ___ # Years
- 98. DON'T KNOW
- 99. REFUSED

9. How long do you think your [BASELINE] would have lasted if you had not replaced it?

- 1. ___ # Years
- 98. DON'T KNOW

Figure 4-30 summarizes the scoring for early retirement based on these three questions.

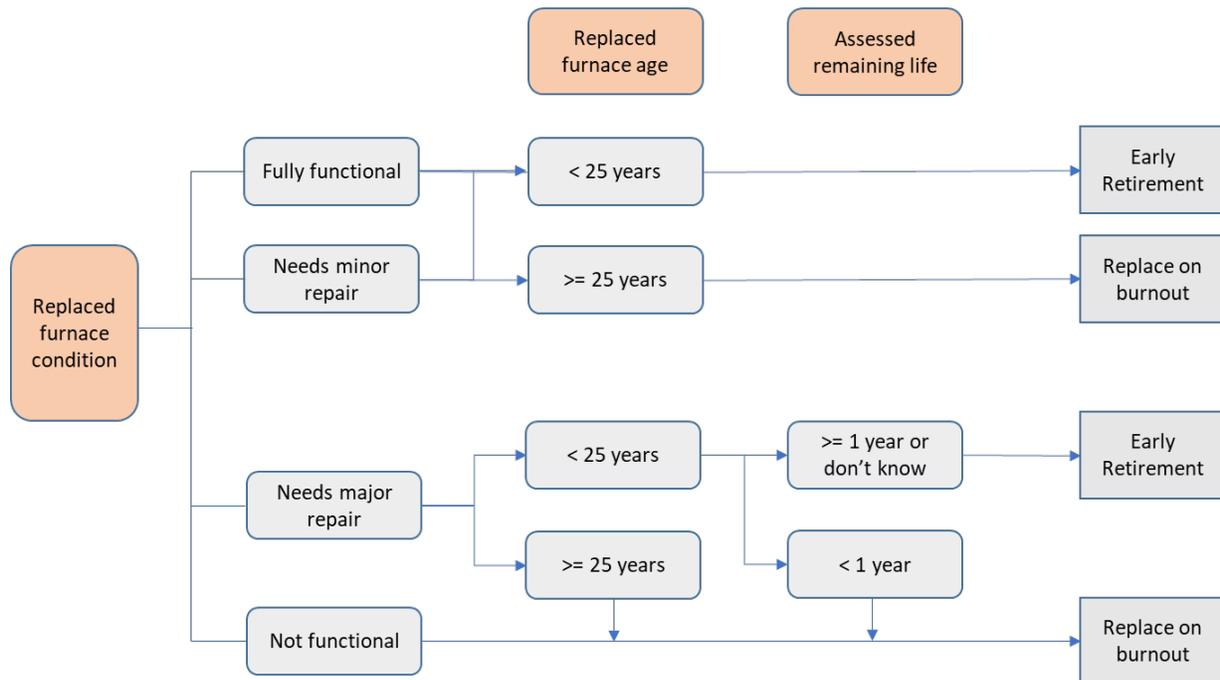


Figure 4-30: Residential Furnace Early Retirement Flowchart

In total, the Evaluators found that 78.26% of BHE furnace retrofits were early retirement.

The average age of functioning and failed units was as follows:

- 14.12 for functioning units

- 20.33 for failed units

Based on the degradation equation from TRM V9.1¹⁰, this leads to an Early Retirement AFUE of:

$$AFUE_{base_{early}} = (.78) \times (1 - .01)^{14.12} = .6942$$

Further, based on the values in Table 4-19, the RUL of the early replacement units is seven years. For years 8-20 of the unit EUL, the normal replacement baseline applies. The savings for each residential retrofit unit were calculated using both the normal and early replacement baselines, and final savings reflect a weighted average of these two values based on participant survey data findings. These values were then applied on a weighted basis to the residential retrofit units using weights of 78.26% early replacement and 21.74% normal replacement. The resulting weighted average baseline is .728.

4.4.4.3 Energy Savings Calculations – Water Heaters

Savings from tankless water heaters were calculated using protocols from Arkansas TRM V9.1 Vol. 2 Section 2.3.1. For sample calculations, see Appendix C.

Gross realization for water heater was 122.4%. The Evaluators attribute this to the following:

- **Correction of the water heater setpoint.** The calculations performed by CLEAResult used 120 degrees Fahrenheit for water heater replacements. This was updated to 124 based off water heater setpoint research conducted by the Evaluators that had been incorporated into TRM V9.1. In Weather Zone 9, this increases savings by 7.4%.
- **Aligning DHW load to match baseline sizing.** Though the direct formula is not visible in the spreadsheet tracking data provided to the Evaluators (as calculations are performed in a back-end system with an Excel export then sent for review), the Evaluators suspect that the DHW load is aligning with 40-gallon systems. The Evaluators were able closely recreate ex ante calculations (to within 3.0% of ex ante estimates) when the baseline was established to align with a high-draw pattern (50-gallon equivalent) tankless system while aligning the DHW load to a medium draw pattern (40-gallon equivalent) system.

4.4.4.4 Energy Savings Calculations – Smart Thermostats

Gross savings were calculated for smart thermostats using protocols AR TRM V9.1 Vol 2 2.1.12. For sample calculations, see Appendix C.

¹⁰ TRM V9.1 Vol. 2 Pg. 44

BHE tracked the baseline thermostat on their program application. The Evaluators applied the appropriate baseline for each line item. Savings calculations and application of square footage was significantly improved compared to prior program years, and the Evaluators found 99% realization for this measure.

4.4.5 Ex Post Savings

Table 4-20 presents the gross savings results of the evaluation of the PY2023 Residential Solutions Program. Total gross savings summarizes the savings calculations performed by TRM V9.1 protocols.

Table 4-20: RSP Ex Post Gross Therms Savings

Pathway	Measure Category	Ex Ante Therms Savings	Ex Post Therms Savings	Gross Realization Rate	EUL	Lifetime Therms Savings
ERP	Furnace Retrofit	57,817	62,419	107.96%	14.97	934,232
	Furnace NC: Builder	9,935	13,294	133.81%	20	265,886
	Furnace NC: Owner	1,665	2,706	162.52%	20	54,120
	Tankless Water Heater Retrofit	3,963	4,859	122.63%	20	97,187
	Tankless Water Heater: NC Builder	703	851	121.14%	20	17,026
	Tankless Water Heater NC: Owner	1,371	1,677	122.32%	20	33,543
	Smart Thermostat	22,243	22,018	98.99%	11	242,201
HES	Home Energy Savings	654,847	655,565	100.11%	17	11,147,826
	Total Gross Savings	752,543	763,390	101.44%	16.76	12,792,023

The resulting net savings are presented in Table 4-21.

Table 4-21: RSP Net Savings Summary

Project Category	Free-Ridership Rate		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Furnace Retrofit	22.00%	21.62%	45,097	48,924	89.77%	732,251
Furnace NC: Builder	9.01%	9.00%	9,040	12,098	99.89%	241,957
Furnace NC: Owner	35.56%	21.62%	1,073	2,121	99.84%	42,419
Tankless Water Heater Retrofit	0.00%	28.30%	3,963	3,484	82.65%	69,683
Tankless Water Heater NC: Builder	9.10%	8.97%	639	775	125.25%	15494
Tankless Water Heater NC: Owner	35.52%	28.29%	884	1,203	121.09%	24,051
Smart Thermostat	35.00%	38.80%	14,485	13,475	99.74%	148,227
Home Energy Savings	6.67%	1.71%	611,195	644,354	107.85%	10,957,199
Overall	8.80%	4.84%	686,347	726,434	106.14%	12,231,281

4.4.6 Non-Energy Benefits Summary

Per Protocol L of the Arkansas TRM V9.1, Evaluators calculated non-energy benefits (NEBs) from each program. Program measures provide the following categories of NEBs:

- Benefits of electricity and liquid propane energy savings as in other fuel savings;
- Benefits of public water and wastewater savings¹¹; and
- Benefits of avoided and deferred replacement costs.

The Evaluators identified potential NEBs associated with each measure category.

4.4.6.1 RSP NEBs: Other Fuel

Table 4-22: RSP Ex Post Net Electric Savings

Measure Category	Net Annual kWh	Net Peak kW	Lifetime Net kWh
Smart Thermostat	159,788	0	1,757,664
Air Sealing	99,451	61.09	1,093,966
Ceiling Insulation	280,376	231.05	5,607,521
Duct Sealing	935,523	438.90	16,839,427
Total	1,475,139	731.04	25,298,578

4.4.6.2 RSP NEBs: Water Savings

Table 4-23: RSP Ex Post Net Water Savings

Pathway	Net Annual Water Saving (Gallons)	Lifetime Net Water Savings (Gallons)
Equipment Rebates	0	0
Home Energy Savings	34,627	346,274
Total	34,627	346,274

4.4.6.3 RSP NEBs: Avoided Replacement Costs (ARCs)

Residential tankless water heaters have an EUL of 20 years. The baseline system has an EUL of 11 years. This makes the systems eligible for the Deferred Replacement Cost Non-Energy Benefit. This NEB was calculated using the IEM calculation tool¹². The input assumptions were as follows:

- Full installed cost of tankless system: \$1,219
- Full installed cost of baseline storage tank system: \$614
- Nominal Discount Rate: 5.62%

¹¹ Though water savings were zero (0) in PY2020, we include this here to provide a comprehensive description of the measure offerings.

¹² Protocol L Avoided & Deferred Replacement Cost_08_31_16.xlsx

- Inflation Rate: 2.04%
- Real Discount Rate: 3.50%

The resulting gross deferred replacement cost is \$355.33 per unit. The calculator for this is provided in Appendix B of this report. For individual line items in the BHE program, this value was scaled by the appropriate NTGR.

There were 136 residential tankless systems rebated in PY2023, and the resulting ARC value is \$43,638.56.

4.4.6.4 RSP NEBs: Deferred Replacement Costs (DRCs)

There were 331 furnaces that were early replacement with a Remaining Useful Life (RUL) of five years. This produces a DRC benefit in that it defers the normal replacement schedule in perpetuity. This NEB was calculated using the IEM calculation tool¹³. The input assumptions were as follows:

- Full installed cost of efficient furnace: \$2,548
- Full installed cost of baseline furnace: \$2,011
- Nominal Discount Rate: 5.62%
- Inflation Rate: 2.04%
- Real Discount Rate: 3.50%

The resulting gross DRC is \$1,145.67 per early retirement. When scaling this to the prevalence of early replacement versus normal replacement, the weighted average gross DRC is \$710.32 per retrofit. The calculator for this is provided in Appendix B of this report. For individual line items in the BHE program, this value was scaled by the appropriate NTGR. The resulting net DRC value is \$184,283.41.

4.5 Conclusions

The program exceeded program goal.	The program met 106.9% of its filed net savings goal.
Realization rates were high across most measure categories.	The overall realization rate was 101.4%. Realization was high for all measure groups.

¹³ Protocol L Avoided & Deferred Replacement Cost_08_31_16.xlsx

Many trade allies are not aware of the Equipment Rebate Pathway.	About two-thirds responding trade allies did not know about the Equipment Rebates pathway until their customer mentioned it to them. Among those trade allies who previously knew about the pathway, the vast majority actively promote it to their customers.
Some trade allies indicated difficulties with the Equipment Rebate Program application.	Some trade allies indicated their customers do not apply for rebates, even when purchasing efficient equipment, due to perceived difficulties with the application process.

4.6 Recommendations

Scan CLEAResult tracking updates for new contractors to target for outreach and education.	With many trade allies stating that they learned of the program from their clients, this would result in new business names periodically entering program tracking. New contractors identified in this manner could be targeted for a program training that enables them to better-market efficient equipment.
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5 Commercial & Industrial Solutions Program (CISP)

CISP is directed at developing and incenting energy efficiency measures for commercial and industrial customers. It is implemented by CLEARResult Consulting on behalf of BHE. CLEARResult handles program administration, marketing and outreach, direct install of energy savings measures, and technical review of custom efficiency projects. Program participants are offered:

- (1) No-cost direct installation of low flow faucet aerators, showerheads, and pre-rinse spray valves (PRSVs), if the participant has natural gas water heating;
- (2) No-cost direct installation of door air infiltration sealing if the participant has natural gas space heating;
- (3) Prescriptive incentives for commercial furnaces, water heaters, commercial boilers, boiler controls, and Prescriptive incentives for commercial kitchen equipment;
- (4) \$.75 per therm for custom projects;
- (5) \$.20 per therm for Strategic Energy Management (SEM) projects; and
- (6) Incentives to trade allies for steam system surveys.

5.1 CISP Overview

CISP's historical performance is summarized in Table 5-1.

Table 5-1: CISP Historical Performance against Goals

Program Year	# Participants		Budget			Net Therms		
	Actual	Goal	Spent	Allocated	%	Achieved	Goal	%
2011	404	790	\$486,284	\$637,926	76.2%	500,906	451,808	110.9%
2012	518	773	\$836,388	\$1,012,822	82.6%	560,574	536,810	104.4%
2013	417	723	\$1,382,015	\$1,410,997	97.9%	954,191	805,150	118.5%
2014	215	762	\$1,331,924	\$1,525,075	87.3%	789,523	694,577	113.7%
2015	385	800	\$1,520,715	\$1,698,848	89.5%	811,600	766,630	105.9%
2016	185	2,817	\$1,638,167	\$1,832,824	89.4%	851,581	798,455	106.7%
2017	157	2,344	\$1,331,689	\$1,374,482	96.9%	714,913	713,150	100.2%
2018	153	2,344	\$1,247,349	\$1,374,482	90.8%	713,833	713,150	100.0%
2019	42	2,344	\$1,296,563	\$1,380,696	93.6%	719,575	713,150	100.9%
2020	58	1,569	\$1,325,452	\$1,501,198	88.3%	745,692	629,741	118.4%
2021	80	1,569	\$1,526,265	\$1,501,198	101.7%	705,541	629,741	112.0%
2022	54	1,569	\$1,617,667	\$1,552,279	104.2%	723,540	629,741	114.8%
2023	159	1,569	\$1,700,900	\$1,552,279	109.6%	753,681	629,741	119.9%

CISP participants fall into one of four categories:

- Direct install;
- Prescriptive furnace, water heater, boiler, and food service rebates;
- Custom audit recipients;¹⁴ and
- Closed custom projects.

Total net Therms by pathway are summarized in Figure 5-1.

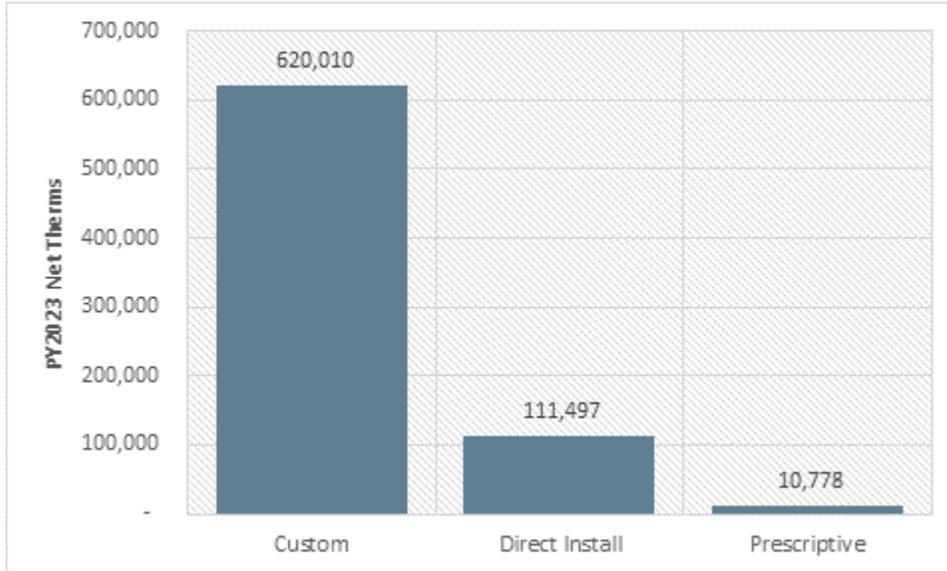


Figure 5-1: Total Net Therms by Program Pathway

These participants are detailed in the subsections to follow.

5.2 Direct Install Participation Summary

In PY2023, there were 54 direct install participants. The summary of participation by facility type and the relative share of program therms savings are summarized in Figure 5-2.

¹⁴ The Evaluators tally audit recipients but do not count them towards BHE’s participation goal.

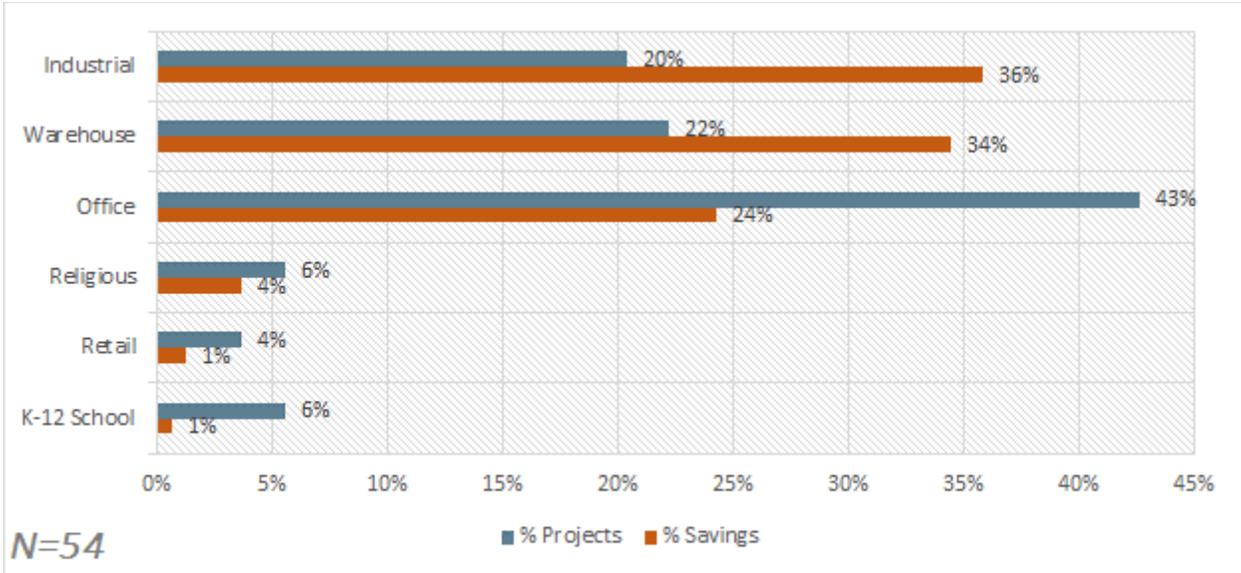


Figure 5-2: Direct Install Participation Summary

5.3 Prescriptive Rebate Summary

Beginning in PY2020, commercial prescriptive furnaces and water heaters were moved from the former Equipment Rebates Program to CISP, fully separating residential and non-residential rebates into discrete programs. Figure 5-3 summarizes CISP PY2023 prescriptive participation and net savings.

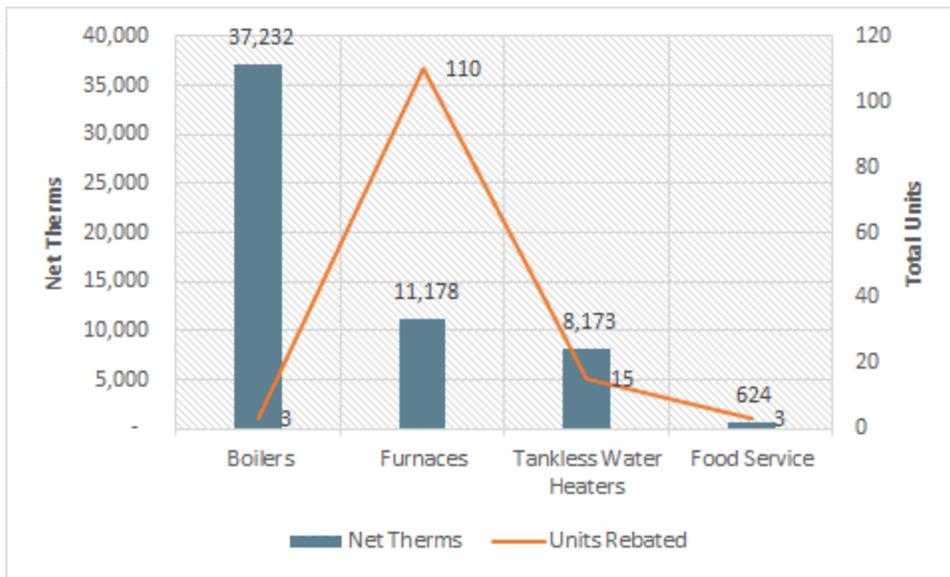


Figure 5-3: CISP Prescriptive Participation Summary

5.4 Closed Custom Project Participation Summary

Table 5-2 summarizes the completed custom projects for the program. Closed custom projects are projects that have been verified by the Evaluators and an incentive has been issued by BHE.

Table 5-2: Custom Project Participation Summary

Facility Type	Project ID	Measure	Ex Post Savings
Medical	EA-0000466121	Boiler Tune-Up Condensate Return Boiler Controls	31,019
Medical	EA-0001408812	Steam Trap Replacement Steam Leak	131,225
University	EA-0000918154	SEM	20,813
Industrial	EA-0000937789	SEM	29,692
Food Processing	EA-0000937794	SEM	80,492
Food Processing	EA-0000951274	Boiler Tune-Up Condensate Return Boiler Controls	84,689
University	EA-0001545100	Boiler Tune-Up Condensate Return Steam Leak Steam Trap Replacement	49,084
Medical	EA-0001690933	Steam Trap Replacement Steam Leak	48,090
Medical	EA-0002158550	Boiler Tune-Up	37,232
Medical	EA-0002161345	Steam Trap Replacement Steam Leak	6,906
Medical	EA-0002161394	Steam Trap Replacement Steam Leak	53,335
Medical	EA-0001150800	Steam Trap Replacement	7,131
Medical	EA-0001150894	Steam Trap Replacement	36,302

5.5 CISP Process Evaluation

This section presents the results and key findings from the data collection activities. These findings are based upon interviews with utility staff, implementation staff, surveys with participants, and thorough and in-depth literature review.

The Evaluators conducted a full process evaluation of the CISP in PY2021 and a partial process evaluation in PY2022 and found that the program was successful in meeting participation,

savings, and satisfaction goals. Table 5-3 and Table 5-4 summarize the Evaluators’ review of the CISP in comparison to TRM V9.1 Protocol C for timing and conditions of conducting a process evaluation.

Table 5-3: Determining Appropriate Timing to Conduct a Process Evaluation

Component	Determination
New and Innovative Components	No. The program is unchanged from PY2022.
No Previous Process Evaluation	No. The program received a process evaluation in PY2022.
New Vendor or Contractor	No. The restructured program continues to be implemented by CLEAResult.

Table 5-4: Determining Appropriate Conditions to Conduct a Process Evaluation

Component	Determination
Are program impacts lower or slower than expected?	No. The program met savings goals in PY2022.
Are the educational or informational goals not meeting program goals?	No. The program has an established trade ally network.
Are the participation rates lower or slower than expected?	No. The program met participant goals in PY2022.
Are the program’s operational or management structure slow to get up and running or not meeting program administrative needs?	No. The PY2Y2021 process evaluation found that operational and management structure to be up to speed and efficient in administering the program.
Is the program’s cost-effectiveness less than expected?	No. The program’s cost-effectiveness exceeded expectations.
Do participants report problems with the programs or low rates of satisfaction?	No. Participant surveys found high satisfaction levels.
Is the program producing the intended market effects?	Yes. Interviews with participants and trade allies have shown market transformation is occurring.

Based on these findings, process evaluation activities were limited to a review of prior recommendations.

5.5.1.1 Data Collection Activities

The process evaluation of the CISP included the following data collection activities:

- **Program Actor In-Depth Interviews.** The Evaluators conducted in-depth interviews with a series of program actors. These interviews covered a range of topics, including marketing efforts, feedback on program delivery, an assessment of barriers to program implementation and success, and recommendations for program improvement. Program actors interviewed include:
 - **BHE Program Staff.** The Evaluators interviewed staff at BHE involved in the administration of the CISP. These interviews built upon interviews conducted in PY2022, keeping apprised of BHE’s involvement as the CISP develops.

- *Third Party Implementation Staff Interviews.* The Evaluators conducted interviews with CLEAResult involved with the CISP. These interviews addressed the development of the program over the PY2023 program year as well as CLEAResult’s perspective on a variety of implementation issues, including conversion of audits to completed projects and the process flow for direct install and custom projects.
- *Participant Surveying.* A census of custom participants was surveyed for this evaluation effort. These surveys included net-to-gross and process issues. The surveys provided valuable data for this process evaluation effort, providing participant feedback as to their program participation, recommendations for program improvement, and insight into the decision-making process.

Table 5-5 summarizes the data collection for this process evaluation effort. This includes the titles, roles, and sample sizes for data collection.

Table 5-5: BHE CISP Data Collection Summary

Target	Component	Activity	n	Precision	Role
BHE Program Staff	Manager, Energy Efficiency	Interview	1	N/A	Overall administration of BHE the larger strategic decisions associated with the EE portfolio. They are also involved with the CISP in the overall coordination of utility resources.
CLEAResult Staff	Program Manager	Interview	2	N/A	The Program Managers handle day-to-day operations, including tracking of outreach and implementation activities, payments for direct installation, and interfacing with Evaluation staff.
Program Participants	Custom	Field Verification	2	N/A	Two on-site inspections were completed in the custom channel in PY2023. A census of custom projects were reviewed and analyzed.

5.5.2 Protocol A: Tracking Data Review

Table 5-6 summarizes the Protocol A tracking data review for the C&I Solitons Program. The program tracking database contained all required fields.

Table 5-6: C&I Solutions Protocol A Summary

Category	Field	Status	Description of Issue(s)
Participating Customer Information	Unique customer identifier, such as account number	✓	
	Customer contact information – name, mailing address, telephone number	✓	
	Date/s of major customer milestones such as rebate application date, approval date, rebate processing date, etc.	✓	
Measure-Specific Information	Measure Group (Equipment Type)	✓	
	Equipment Fuel/Energy Source	✓	
	Equipment Quantity	✓	
	Efficiency Level	X	Tracking data did not include furnace or boiler efficiency levels.
	Estimated Savings	✓	
	Estimated incremental measure cost	✓	
	Equipment Useful Life	✓	
	Measure Name – Text Description	✓	
	Measure Name – Numerical Code	N/A	
	Serial Number	N/A	
	Reported age of equipment replaced	N/A	
Reported measure type of equipment replaced	✓		
Other inputs necessary for the use and compliance with the TRM	x	Tracking data did not include furnace or boiler efficiency levels.	
Vendor-Specific Information	Name and Contact Information for Contractor	✓	
	Contractor Type	✓	
	Date of Installation	✓	
	Cost of the installed equipment	✓	
	Efficiency level of the installed equipment	✓	
Program Tracking Information	Date of the initial program contact/rebate information	✓	
	Date of rebate/incentive paid	✓	
	Incentive amount paid to-date	✓	
	Incentive amounts remaining	✓	
	Application Status (i.e., number of applications approved, pending, or denied)	✓	
	Reason and reason code for application denial	✓	
Program Costs	Overall program budgets	✓	
	Program expenditures to-date	✓	
	Incentive Costs	✓	
	Administrative Costs	✓	
	Marketing/Outreach Costs	✓	
	Evaluation Costs	✓	
Marketing and Outreach Activities	Advertising and marketing spending levels	-	Not itemized from total marketing costs in data provided to the Evaluators.
	Media schedules	N/A	
	Summary of number of community events/outreach activities	✓	

	Other media activities – estimated impressions via mailings, television/radio; print ads.	✓	
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5.5.3 Response to Program Recommendations

Table 5-7 summarizes the PY2022 recommendation and BHE’s response.

Table 5-7: CISP Response to PY2020 Recommendations

Recommendation	BHE Response	Status of Issue
Estimate water impacts in customer audit report payback calculations/ROI for relevant projects. Projects that save water can have significantly more rapid payback periods than just based solely on their gas savings. CLEAResult should factor this into audit report calculations when the opportunity presents itself (steam leak repair, condensate return, etc.).	Accepted and in progress for implementation.	In Progress

5.5.4 Program Theory & Design

The CISP was designed to provide outreach in hard-to-reach sectors of the C&I markets. The bullets below list program activities and their expected outcomes.

- **Direct installation of high-return measures.** The CISP provides no-cost direct installation of weather stripping, low flow faucet aerators, PRSVs, and showerheads. These measures have a high return of savings relative to their cost and as such can be provided free-of-charge and remain cost-effective. The resulting savings are unlikely to occur absent the program; generally, if a respondent does not already have the equipment in place, the direct install activities induce an action that was not planned. These activities are also intended to serve as an introduction to energy efficiency for the recipients, and that they will then be further interested in participating in the custom component of the program.
- **Energy audits to medium and large customers.** These audits are conducted by CLEAResult staff, providing recommendations for energy efficiency improvements and an audit report. These audits are intended to generate the bulk of the program savings, yielding high-return custom projects.
- **Steam system survey incentives.** These incentives defray the cost of steam system surveys for participating trade allies, allowing them to provide detailed project scoping at no upfront cost to them or to the customer.
- **Incentives for custom measures.** The CISP provides \$0.75 per Therm for verified savings from custom projects (\$.20 per therm in the case of Strategic Energy Management).

These projects may be driven by a program-funded audit, generated by a trade ally, or be customer-directed.

- **Incentives for prescriptive measures.** This includes furnaces, water heaters, boilers, and food service equipment at fixed incentive rates.

5.5.5 Program Administration

The CISP is overseen by the Manager of Energy Efficiency at BHE. This manager's responsibilities primarily include interfacing with CLEAResult, who directly implements the program. Other activities by this manager include providing updated customer lists to CLEAResult to better-facilitate their implementation, review of custom applications, and at times assisting CLEAResult in customer interactions.

For CLEAResult, the program overall is led by the Program Manager, who oversees the implementation of the CISP from CLEAResult's Fayetteville, AR office. This manager handles high-level issues across the programs, including regulatory compliance and reporting, as well as some level of intervention on the larger projects.

Much of the day-to-day activity is handled by the Program Manager, who reviews direct install and audit activity, and coordinates with the Evaluators in facilitating EM&V activities.

Audit activities are run by engineering staff at CLEAResult. Titles for staff that engage in this activity may vary depending upon the complexity of the facility¹⁵. These engineers conduct the energy audits. Additionally, their responsibilities include development of the audit report and recommendations. The Direct Install Program Manager oversees crews that perform direct installation. Further, the Associate Account Manager follows up with customers to gauge interest in completing a project.

There were no major changes to program design in 2023.

5.5.6 Program Implementation and Delivery

CLEAResult provides the Evaluators with updates regarding their pipeline of custom projects. These updates listed the full scope of facility audits, expected savings with associated recommended measures, and what stage the project was in. These stages are:

- *Pipeline.* Projects listed as Pipeline are in the first phase of involvement in the CISP. These participants are customers that have discussed the possibility of a facility audit

¹⁵ Examples include (but are not limited to) Energy Engineer, Senior Energy Engineer, and Senior Program Consultant.

and indicated interest to CLEAResult. These facilities will receive a Pre-Inspection at a later date and have not signed a project application.

- *Pre-Inspected.* Projects listed as Pre-Inspected are in the phase where CLEAResult has completed a facility audit. During these audits, CLEAResult conducts a comprehensive review of the facility's systems and operational practices. On this basis, CLEAResult then formulates initial recommendations for energy efficiency improvements. These are discussed with facility staff during the audit in order to address the feasibility of recommended measures.
- *Pre-Installation Calculation.* At this phase, CLEAResult is compiling high-level data needed to provide an initial estimate of energy savings. This step of the process compiles the information collected in the site audit, which are then used in the development of an Audit Report.
- *Audit Report Complete.* In this phase, feasible measures from the Pre-Inspection are compiled into a formal audit report, providing the participant with further detail as to the scope of the project, initial savings estimates, associated incentives, expected project costs, and the payback period of the measure. Additionally, should the measure provide operational benefits to the facility (such as improved comfort or product reliability), these are included as well to provide the customer with a full scope of the benefits of the project. This report is provided at no cost to the participant.
- *Project Agreement.* At this point, the customer has informed CLEAResult and BHE that they intend to install a program-recommended measure. When this occurs, CLEAResult then involves the Evaluators. CLEAResult provides the Evaluators with an M&V plan for the facility, detailing the project scope and proposed data collection and analysis. The Evaluators' engineering staff then reviews the M&V plan and makes recommendations for any changes needed. If this revises the savings amount, the reserved incentive amount in the application is revised. A project agreement is then signed, in which the reserved incentive amount is detailed and reflects edits made by the Evaluators.
- *Post-Inspection.* This phase marks the completion of post-inspection for an installed measure. CLEAResult has, at this point, post-inspected a measure and revised savings accordingly if the installed project differs from the proposed project. In some rare instances, the participant may then be paid out for 60% of the reserved incentive, with the remainder held in reserve to true-up the final incentive amount after M&V is completed. There are times when this may occur for a project with an M&V period at extends across the calendar year.
- *M&V.* M&V marks the phase when post-installation data is collected for an installed project to allow for calculation of a final savings estimate, from which the remaining

incentive to the customer is determined. There are some measures that do not require post-retrofit data; for such measures, the M&V phase is short and requires completion of calculations based upon inputs verified during the Post-Inspection. For facilities that require post-installation data, the data collection period can range from 30 days to 6 months.

- *Complete*. Facilities marked as Complete have received their full incentive.

The process flow for the CISP is displayed in the figure below.

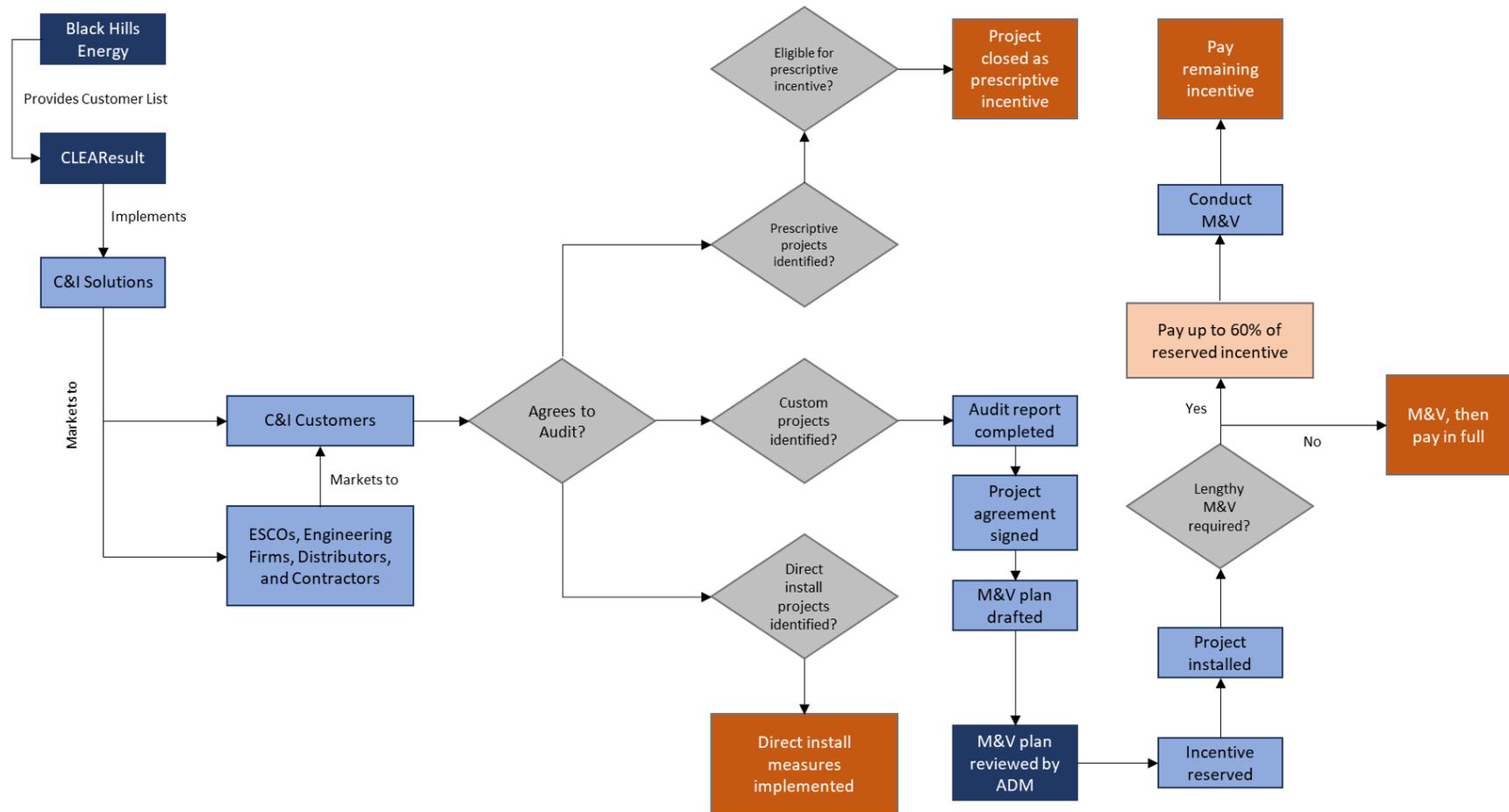


Figure 5-4: C&I Solutions Process Flow

5.5.7 Trade Allies

C&I customers can use any licensed contractor for their equipment upgrades. BHE does have a list of 15-20 pre-approved and recommended trade allies for various install types. Staff are trying to diversify their trade ally list to ensure certain install types, such as steam traps, are not solely dependent on one to two trade allies.

5.6 CISP Impact Evaluation

The impact evaluation of the CISP included the following:

- *Custom Project M&V.* The Evaluators conducted project-specific M&V on a census of custom projects completed through the CISP. Each project included an M&V plan and a project-specific report. The reports are provided in Appendix A.
- *Free-Ridership Estimation.* A free ridership rate for DI participants was estimated through participant surveying. Respondents were asked a series of questions related to their past experience with the appropriate measures, whether they had ever installed similar equipment at the participating premise or at other premises within their organization, and whether they knew of the potential savings from the DI measures prior to participating. Given the types of measures covered by the DI component, the free ridership rate is essentially focused on to what extent participating organizations had policies in place to install such equipment anyway. If such policies were not in place, then the installation of the equipment is generally considered to be program-induced.

5.6.1 CISP Direct Install Impact Evaluation

For Direct INTAL, the Evaluators applied prior findings for in-service rates and NTGRs, and conducted a database review of deemed savings calculations. For sample TRM calculations, see Appendix C.

5.6.1.1 Direct Install Free-Ridership

In prior evaluations, the methodology for DI Free-Ridership was focused on the participants' past experiences with the appropriate equipment and whether they had organizational policies in place to install such equipment. Respondents were asked:

Q22. Before to participating in the C&I Solutions Program, did you have plans to install [LIST MEASURE]?

Q23 Would you have gone ahead with this planned project even if you had not participated in the program?

Twenty percent of respondents stated that they were aware of the savings potential from such equipment.

Q27 If the [PROGRAM] program representative had not recommended installing the [PROJECT_DESCRIPTION], how likely is it that you would have installed it anyway?

1. Definitely would have installed
2. Probably would have installed
3. Probably would not have installed
4. Definitely would not have installed
98. Don't know

These are combined into the following factors:

- A. **Prior Plans:** If the respondent indicated plans to install prior to participation, they receive a “1” for this metric.
- B. **Installation counterfactual:** If they respondent states that they would have gone ahead with this project without the program, they receive a “1” for this factor.
- C. **Program Influence:** If a respondent states that they “Definitely would have” or “probably would have” installed this equipment without the program, they receive a “1” for this factor.

To be found a free rider, a respondent must receive a “1” score for all three factors. The direct install pathway was found to have 100% NTGR.

5.6.1.2 CISP Prescriptive Projects Impact Evaluation

The CISP processed 131 prescriptive rebates in PY2023. These projects included:

- 110 furnaces;
- 15 water heaters;
- 3 boilers;
- 3 convection ovens; and
- 3 fryers.

The Evaluators applied TRM V9.1 protocols and calculated savings by measure. Savings are summarized in Table 5-8.

Table 5-8: BHE CISP Prescriptive Project Summary

Measure	Ex Ante Gross Savings	Ex Post Gross Savings	Gross Realization Rate	Gross Lifetime Savings
Furnaces	16,795	16,168	96.3%	323,353
Water Heaters	3,026	2,909	96.1%	58,176
Boilers	7,156	7,156	100.0%	143,129
Fryers	2,798	2,798	100.0%	33,580
Convection Ovens	823	823	100.0%	9,877
Total	30,599	29,854	97.6%	568,114

Causes for revision in savings included:

- **Water heaters:** The Evaluators cannot discern the source of the discrepancy, other than it is derived from the DHW load lookup value (this being the only input that can affect savings to this magnitude).
- **Furnaces:** The Evaluators made corrections for facility type on a small number of projects.

5.6.1.3 CISP Custom Project Impact Evaluation

The Evaluators opted for a census of custom projects in order to capture the full variability associated with these projects; the measures are often unique with idiosyncratic issues, and as such extrapolation from the M&V of other projects would be inappropriate. Table 5-9 summarizes the custom projects completed and evaluated in PY2023. “Ex Ante Savings” is the value calculated by CLEAResult after M&V. “Ex Post Savings” is the savings calculation completed by the Evaluators.

Table 5-9: BHE CISP Custom Project Summary

Facility Type	Project ID	Measure	Ex Ante Savings	Ex Post Savings	M&V Protocol
Medical	EA-0000466121	Boiler Tune-Up, Condensate Return, Boiler Controls	31,019	31,019	Option A
Medical	EA-0001408812	Steam Trap Replacement, Steam Leak	135,225	135,225	Deemed, Option A
Food Processing	EA-0000951274	Boiler Tune-Up, Condensate Return, Boiler Controls	84,689	84,689	Option A
University	EA-0001545100	Boiler Tune-Up, Condensate Return, Steam Leak, Steam Trap Replacement	49,084	49,084	Deemed, Option A
Medical	EA-0001690933	Steam Trap Replacement, Steam Leak	48,090	48,090	Deemed, Option A
Medical	EA-0002158550	Boiler Tune-Up	37,232	37,232	Deemed, Option A
Medical	EA-0002161345	Steam Trap Replacement, Steam Leak	6,906	6,906	Deemed, Option A
Medical	EA-0002161394	Steam Trap Replacement, Steam Leak	53,335	53,335	Deemed, Option A
Medical	EA-0001150800	Steam Trap Replacement	7,131	7,131	Deemed, Option A
Medical	EA-0001150894	Steam Trap Replacement	36,302	36,302	Deemed, Option A
Total			489,013	489,013	

Table 5-10: BHE CISP SEM Project Summary

Facility Type	Project ID	Measure	Ex Ante Savings	Ex Post Savings	M&V Protocol
University	EA-0000918154	SEM	20,813	20,813	Option A
Industrial	EA-0000937789	SEM	29,692	29,692	Option A
Food Processing	EA-0000937794	SEM	80,492	80,492	Option A
Total			130,997	130,997	

5.6.1.4 Custom Free-Ridership

The Evaluators conducted interviews with nine decision-makers responsible for the completed custom projects in the CISP program in PY2023. Given the small number of interviews, reporting data in terms of percent response by question does not adequately present the participant response to the program. The methodology used by the Evaluators in determining the free ridership rates for custom projects examined the following factors:

- *Knowledge gained from program outreach.* If the project originated from program outreach (which may include program-sponsored training courses or facility audits), the respondent is asked if they had prior knowledge of the energy-saving opportunity recommended and eventually installed. If the respondent learned of the measure through the program audit or program-sponsored training, then they are considered to not have been free riders, in that in the absence of the program, the likelihood of the facility receiving a similarly detailed audit are low. Questions used in evaluating this criterion include:

FI-1 Prior to participating in the C&I Solutions Program, did your organization install any equipment similar to [EQUIPMENT/MEASURE] at your facility without financial incentives or rebates?

- Yes
- No

FI-1a Did you learn of this measure through your participation in the Commercial & Industrial Solutions Program?

- Yes [IF YES, ASK FI-1b] Do you recall how you learned of the measure?
- No

- *Prior plans for a similar measure.* This component is examined in instances where the respondent knew of the measure prior to receiving and technical assistance through the C&I Solutions Program. Respondents are asked a series of questions related to whether they had plans for installing this equipment prior to having learned of the available financial incentives from the C&I Solutions program. Questions used in this component include:

FI-1 Prior to participating in the C&I Solutions Program, did your organization install any equipment similar to [EQUIPMENT/MEASURE] at your facility without financial incentives or rebates?

- Yes
- No

FI-2 Did you have plans to install the [EQUIPMENT/MEASURE] that was upgrades through C&I Solutions before participating in the program?

- Yes
- No

If Yes: FI-2a Would you have gone ahead with this planned installation without the program rebates?

- Yes
- No

FI-2b Would this installation have included the same equipment without the program rebates?

- Yes
- No

- *Analysis of measure payback.* Respondents are asked to indicate what their required payback period is for energy efficiency improvements. This value is compared against the measure payback with and without the program incentive. If the financial incentive brings the project from over the threshold to under the threshold, then the project is considered to have been sufficiently influenced by the program incentive. This includes the following questions:

DM-5 Does your organization require a specific payback period in order to implement energy efficiency improvements?

- Yes [ASK DM-5A]
- No [SKIP TO DM-6]
- Don't know [DON'T READ]

DM-5a What **payback length of time** do you normally require in order to consider an energy investment cost effective?

___ Years

- Don't know

The stated payback requirement by the respondent is then compared against the payback of the recommended project with and without the program incentive.

- *Modification of the project.* Respondents are asked a series of questions addressing whether they modified the project as a result of their program participation. This includes changes in equipment quantity and/or efficiency level (where appropriate for the measure) and a change in project timing. Questions used to analyze this component include:

FI-5 If the C&I Solutions through C&I Solutions Program were not available, would you have installed the...

- Same quantity of energy efficient equipment,
 - A lower quantity, or
 - No energy efficient equipment at all?
- [IF FI-5 = "Lower Quantity"]: FI-5a: By percentage, how much lower?

FI-6 If the C&I Solutions program were not available, would you have installed ...

- The same equipment with the same efficiency level,
- The same equipment with a lower energy efficiency level, but still above minimum code, or
- standard efficiency equipment?

[IF FI-6 = "Lower efficiency level, but still above minimum code"]: FI-6a: By percentage, how much lower?

FI-7 Did the C&I Solutions rebate allow you to install [EQUIPMENT/MESURE] sooner than you otherwise would have?

Yes

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IF YES: FI-7a When would you otherwise have installed the equipment? (READ IF NEEDED)

- In less than 6 months later
- In 6-12 months later
- In 1-2 years later
- In 3-5 years later
- In more than 5 years later
- No, did not affect timing of purchase and installation

The scoring mechanism for custom projects is presented in Figure 5-5.

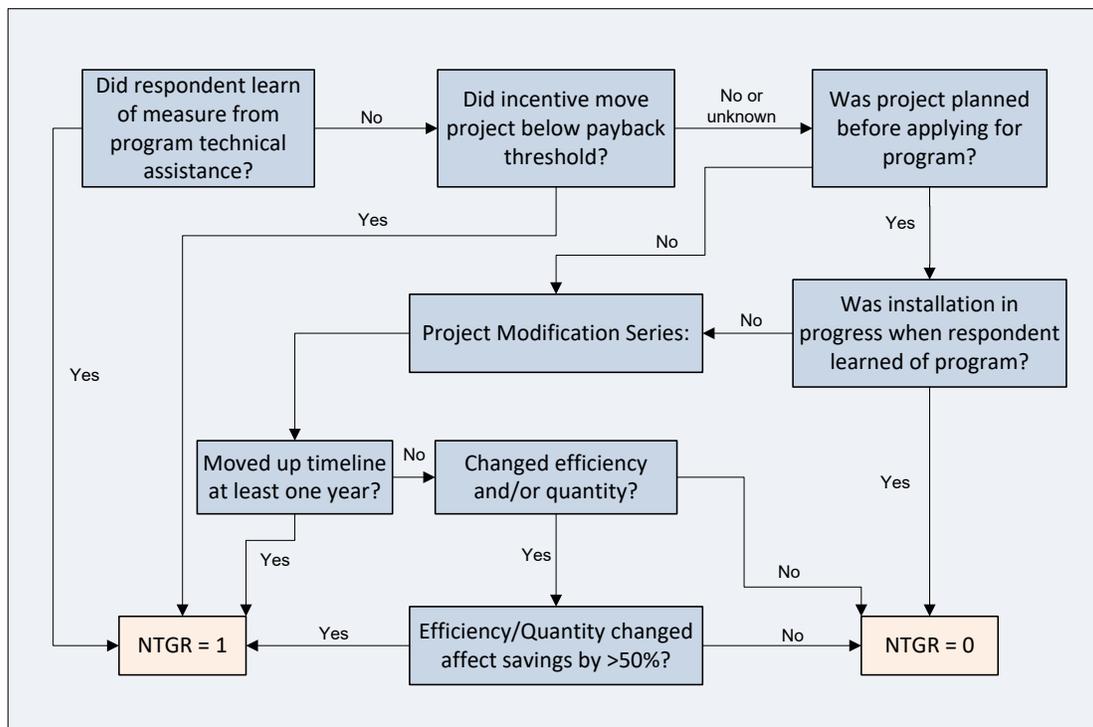


Figure 5-5: CISP Custom Project Free-Ridership Diagram

The resulting NTGRs by project are presented in Table 5-11.

Table 5-11: CISP Custom Project Free-Ridership Results

Facility Type	Project ID	Measure	Ex Post Savings	NTGR
Medical	EA-0000466121	Boiler Tune-Up, Condensate Return, Boiler Controls	31,019	100.0%
Medical	EA-0001408812	Steam Trap Replacement, Steam Leak	135,225	100.0%
Food Processing	EA-0000951274	Boiler Tune-Up, Condensate Return, Boiler Controls	84,689	100.0%
University	EA-0001545100	Boiler Tune-Up, Condensate Return, Steam Leak, Steam Trap Replacement	49,084	100.0%
Medical	EA-0001690933	Steam Trap Replacement, Steam Leak	48,090	100.0%
Medical	EA-0002158550	Boiler Tune-Up	37,232	100.0%
Medical	EA-0002161345	Steam Trap Replacement, Steam Leak	6,906	100.0%
Medical	EA-0002161394	Steam Trap Replacement, Steam Leak	53,335	100.0%
Medical	EA-0001150800	Steam Trap Replacement	7,131	100.0%
Medical	EA-0001150894	Steam Trap Replacement	36,302	100.0%
Total			488,013	100.0%

5.7 Participant Spillover

Participant spillover is defined as savings from program participants that was not incentivized by the BHE programs. During participant surveying, both DI and Custom participants are asked questions addressing whether their participation had led to the installation of equipment that was not rebated by BHE. The estimated savings from these projects are tallied and added to the program savings as Participant Spillover.

OS-3 Has your organization’s participation in the C&I Solutions Program led you to buy any energy efficient equipment for which you did not apply for a financial incentive?

Yes

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If Yes: OS-3a What type of equipment? _____

No

Don’t know [DON’T READ]

The Evaluators did not identify any participant spillover.

5.7.1.1 Partial-Participant Spillover

Partial-participant spillover are savings resulting from projects that were recommended to recipients of audits through the CISP that were completed without filing for program incentives. Respondents are asked:

Have you since implemented any of the recommendations from your facility audit?

- a. If Yes: Why didn't you install these measures through the available incentive program?

It is then clarified as to whether the respondent installed the project as specified in the audit or made modifications to the project. This is combined in providing an estimate of non-incentivized savings, which constitutes the Partial Participant Spillover.

5.8 Summary of Non-Energy Benefits

Table 5-12 summarizes the non-energy benefits by measure that are credited to the CISP.

Table 5-12: CISP Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	Avoided Replacement Cost
Steam Leak Repair		✓		
Condensate Return		✓		
Faucet Aerators		✓		
Weather Stripping	✓			
Tankless Water Heaters				✓

5.8.1.1 Water Savings Calculation Procedure

The TRM V9.1 provides detail for calculation of water savings for the following measures:

- Faucet Aerators (3.3.2);

The deemed savings procedures for these measures require calculation of water savings, and the water savings claims comply with TRM protocols.

5.9 Ex Post Savings

Table 5-13 presents the gross savings results of the evaluation of the PY2023 CISP. Total gross savings summarizes the savings calculations performed by TRM protocols for direct install measures as well as the project-specific M&V of custom measures.

Table 5-13: CISP Ex Post Therms Savings

Measure Category	Ex Ante Therms Savings	Ex Post Therms Savings	Gross Realization Rate	EUL	Lifetime Therms Savings
Direct Install	111,614	111,497	99.9%	11.00	1,225,997
Prescriptive	30,599	29,854	97.6%	19.03	568,114
Custom	619,991	620,010	100.0%	6.16	3,821,188
Total	762,204	761,361	99.9%	7.38	5,615,299

Net savings for the CISP were calculated using survey data of direct install and custom participants. The resulting net savings are presented in Table 5-14.

Table 5-14: CISP Net Savings Summary

Measure Category	Free-Ridership Rate		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Direct Install	3.83%	3.83%	107,339	107,227	99.9%	1,179,025
Prescriptive	21.50%	11.42%	24,020	26,444	110.1%	506,518
Custom	0.00%	0.00%	619,991	620,010	100.0%	3,821,188
Total	2.29%	1.01%	751,351	753,681	100.3%	5,506,730

The Evaluators applied TRM V9.1 Volume 1, Section II, Protocol L1 to calculated water savings from faucet aerators and low-flow showerheads. Avoided costs for water savings is calculated using TRM V9.1 Volume 1, Section II, Protocol L2. The Evaluators relied on the TRM-calculated marginal water rates. The corrected marginal water rates below are reported both for PY2023.

Table 5-15: Total Marginal Water Rates

Customer Class	Marginal Water Rates (per 1,000 gallons)	Marginal Sewage Rates (per 1,000 gallons)	Total Combined Marginal Water Rates (per 1,000 gallons)
Residential	\$3.97	\$5.59	\$9.57
Commercial	\$3.61	\$5.70	\$9.31
Average Cost \$/Gallon	\$3.79	\$5.65	\$9.44

Table 5-16 summarizes water savings from the CISP.

Table 5-16: Commercial & Industrial Solutions Ex Post Net Water Savings

Measure Category	Net Annual Water Saving (Gallons)	Lifetime Net Water Savings (Gallons)
Custom	1,070,420	1,070,420
Direct Install	120,000	120,000
Prescriptive	0	0
Total	1,190,420	1,190,420

5.10 Avoided & Deferred Replacement Cost

The Evaluators estimated net ARC of \$144 for commercial tankless systems. With 15 systems rebated in PY2023, total ARC for the CISP is \$2,154.

5.11 Conclusions

<p>The program met savings goals and was highly cost-effective.</p>	<p>Savings increased by 3.8% compared to PY2022, and the program met 119.7% of its net savings goal</p> <p>Participation increased significantly in the Prescriptive Pathway for the second straight year. Savings by year from this pathway for the program cycle were:</p> <ul style="list-style-type: none"> • PY2020: 24,400 • PY2021: 36,398 • PY2022: 48,397
<p>NEBs have increased significantly.</p>	<p>Water savings decreased significantly compared to PY2022. Savings by year from this pathway for the program cycle were:</p> <ul style="list-style-type: none"> • PY2020: 435,401 • PY2021: 16,312,350 • PY2022: 41,015,414 • PY2023: 1,190,120 <p>This is a volatile value year-over-year as it is heavily driven by the relative prevalence of custom projects that save water.</p>
<p>SEM is growing in prevalence in the Custom Pathway.</p>	<p>SEM constituted 21% of CISP Custom Pathway savings in PY2023, up from 15% in PY2022.</p>

6 Low Income Pilot Program

The Low Income Pilot Program (LIPP) was designed to comply with Act 1102. LIPP is an extension of the Consistent Weatherization Approach (CWA), and it is targeted to customers who meet the income eligibility requirements of the Low Income Home Energy Assistance Program (LIHEAP).

The program provides energy assessments, along with direct installation of low-cost measures and pre-qualification for building envelope improvements.

- Direct install measures include:
- Faucet aerators; and
- Low flow showerheads.

Weatherization measures include:

- Air infiltration;
- Duct sealing; and
- Ceiling insulation.

Additionally, the program offers a maximum of \$500 per participating residence to meet the health code standards required to weatherize the residence. Health and safety funding may be used to provide carbon monoxide detectors, smoke detectors, or other required measures.

6.1 Program Overview

Table 6-1 summarizes the historical performance of LIPP.

Table 6-1: LIPP Historical Performance against Goals

Program Year	# Participants		Budget		Net Therms	
	Actual	Goal	Spent	Allocated	Achieved	Goal
2020	41	123	\$80,675	\$81,904	21,782	19,596
2021	39	123	\$76,619	\$81,904	25,244	19,596
2022	40	123	\$100,189	\$83,696	31,698	19,596
2023	40	123	\$88,790	\$83,696	24,150	19,596

6.2 Participation Summary

The LIPP had 40 participants in PY2023. Figure 6-1 summarizes savings by measure for PY2023.

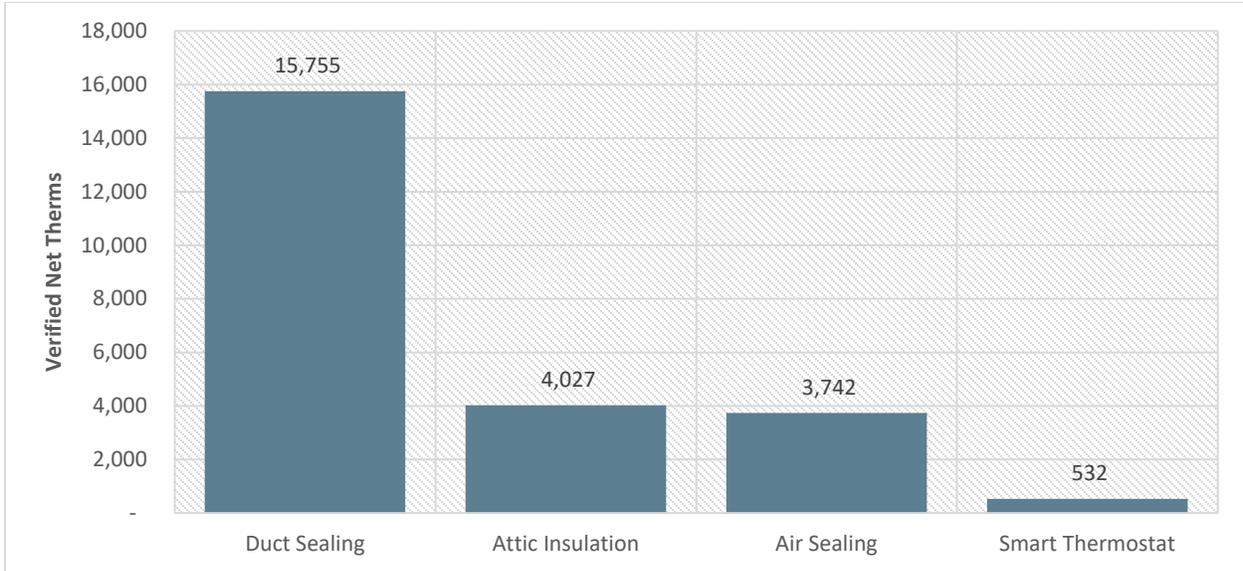


Figure 6-1: Program Savings Share by Measure

In addition, incentives were provided for 38 assessments and health and safety spending at all 38 of 40 participant homes.

6.3 Program Theory & Design

LIPP was created in response to Act 1102 and targets low income BHE customers. The program follows the design of RSP HES Pathway and includes enhanced health and safety measures.

6.3.1.1 Program Administration

The LIPP is overseen by the Manager of Energy Efficiency at BHE. This manager’s responsibilities primarily include interfacing with CLEAResult, who directly implements the program. Other activities by this manager include providing updated customer lists to CLEAResult to better facilitate their implementation, participation in outreach events, and at times assisting CLEAResult in customer interactions.

For CLEAResult, the roles and responsibilities of program staff are as follows:

- **Program Manager.** The Program Manager oversees day-to-day activities, supervises program staff, and handles complaints from customers or contractors.
- **Program Coordinator/Specialist.** This staff member coordinates tracking data, develops samples for quality assurance inspection, and supports reporting and invoicing requirements.
- **QA Verification Specialist.** The QA Verification Specialist conducts post inspections and communicates inspection results to contractors.

6.3.1.2 Program Implementation & Delivery

They key components of LIPP implementation are as follows:

- **Customer verification:** Potential customers interested in the program are confirmed as a BHE customer by program staff.
- **A comprehensive assessment of the customer's home:** Once the customer is prequalified by the contractor as residing in a home that fits the program requirements, the contractor schedules a comprehensive audit of the home and develop a recommended action plan of weatherization upgrades for the participant.
- **Direct installation of immediate energy savings measures:** While performing the comprehensive audit, the contractor installs energy efficient measures throughout the home, including low-flow aerators and showerheads.
- **Installation of a set of weatherization and H&S measures:** The contractor and customer will decide on what upgrades will be undertaken for the home. Based on review of the plan, the customer and contractor will develop an installation plan, and upgrades.

6.3.1.3 Marketing

CLEAResult is the implementer for the LIPP and oversees marketing efforts. In PY2023, LIPP marketing was largely confined to customer referral based on eligibility assessment.

6.3.1.4 Quality Assurance

In the HES Pathway, staff at CLEAResult conducts post inspections at a minimum of 10% of the projects completed by each trade ally. For the LIPP, QA inspections were performed at 50% of PY2023 projects.

6.3.1.5 CWA Metrics Summary

This section presents the required metrics for BHE's LIPP program. Though not explicitly required under Act 1102, the Evaluators have provided this for the purpose of comparability to the HES Pathway.

Table 6-2: CWA Required Process Evaluation Metrics

Metric	Value
Program Name	Low Income Pilot Program
CWA Implementation	Yes
Total Audits Completed	38
Total Submitted Projects	40 homes, 111 measures
Conversion Rate	100.0%
Measures installed per-project	Energy-saving: 2.78 Health & Safety (no energy savings): 3.80
Cost per participant	\$1,403.37
Percent of contractors promoting program	100% (3 Contractors)

Table 6-3: LIPP Alignment with CWA Requirements

Requirement	Alignment with Requirement	Percent of Participants Receiving
Includes Applicable DI Measures	Yes	22.5%
Aerators	Yes	0%
Showerheads	Yes	0%
Smart Thermostat	Yes	22.5%
Efficient lighting	Yes	N/A
Smart strips	Yes	N/A
Prequalifies homes based on year of construction or energy costs	Yes, the customer must have had a bill in the last twelve months that exceeded. Five cents per square foot or the home's age is 10 years or greater.	Not in tracking data
TRC is used to assess program cost-effectiveness	Yes	N/A
Measures screened using SIR or comparable metric	Program uses TRC	N/A
Includes Core No Cost Measures	Yes	100.0%
Audit (walk through)	Yes	95.0%
Audit (virtual)	N/A	N/A
Ceiling insulation	Yes	67.5%
Duct sealing	Yes	92.5%
Air infiltration reduction	Yes	85.0%
Safety testing and/or measures	Yes	Not in tracking data
Offers other utility measures	Yes	22.5%
Contractors are certified BPI Building Analyst or RESNET HERS Rater	Yes, for duct sealing, air infiltration, and assessments. Insulation requires Arkansas Home Improvement Specialty License.	N/A

Figure 6-2 summarizes expenditures per-home by measure group. Overall spending per home increased by 10.5% from PY2021 to PY2023, though H&S per home declined from \$449 to \$324.

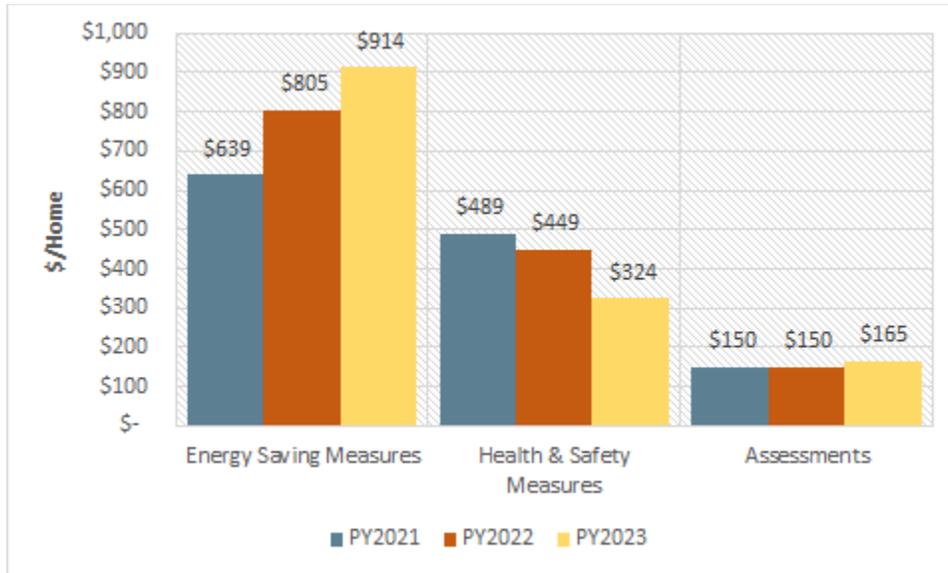


Figure 6-2: LIPP Spending Per-Home

6.3.1.6 Act 1102 Eligibility Summary

Figure 6-3 summarizes the extent to which LIPP participants were age-eligible, income-eligible or eligible on both criteria (as a cross-tabulation of the first two categories).

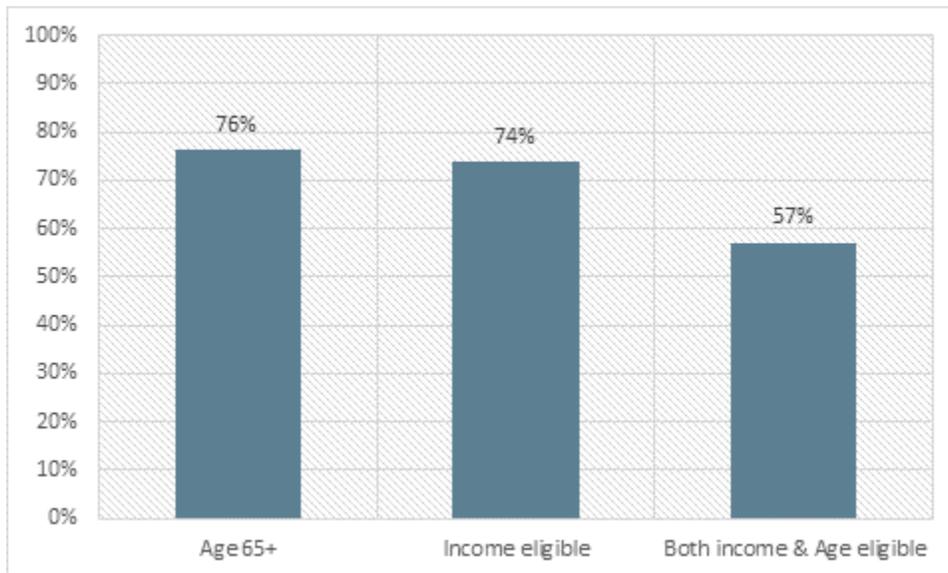


Figure 6-3: BHE LIPP Act 1102 Eligibility Summary

6.3.1.7 Health and Safety Measures

Act 1102 specifies required spending on health and safety improvement in LIPP homes. The LIPP had the following H&S measures:

- Air Purifier
- Air Cycler Fan Controller
- CO Detector
- New Bath Fan with Venting to Outside
- Venting for Existing Bath Fan
- Plumbing Services
- Electrical Services
- Smoke Detector
- Other

Figure 6-4 summarizes H&S measure spending and percent of homes receiving each measure.

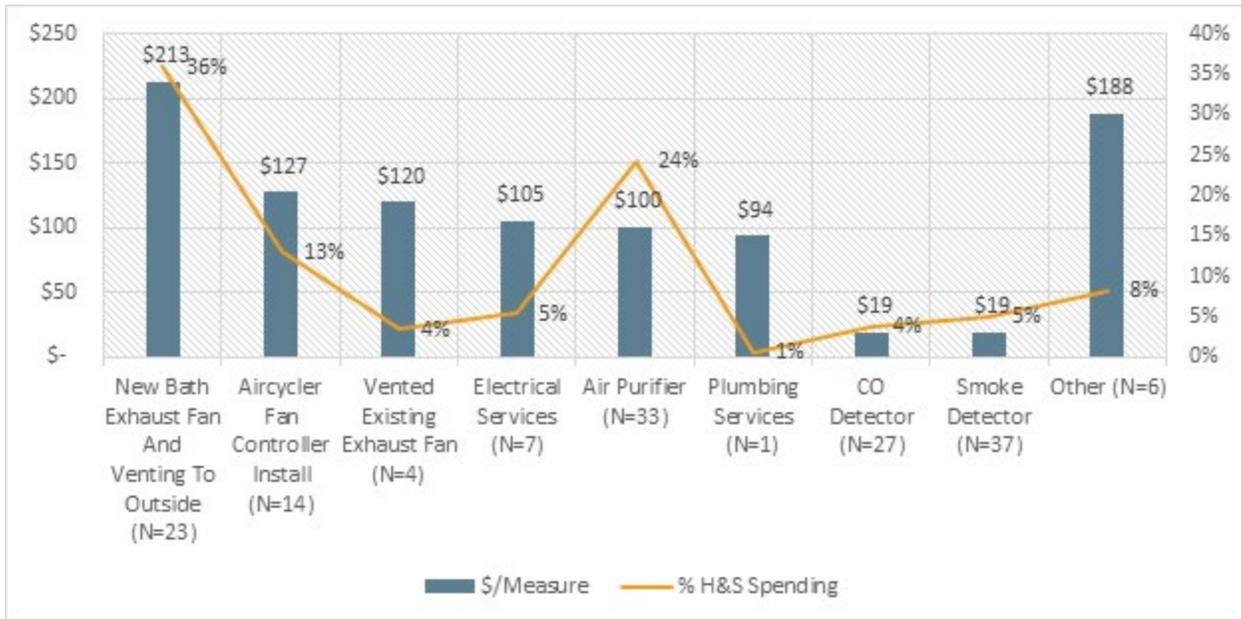


Figure 6-4: Summary of H&S Measure Spending

6.4 Process Evaluation

Table 6-4 and

Table 6-5 summarize the Evaluators’ review of the LIPP in comparison to TRM V9.1 Protocol C for timing and conditions of conducting a process evaluation.

Table 6-4: Determining Appropriate Timing to Conduct a Process Evaluation

Component	Determination
New and Innovative Components	No. The program is implemented in the same manner as in PY2023.

No Previous Process Evaluation	No. The program received a process evaluation in PY2020 and PY2021.
New Vendor or Contractor	No. The program is still implemented by CLEAResult .

Table 6-5: Determining Appropriate Conditions to Conduct a Process Evaluation

Component	Determination
Are program impacts lower or slower than expected?	No. The program met savings goals in PY2022.
Are the educational or informational goals not meeting program goals?	No. The achieved educational goals in PY2022.
Are the participation rates lower or slower than expected?	No. The achieved participation goals in PY2022.
Are the program’s operational or management structure slow to get up and running or not meeting program administrative needs?	No. Administration has been effective, providing both energy efficiency and health & safety measures.
Is the program’s cost-effectiveness less than expected?	No. Cost-effectiveness exceeded plan expectations.
Do participants report problems with the programs or low rates of satisfaction?	Unknown. Participants not yet surveyed,
Is the program producing the intended market effects?	Premature to fully determine, but program has thus far achieved all Pilot goals.

The Evaluators conducted a limited process evaluation.

6.4.1 Data Collection Activities

The process evaluation of LIPP included the following activities:

- *Program Actor In-Depth Interviews.* The Evaluators conducted in-depth interviews with a series of program actors. These interviews covered a range of topics, including marketing efforts, feedback on program delivery, an assessment of barriers to program implementation and success, and recommendations for program improvement. Program Actors interviewed include:
 - *BHE Program Staff.* The Evaluators interviewed staff at BHE involved in the administration of the LIPP.
 - *Third Party Implementation Staff Interviews.* The Evaluators conducted interviews with CLEAResult involved with the LIPP.
- *Participant Surveys.* The Evaluators conducted a cross-cutting participant survey for BHE, SUA, and AOG Act 1102 programs.

Table 6-6 summarizes the data collection for this process evaluation effort. This includes the titles, role, and sample sizes for data collection.

Table 6-6: BHE LIPP Data Collection Summary

Target	Component	Activity	n	Precision Met	Role
BHE Program Staff	Manager of Energy Efficiency; 3 Coordinators	Interview	4	NA	Overall administration of BHE EE programs. This manager is involved in the larger strategic decisions associated with the EE portfolio and is involved with the LIPP and in the overall coordination of utility resources.
CLEARResult Staff	Program Manager	Interview	1	NA	Handles day-to-day operations, application review, billing, and logistics.
Participants	Participants	Survey	20	-	The Evaluators conducted a multi-utility survey of BHE, SUA, and AOG participants. The cross-cutting results are presented in this chapter. The survey encompassed multiple utilities due to the small participant population available for individual utilities.

6.4.2 Protocol A: Tracking Data Review

Table 6-7 summarizes the Protocol A tracking data review for the LIPP. The CLEARResult DSMT tracking database contained all required fields.

Table 6-7: LIPP Protocol A Summary

Category	Field	Status	Description of Issue(s)
Participating Customer Information	Unique customer identifier, such as account number	✓	
	Customer contact information – name, mailing address, telephone number	✓	
	Date/s of major customer milestones such as rebate application date, approval date, rebate processing date, etc.	✓	
Measure-Specific Information	Measure Group (Equipment Type)	✓	
	Equipment Fuel/Energy Source	✓	
	Equipment Quantity	✓	
	Efficiency Level	✓	
	Estimated Savings	✓	
	Estimated incremental measure cost	✓	
	Equipment Useful Life	✓	
	Measure Name – Text Description	✓	
	Measure Name – Numerical Code	N/A	
	Serial Number	N/A	
Reported age of equipment replaced	N/A		
Reported measure type of equipment replaced	✓		

	Other inputs necessary for the use and compliance with the TRM	✓	
Vendor-Specific Information	Name and Contact Information for Contractor	✓	
	Contractor Type	✓	
	Date of Installation	✓	
	Cost of the installed equipment	✓	
	Efficiency level of the installed equipment	✓	
Program Tracking Information	Date of the initial program contact/rebate information	✓	
	Date of rebate/incentive paid	✓	
	Incentive amount paid to-date	✓	
	Incentive amounts remaining	✓	
	Application Status (i.e., number of applications approved, pending, or denied)	✓	
	Reason and reason code for application denial	✓	
Program Costs	Overall program budgets	✓	
	Program expenditures to-date	✓	
	Incentive Costs	✓	
	Administrative Costs	✓	
	Marketing/Outreach Costs	✓	
	Evaluation Costs	✓	
Marketing and Outreach Activities	Advertising and marketing spending levels	-	Not itemized from total marketing costs in data provided to the Evaluators.
	Media schedules	N/A	
	Summary of number of community events/outreach activities	✓	
	Other media activities – estimated impressions via mailings, television/radio; print ads.	✓	

6.4.3 Response to Program Recommendations

Error! Reference source not found. summarizes the PY2022 recommendation and BHE’s response.

Table 6-8: LIPP Response to PY2022 Recommendations

Recommendation	BHE Response	Status of Issue
Screen additional weatherization measures for joint cost-effectiveness with the current program bundle. Wall and floor insulation are potentially cost-effective for the program and should be screened for potential inclusion for the next program cycle	Measures are being screened for future inclusion.	In progress.

6.4.3.1 LIPP Participant Survey Results

Evaluators conducted a survey of Low-Income Weatherization Program participants to gather feedback about customers engagement with and experience of the programs offered by Arkansas Oklahoma Gas, Summit Arkansas, and Black Hills Energy. Participants were sent a letter in the mail inviting them to complete an online survey, followed by up to three phone and email reminders. Twenty participants responded in total (Table 6-9). Due to low response rates, the three utilities are analyzed together.

Table 6-9 Response by Utility (n=20)

Utility	Count
Arkansas Oklahoma Gas	6
Summit AR	8
Black Hills Energy	6
Total	20

6.4.3.2 Respondent Characteristics

Table 6-10 presents respondents’ demographic characteristics.

Table 6-10: Respondent Characteristics

Answer	%	Count
Housing Status (n=20)		
Rent	5.0%	1
Own	85.0%	17
Prefer not to answer	10.0%	2
Housing Type (n=20)		
Single-family home	85.0%	17
Manufactured or mobile home	10.0%	2
Duplex or townhome	5.0%	1
Building Age (n=20)		
Before 1960	25.0%	5
1960 to 1969	5.0%	1
1970 to 1979	5.0%	1
1980 to 1989	15.0%	3
1990 to 1999	15.0%	3
2000 to 2009	15.0%	3
2010 or later	0.0%	0
Don't know	20.0%	4
Building Size (n=20)		
Less than 1,000 square feet	10.0%	2
1,000 to 1,999 square feet	40.0%	8

2,000 to 2,999 square feet	15.0%	3
3,000 to 3,999 square feet	5.0%	1
4,000 square feet or more	5.0%	1
Don't know	25.0%	5
Household Size (n=20)		
1 person	25.0%	5
2 people	40.0%	8
3 people	5.0%	1
4 people	20.0%	4
Prefer not to answer	10.0%	2
Age (years) (n=20)		
18 - 24	5.0%	1
25 - 34	0.0%	0
35 - 44	5.0%	1
45 - 54	15.0%	3
55 - 64	10.0%	2
65 - 74	25.0%	5
75+	30.0%	6
Prefer not to answer	10.0%	2
Household includes elderly (65+ years old) (n=20)		
Yes	30.0%	6
No	70.0%	14
Employment Status (n=20)		
Working or attending school outside of the home	19.1%	4
Retired	66.7%	14
Unemployed	0.0%	0
On medical, disability or maternity leave	4.8%	1
Stay-at-home parent or care provider	4.8%	1
Prefer not to answer	4.8%	1

6.4.3.3 Program Awareness

Respondents learned about the program through a variety of avenues, most commonly word of mouth (45.5%, n =10) (Figure 6-5). Respondents decided to participate in the program to save money on energy bills (23.2%, n=13) and improve the comfort of their home (17.9%, n=10) among other reasons (**Error! Reference source not found.**).

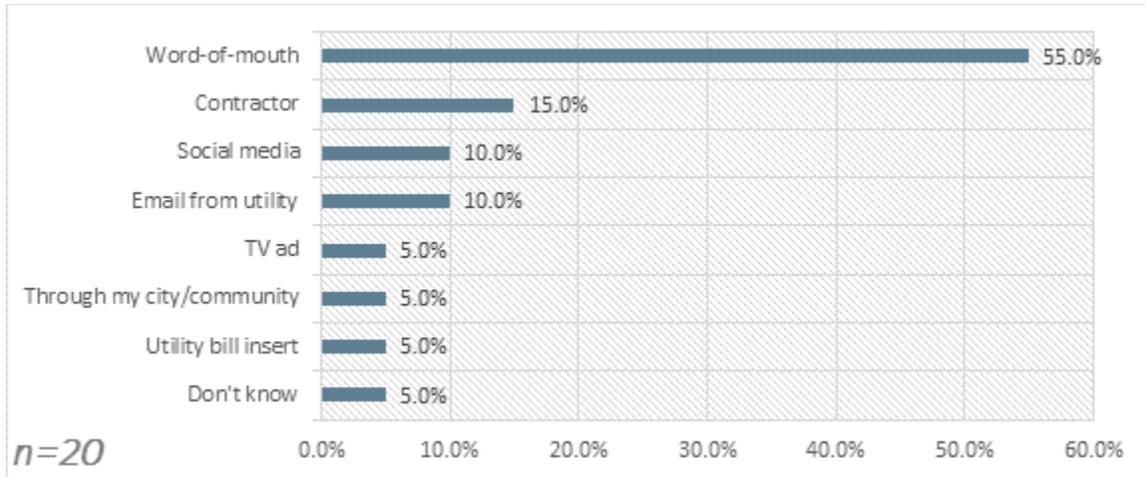


Figure 6-5 Program Awareness

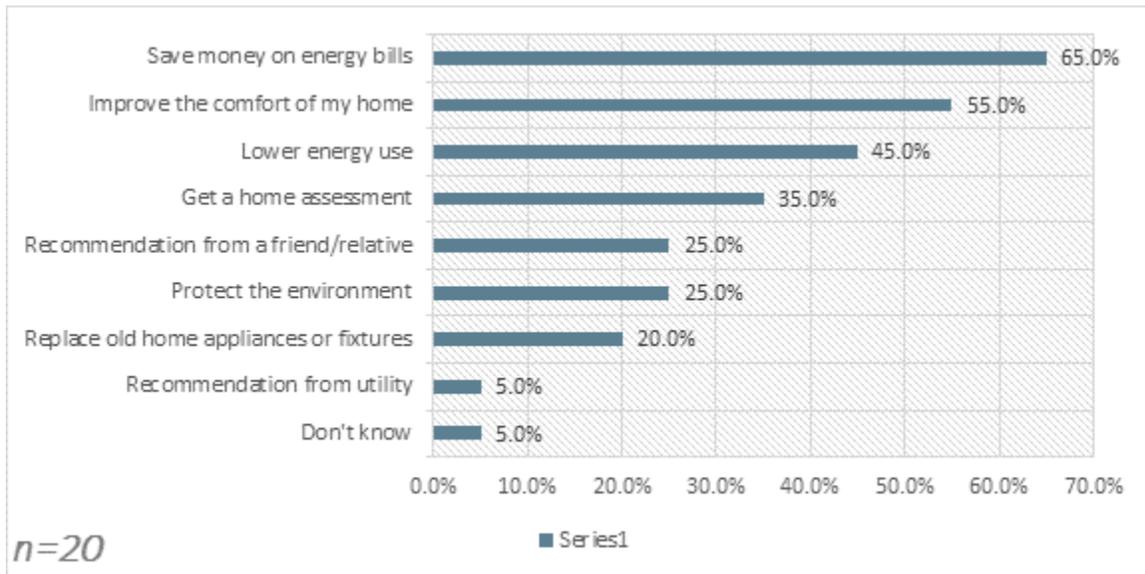


Figure 6-6: Program Enrollment Motivation

6.4.3.4 Home Energy Assessment

More than a fifth of respondents wanted the assessment to learn how they can save energy to save money on energy bills (Figure 6-7).

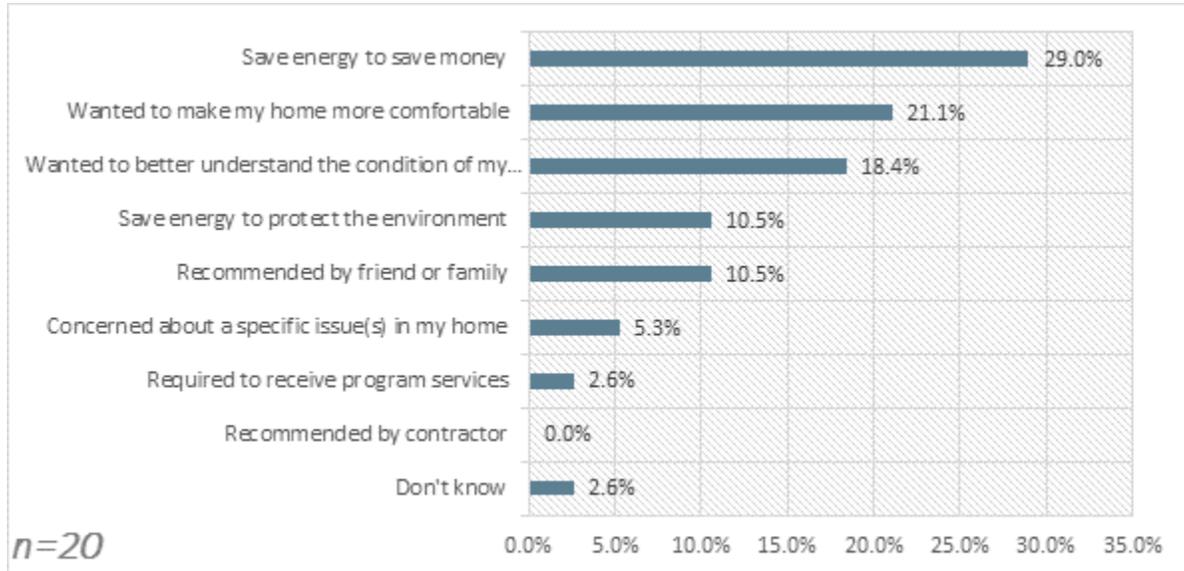


Figure 6-7: Motivation for Assessment

Almost all respondents who received an energy assessment (n=15) were at home when the assessment was conducted (93.3%, n=14). All assessments were done in-person and all but 2 of the energy assessors discussed the assessment findings with the respondents (85.7%, n=12). Almost two thirds of the respondents who were home for the assessment remember receiving a written report after the assessment (64.3%, n=9). **All but two respondents implemented all the recommendations provided by the assessor (66.7%, n=2)**, those who did not complete all the recommendations were due to cost (n=1) and thermostat replacement (n=1).

In general, respondents who received an assessment and were home during the assessment were satisfied with all aspects of the assessment (Figure 6-8); the one respondent who indicated some level of dissatisfaction with the program explained that their door was not properly sealed. More than three quarters of respondents also found the information provided in the assessment to be very or extremely useful (78.6%, n=11) (Figure 6-9).

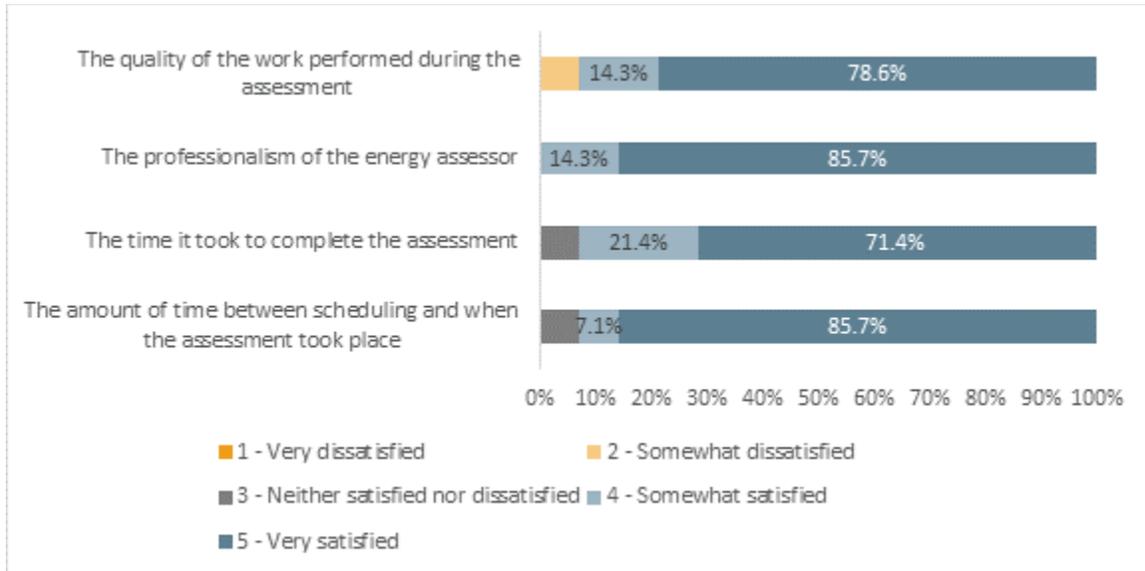


Figure 6-8: Home Energy Assessment Satisfaction (n=14)

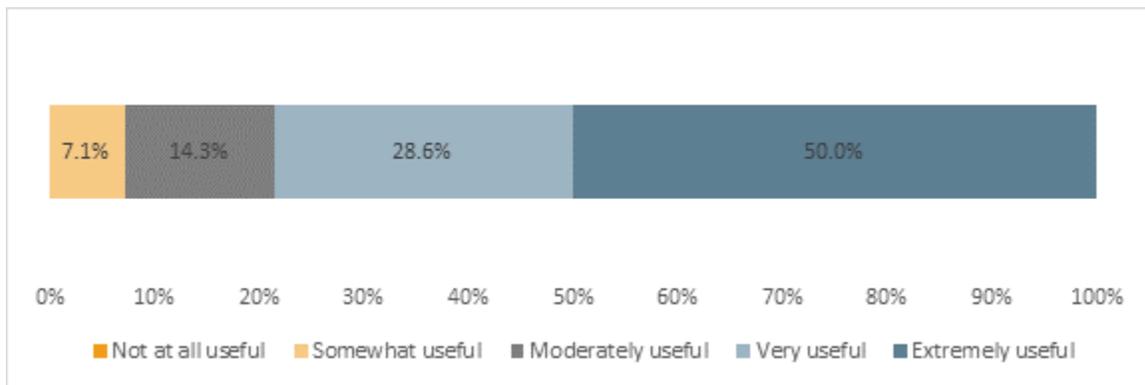


Figure 6-9: Usefulness of Information Provided (n=14)

Most respondents completed the program application themselves (60.0%, n=12); None of them thought it was difficult to complete. Half of respondents were contacted by a contractor they did not previously know (50.0%, n=10) (Figure 6-10).

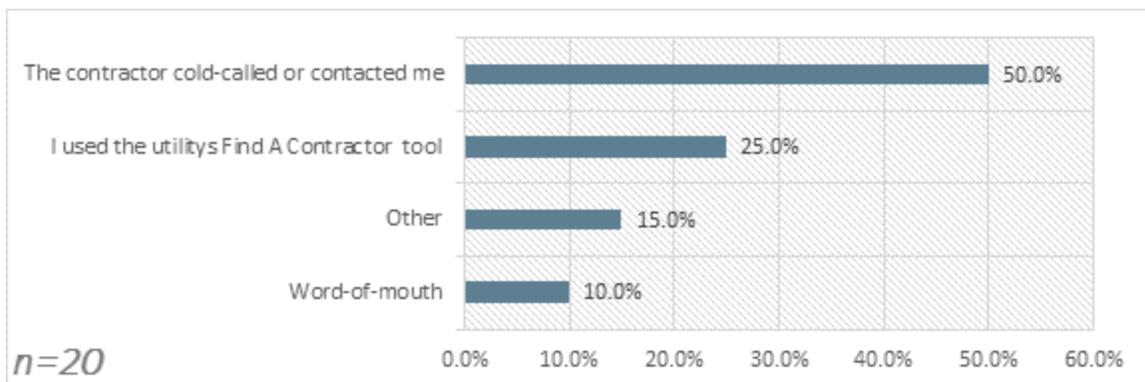


Figure 6-10: Contractor Connection

6.4.3.5 Satisfaction

Respondents were generally satisfied with the weatherization program and the utility company as their service provider (Figure 6-11). Three respondents indicated some level of dissatisfaction. Dissatisfaction was due to the quality of work completed (n=1), the impact on bills (n=1), and the non-installation of a thermostat (n=1). The majority of respondents have recommended the program to friends and family (80.0%, n=16). When given the opportunity to provide feedback on the program in general, three respondents asked for the chance to have contractors follow-up for additional changes or touch ups (n=3), two respondents desired more skilled contractors (n=2), two respondents asked for more or better advertising of the program (n=2), one respondent did not receive a gift certificate after recommending the program to others (n=1), and one respondent asked for before and after pictures of work done by contractors (n=1).

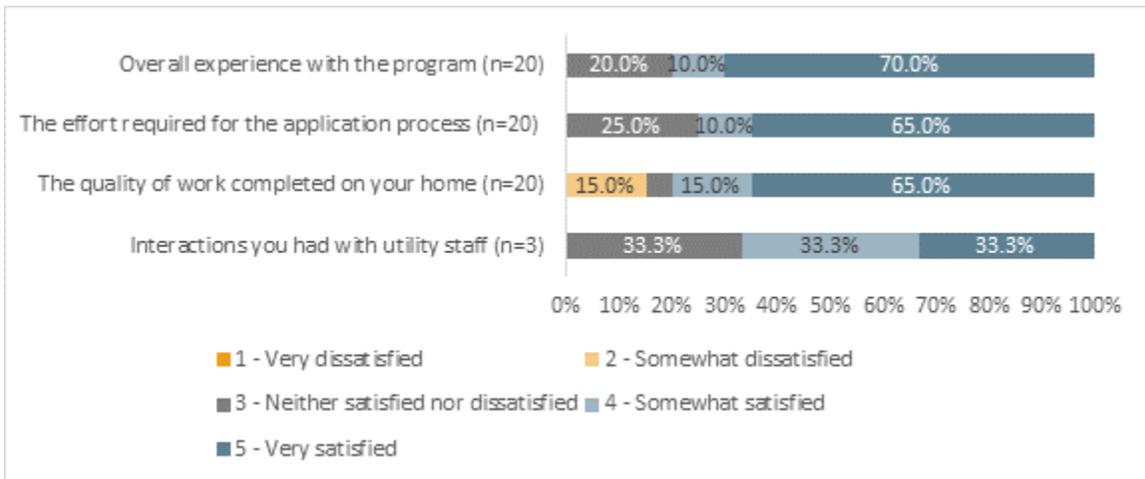


Figure 6-11: Program Satisfaction

Most respondents noted that participating in the weatherization program has improved their satisfaction with the utility in general (80.0%, n=16) and 60.0% (n=12) have seen a decrease in their energy bill since participating in the program (Figure 6-12).

Figure 6-12: Change in Energy Bill (n=20)

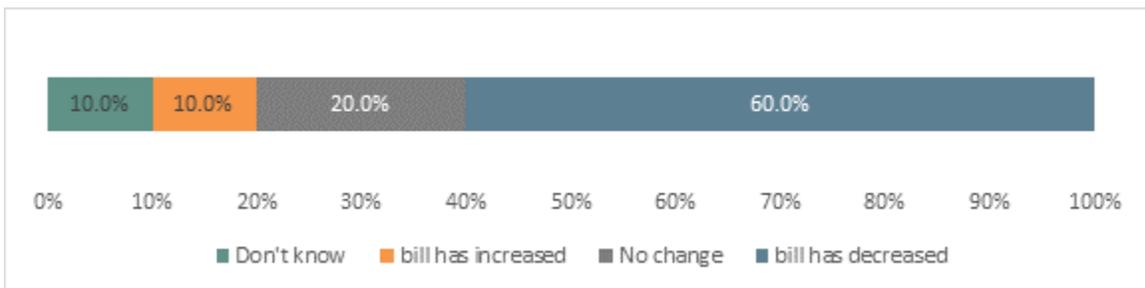


Figure 6-13: Change in Energy Bill (n=20)

6.5 LIPP Impact Evaluation

The evaluation effort of the LIPP included the following:

- *Desk Review of Residential Calculations.* The Evaluators utilized TRM V9.1 values in assessing savings from measures included in the program.

6.5.1.1 Tracking Review

The impact evaluation began with a review of program tracking data, which included a separate row for each measure installed. Table 6-11 summarizes ex ante savings by measure for the LIPP.

Table 6-11: LIPP Ex Ante Summary

<i>Measure</i>	<i>Ex Ante Therms</i>
Duct Sealing	17,330
Ceiling Insulation	7,447
Air Sealing	3,523
Smart Thermostat	2,094
Total	30,393

The tracking data provided measured values for duct pressurization testing and blower door tests, allowing for the recreation of ex ante calculations based on leakage reduction. Ceiling insulation included an indicator for baseline R-value. Program specifications are to bring the home's insulation level up to R-38. The maximum allowed baseline insulation in the program is R-15. The TRM V9.1 allows for up to a minimum of R-22 but the program allows a max of R-15 due to cost-effectiveness issues with preexisting insulation above that level.

- First, the program tracking database was reviewed to determine the scope of the program and to ensure there were no duplicate project entries.
- Next, a detailed desk review was conducted for a census of projects in the tracking system. The desk review process entails recalculation of therms and non-energy benefits for each measure and for each participant.
- Field verification rates from the HES pathway were applied to the LIPP.

After determining the ex post savings impacts for each sampled project, the ex post savings were combined with the ex-ante savings from the projects not included in the sample to determine program level savings

6.5.1.2 Net Savings Estimates

The Evaluators assigned a NTG of 100% to the LIPP, keeping with industry best practices for low income weatherization programs as specified in the Department of Energy Uniform Methods Project¹⁶.

6.5.2 Ex Post Savings

Table 6-12 presents the gross savings results of the evaluation of the PY2023 LIPP. Total Gross Savings summarizes the savings calculations performed by TRM protocols for program measures.

Table 6-12: LIPP Ex Post Savings Summary

<i>Measure</i>	<i>Ex Ante Therms</i>	<i>Ex Post Therms</i>	<i>Gross Realization Rate</i>	<i>EUL</i>	<i>Lifetime Therms</i>
Duct Sealing	15,755	15,739	99.9%	18	283,298
Ceiling Insulation	4,027	3,992	99.1%	20	79,833
Air Sealing	3,742	3,891	104.0%	11	42,800
Smart Thermostat	532	528	99.3%	11	5,811
Total	24,055	24,150	100.4%	17.05	411,742

With a 100% NTGR due to the income requirements of the program, net impacts equal gross impacts.

6.5.2.1 Water & Electric NEBs

In prior program years, the LIPP had 100% overlap with SWEPCO and as a result no electric NEBs were assigned to the program. In PY2023, the LIPP had homes that were solely paid by BHE. The resulting NEBs are summarized in Table 6-13 below.

Table 6-13: LIPP Electric NEBs

<i>Measure</i>	<i>Net kWh</i>	<i>Net kW</i>	<i>Net Lifetime kWh</i>
Duct Sealing	12,058	5.62	217,047
Ceiling Insulation	2,087	1.82	41,731
Air Sealing	1,572	0.93	17,293
Smart Thermostat	1506.6	0.00	16,573
Total	17,223	8.36	292,644

¹⁶ https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter23-estimating-net-savings_0.pdf

6.6 Conclusions

The program met savings goals and was highly cost-effective.	Though savings decreased by 24% compared to PY2022, the program still met 123% of its net savings goal. .
Survey respondents indicated high satisfaction.	Respondents noted high satisfaction across all categories, including 70% reporting being “very satisfied” with the program overall.

6.7 Recommendations

Develop case studies for program marketing.	Similar to how case studies support marketing efforts for C&I Solutions, the LIPP could benefit from case studies from a mix of income as well as age-qualified participants.
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7 Appendix A: Site Reports

This appendix contains the individual site reports for CISP.

Program C&I Solutions
Project ID EA-0002158550
Facility SIC Code 3999 – Manufacturing Industries, Not Elsewhere Classified
Measures Boiler Replacement
Annual Consumption 2,017,100 therms

Project Background

The participant is a manufacturing facility that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Boiler Replacement

Savings will come from replacing the old boiler with a new, more efficient model.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Steam Trap Replacement

The following table shows relevant boiler parameters required for annual energy savings.

Boiler Parameters

<i>Boiler Capacity</i>	η_{pre} (%)	η_{post} (%)
23,432,500	79%	86%

Calculations for the annual therms savings use the following equations:

Boiler Replacement Annual Energy Savings

$$Therm_{savings} = \frac{Capacity \times EFLH_H \times \left(\frac{1}{\eta_{pre}} - \frac{1}{\eta_{post}} \right)}{Therm\ Conversion\ Factor}$$

$$Therm/hr_{savings} = \frac{Capacity \times \left(\frac{1}{\eta_{pre}} - \frac{1}{\eta_{post}} \right)}{Therm\ Conversion\ Factor}$$

Where:

Capacity = Rated equipment heating capacity, BTU/h

EFLH_H = Equivalent full-load hours for heating

η_{pre} = Efficiencies listed in Table 244 for replace on burnout projects should be used

η_{post} = Nameplate Efficiency of the new boiler

Therm Conversion Factor = 100,000 BTU/therm

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Boiler Replacement	20 years

Calculated Savings:

Boiler Replacement

. Boiler Replacement Savings

<i>Boiler Capacity</i>	<i>η_{pre} (%)</i>	<i>η_{post} (%)</i>	<i>EFLH_H</i>	<i>Therms Savings</i>	<i>Therms/hr Savings</i>
23,432,500	79%	86%	1,628	37,232	23
Total:				37,232	23

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Boiler Replacement	37,243	37,232	100%	744,640
TOTAL	37,243	37,232	100%	744,640

Measure Cost, Incentive, & Payback

The Evaluators were not provided with invoices. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
37,232	\$0.49	\$18,244	\$326,777	\$27,932	\$27,932	7	18

Program C&I Solutions
Project ID EA-0002161394
Facility SIC Code 8062 - General Medical and Surgical Hospitals
Measures Steam Traps Repair
 Steam Leak Repair
Annual Consumption 609,487 therms

Project Background

The participant is general hospital that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam Trap Replacement
- ECM #2: Repair Steam Leaks
-

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads such as sterilization. Savings will come from repairing the failed steam traps throughout the site’s steam system.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°
- Annual operating hours for the on-site steam system are 8,760 and 5,840 hours
- Combustion efficiency is 81% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis.

Steam Trap Replacement

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	1/4	60	1	Process	65	81%	8,760
2	13/66	60	1	Drip	65	81%	8,760

3	13/66	60	1	Drip	65	81%	8,760
4	13/66	60	1	Drip	65	81%	8,760
5	5/32	60	1	Drip	65	81%	8,760
6	1/8	60	1	Process	65	81%	5840
7	8/73	60	1	Drip	65	81%	8,760
8	11/64	60	1	Process	65	81%	5840
9	2/17	60	1	Drip	65	81%	8,760
10	2/17	60	1	Drip	65	81%	8,760
11	2/17	60	1	Drip	65	81%	8,760
12	1/8	60	1	Drip	65	81%	8,760

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Stream Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 83%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	1" GV leak	1	1	60	10	81%
2	Bad 3 Way Vlv	1	1	60	10	81%
3	Trap 137 4" Flg Lk	1	5	60	10	81%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, an alternate method was used.

Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equating Steam Plume Length to Flow Rate

$$Leak\ Rate\ \left(\frac{kg}{hr}\right) = 2.5678 \times \exp[1.845 \times Plume\ Length\ (m)]$$

$$Leak\ Rate\ \left(\frac{lb}{hr}\right) = 5.661 \times \exp[0.562 \times Plume\ Length\ (ft)]$$

Equation 3. Calculation for Heat Loss

$$Heat\ Loss\ \left(\frac{Btu}{hr}\right) = Leak\ Rate\ \left(\frac{lb}{hr}\right) \times \left[Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (33.6 BTU/lb)

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years
Repair Steam Leaks	10 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

Steam Trap #	Discharge Rate (lbs/hr)	Percent Failed	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Latent Heat of Evaporation, H_{fg} (BTU/lb)	Therms Savings
1	80	50%	1,182	33	1,141	4,972
2	77	80%	1,182	33	1,141	7,657
3	77	45%	1,182	33	1,141	4,307
4	77	40%	1,182	33	1,141	3,828
5	48	60%	1,182	33	1,141	3,580
6	20	60%	1,182	33	1,141	994
7	23	20%	1,182	33	1,141	572
8	37	20%	1,182	33	1,141	613
9	27	80%	1,182	33	1,141	2,685
10	27	70%	1,182	33	1,141	2,349
11	27	30%	1,182	33	1,141	1,007
12	31	100%	1,182	33	1,141	3,853
Total:						36,417

Repair Steam Leaks

Steam Leak #	Description	Quantity of Leaks	Plume Length (ft)	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Therms Savings
1	1" GV leak	1	1	1,182	34	1,233
2	Bad 3 Way Vlv	1	1	1,182	34	1,233
3	Trap 137 4" Flg Lk	1	5	1,182	34	11,677
Total						14,144

Overall project savings are as follows:

Overall Project Savings

Measure	Expected Annual therms Savings	Realized Annual therms Savings	Realization Rate	Lifetime therms Savings
Steam Trap Repair	36,237	36,417	100%	182,085
Repair Steam Leaks	14,079	14,144	100%	144,138
TOTAL	50,317	50,561	100%	326,221

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$48,339. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
326,221	\$0.49	\$24,675	\$48,339	\$37,737	\$35,322	1.2	0.5

Program C&I Solutions
Project ID EA-0002161345
Facility SIC Code 8062 - General Medical and Surgical Hospitals
Measures Steam Traps
Annual Consumption 35,070 therms

Project Background

The participant is a General Hospital that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam Trap Replacement
- ECM #2: Repair Steam Leaks

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads such as sterilization. Savings will come from repairing the failed steam traps throughout the site’s steam system.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°F
- Annual operating hours for the on-site steam system are 8,760 hours
- Combustion efficiency is 83% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis

Steam Trap Replacement

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	1/8	70	1	Drip	65	83%	8,760

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Stream Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 83%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	PRV Lk trap 3	1	1	70	10	83%
2	PRV Lk Trap 4	1	1	24	10	83%
3	DA Tank Vlv Lk	1	1	70	10	83%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, an alternate method was used.

Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equation 2. Equating Steam Plume Length to Flow Rate

$$\text{Leak Rate } \left(\frac{kg}{hr}\right) = 2.5678 \times \exp[1.845 \times \text{Plume Length (m)}]$$

$$\text{Leak Rate } \left(\frac{lb}{hr}\right) = 5.661 \times \exp[0.562 \times \text{Plume Length (ft)}]$$

Equation 3. Calculation for Heat Loss

$$\text{Heat Loss } \left(\frac{Btu}{hr}\right) = \text{Leak Rate } \left(\frac{lb}{hr}\right) \times \left[\text{Steam Enthalpy } \left(\frac{Btu}{lb}\right) - \text{MW Enthalpy } \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value using **Error! Reference source not found.**

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (33.6 BTU/lb)

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years
Repair Steam Leaks	10 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Percent Failed</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Latent Heat of Evaporation, H_{fg} (BTU/lb)</i>	<i>Therms Savings</i>
1	80	80%	1,182	33	1,141	3,404
Total:						3,404

Repair Steam Leaks

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	1" GV leak	1	1	1,151	34	1,206
2	Bad 3 Way Vlv	1	1	1,136	34	1,190
3	Trap 137 4" Flg Lk	1	1	1,151	34	1,206
Total						3,602

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Trap Repair	3,404	3,404	100%	17,021
Repair Steam Leaks	3,604	3,602	100%	36,022
TOTAL	7,008	7,006	100%	53,043

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$21,096. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
7,006	\$0.60	\$4,225	\$21,096	\$5,256	\$4,904	0.43	0.2

Program C&I Solutions
Project ID EA-0000951274
Facility SIC Code 5142- Packaged Frozen Foods
 Steam Leaks
Measures Insulation
 Steam Trap
Annual Consumption 2,303,350 therms

Project Background

The participant is a food processing facility that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam leak repair
- ECM #2: Steam system thermal insulation
- ECM #3: Steam trap replacement

The site uses steam for heating and process loads in the facility. Savings will come from improved energy efficiency resulting from reduced steam losses and reduced heat losses.

M&V Methodology

The M&V plan was generally guided by the International Performance Measurement and Verification Protocol 2021 (IPMVP) Option A – Key Parameter Measurement. Using this option, savings were determined by performing pre and post field measurements.

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

Steam Leak Parameters

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	3/8 TEE W/HOLE #1	1	1	90	10	83%
2	VALVE OFF NOW BUSTED COIL	1	2	90	17	83%
3	UNION/VALVE LEAK	1	1	90	10	83%
4	GATE VALVE LK	1	1	90	10	83%
5	UNION LEAK	1	1	90	10	83%
6	UNION LEAK	1	1	90	10	83%
7	RELIEF VLV LK	1	2	90	17	83%
8	NIPPLE LEAK	1	2	90	17	83%

9	PACKING/UNION	1	3	90	31	83%
10	NIPPLE LEAK	1	1	90	10	83%
11	BAD RELIEF VLV	1	1	90	10	83%
12	RELIEF VLV LK	1	1	90	10	83%
13	UNION LEAK	1	2	90	17	83%
14	RED BUSH LK	1	1	90	10	83%
15	UNION / NIP /G	1	3	90	31	83%
16	STR LEAK	1	1	90	10	83%
17	BUSTED CHECK V	1	1	90	10	83%
18	Y-STR BUSTED	1	1	90	10	83%
19	UNION LK	1	1	90	10	83%
20	B ROOF STORAGE FREEZER	2	1	90	10	83%
21	A-PF BUSTED PIPE	1	4	90	54	83%
22	PREP SAUCE AREA KETTLE RELIEF VALVE LEAK	2	2	90	17	83%
23	SOUTH FRYER LINE UNION LEAKS	3	4	90	54	83%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, the alternate method was used. Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equating Steam Plume Length to Flow Rate

$$Leak\ Rate\ \left(\frac{kg}{hr}\right) = 2.5678 \times \exp[1.845 \times Plume\ Length\ (m)]$$

$$Leak\ Rate\ \left(\frac{lb}{hr}\right) = 5.661 \times \exp[0.562 \times Plume\ Length\ (ft)]$$

. Calculation for Heat Loss

$$Heat\ Loss\ \left(\frac{Btu}{hr}\right) = Leak\ Rate\ \left(\frac{lb}{hr}\right) \times \left[Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (34.2 BTU/lb)

Steam System Thermal Insulation

Through this method, energy savings are calculated using key data and through the North American Insulation Manufacturers Association’s 3E Plus software:

[\(http://www.pipeinsulation.org/\)](http://www.pipeinsulation.org/).

Measurement and verification activities are based on the following assumptions:

- Insulation thickness: 1.5 in
- Insulation material type: 450°F MF Blanket, Type II, C553-13
- Jacket: All service Jacket
- **Process and ambient air temperature varied based on the measure. See table below.**

The 3E Plus software was used to calculate heat loss (btu/hr/ft) for bare piping (pre-retrofit) and piping with 1.5-in insulation (post-retrofit). The software required these inputs: process temperature, ambient temperature, pipe size, base metal, insulation, and jacket material. Annual therms savings was calculated using the following equation:

Pipe Insulation Installation Annual Energy Savings

$$\text{Annual Therms Savings} = \frac{\text{Heat Loss} \left(\frac{\text{Btu}}{\text{hr}} \right) \times \text{Annual Operating Hours} \left(\frac{\text{hrs}}{\text{yr}} \right)}{\text{Boiler Efficiency} \times 100,000 \left(\frac{\text{BTU}}{\text{CCF}} \right)}$$

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency

100,000 Btu/CCF = conversion factor (BTU/yr to CCF/yr)

Table 2. Pipe/Valve Insulation Parameters

Entry #	Description	Object To Insulate	Pipe Length	Pipe Diameter	Valve or Fitting Total Length	Valve Fitting Size	Tank Surface Area
1	2 " P.5/UN/P.5/STR/P1/UN	Pipe	2	2			
2	2 " P.5/UN/P.5/STR/P1/UN	Valve or Fitting			8.5	2	

3	2" P.5/UN/P.5/STR/P1/UN	Pipe	2	2			
4	2" P.5/UN/P.5/STR/P1/UN	Valve or Fitting			8.5	2	
5	2" P1/EL/P1	Pipe	2	2			
6	2" P1/EL/P1	Valve or Fitting			2.8	2	
7	4" 150lb GV	Valve or Fitting			3.4	4	
8	4" 150lb GV	Valve or Fitting			3.4	4	
9	Two 12" 150lb GV v/v Bonnet	Valve or Fitting			8.5	12	
10	6" P1/6" 300lb FLG/P2	Pipe	3	6			
11	6" P1/6" 300lb FLG/P2	Valve or Fitting			3.7	6	
12	4" 150lb GV	Valve or Fitting			3.4	4	
13	1" GV/BV/MK45-1	Valve or Fitting			6.8	1	
14	4" 150lb GV	Valve or Fitting			3.4	4	
15	P3/4" 150lb FLG	Pipe	3	4			
16	P3/4" 150lb FLG	Valve or Fitting			3.4	4	
17	4" 150lb GV Bonnet	Valve or Fitting			3.4	4	
18	4" 150lb GV Bonnet	Valve or Fitting			3.4	4	
19	1-1/2" 4Way/Cap	Valve or Fitting			5.2	1.5	
20	1" UN/P2	Pipe	2	1			
21	1" UN/P2	Valve or Fitting			2.3	1	
22	LWCO 10x8	Cylindrical Tank					2.8
23	1" P.5/UN/P1/4Way/P4/UN/4Way	Pipe	5.5	1			
24	1" P.5/UN/P1/4Way/P4/UN/4Way	Valve or Fitting			9.1	1	
25	1" 4Way/CAP/P.5/UN/P1.5	Pipe	2	1			
26	1" 4Way/CAP/P.5/UN/P1.5	Valve or Fitting			6.8	1	
27	Level Gauge 17x9	Cylindrical Tank					3.3
28	1" UN/P1/4Way/P.5/TEE/P3	Pipe	4.5	1			
29	1" UN/P1/4Way/P.5/TEE/P3	Valve or Fitting			6.8	1	
30	Manway Sight Glass 24"	Cylindrical Tank					0.5
31	Hand Holds 9.5"	Cylindrical Tank					1.2
32	6" 300lb GV	Valve or Fitting			3.7	6	
33	6" 300lb KingValve	Valve or Fitting			3.7	6	
34	8" 300lb FLG spacer	Valve or Fitting			3.9	8	
35	3" PRV/Reducer	Valve or Fitting			3.2	3	
36	2" P/CAP	Pipe	1	2			
37	2" P/CAP	Valve or Fitting			2.8	2	
38	6" 300lb FLG	Valve or Fitting			3.7	6	
39	6" 150lb GV	Valve or Fitting			3.7	6	
40	Boiler Manway 16.5 x 12.5	Cylindrical Tank					7.5
41	4" 150lb Y Strainer	Valve or Fitting			3.4	4	
42	4" 150lb PRV	Valve or Fitting			3.4	4	
43	Four 4" 150lb GV	Valve or Fitting			13.6	4	
44	10" 300lb FLG	Valve or Fitting			4.1	10	
46	6" 150lb GV	Valve or Fitting			3.7	6	

47	6" 150lb GV	Valve or Fitting			3.7	6	
48	American Marsh Pump	Cylindrical Tank					25.1
49	4" 150lb BV	Valve or Fitting			3.4	4	
50	4" 150lb BV	Valve or Fitting			3.4	4	
51	4" SS P1/EL/P3/EL	Pipe	4	4			
52	4" SS P1/EL/P3/EL	Valve or Fitting			6.8	4	
53	4" 150lb FLG	Valve or Fitting			3.4	4	
54	Hot Oil Skid	Pipe	34	1			
55	Hot Oil Skid	Valve or Fitting			22.1	1.25	

Steam Trap Replacements

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

Steam Trap #	Orifice Size (in.)	Inlet Pressure (psig)	Outlet Pressure (psig)	Service (Drip/Process)	Feedwater Temperature (°F)	Boiler Efficiency	Operating Hours
1	2/17	90	1	Tracer/Drip	180	83%	8,760
2	1/4	90	1	Coil/Process	180	83%	5,840
3	2/17	90	1	Tracer/Drip	180	83%	8,760
4	7/64	90	1	Coil/Process	180	83%	4,380
5	8/73	90	1	Coil/Process	180	83%	4,380
6	2/17	90	1	Coil/Process	180	83%	4,380
7	2/17	90	1	Coil/Process	180	83%	4,380
8	2/23	90	1	Tracer/Drip	180	83%	5,840
9	2/17	90	1	Coil/Process	180	83%	5,840
10	2/17	90	1	Coil/Process	180	83%	5,840
11	2/17	90	1	Coil/Process	180	83%	5,840
12	2/17	90	1	Tracer/Drip	180	83%	8,760
13	2/17	90	1	Tracer/Drip	180	83%	8,760
14	2/17	90	1	Tracer/Drip	180	83%	8,760
15	7/64	90	1	Tracer/Drip	180	83%	8,760
16	2/17	90	1	Coil/Process	180	83%	5,840
17	1/6	90	1	Coil/Process	180	83%	5,840
18	2/17	90	1	Coil/Process	180	83%	5,840
19	2/17	90	1	Tracer/Drip	180	83%	8,760
20	7/64	90	1	Coil/Process	180	83%	5,840
21	7/64	90	1	Coil/Process	180	83%	5,840
22	13/66	90	1	Tracer/Drip	180	83%	5,840
23	3/32	90	1	Tracer/Drip	180	83%	8,760
24	5/64	90	1	Tracer/Drip	180	83%	8,760
25	2/11	90	1	Tracer/Drip	180	83%	8,760
26	2/17	90	1	Tracer/Drip	180	83%	8,760

27	13/66	90	1	Tracer/Drip	180	83%	8,760
28	13/66	90	1	Tracer/Drip	180	83%	8,760
29	2/17	90	1	Tracer/Drip	180	83%	8,760
30	2/11	90	1	Tracer/Drip	180	83%	8,760
31	8/73	90	1	Tracer/Drip	180	83%	8,760
32	2/17	90	1	Tracer/Drip	180	83%	8,760
33	2/17	90	1	Tracer/Drip	180	83%	8,760
34	2/17	90	1	Tracer/Drip	180	83%	8,760
35	1/8	90	1	Tracer/Drip	180	83%	8,760
36	2/11	90	1	Tracer/Drip	180	83%	8,760
37	2/11	90	1	Tracer/Drip	180	83%	8,760
38	2/23	90	1	Coil/Process	180	83%	8,760
39	2/17	90	1	Tracer/Drip	180	83%	8,760

Calculations for the annual therms savings use the following equation:

. Steam Trap Replacement Annual Energy Savings

$$Annual\ therms\ Savings = \frac{Steam\ Trap\ Discharge\ Rate \times OpHrs \times h_{fg}}{EC_{Base} \times Therm\ Conversion\ Factor}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 85%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using DOE source documents, Armstrong Coefficients for liquid vs. vapor discharge (www.armstronginternational.com), and in-service discharge rates.

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Leak Repairs	5 years
Steam System Thermal Insulation	15 years
Steam Trap Replacement	5 years

Calculated Savings:

Steam Leak Repairs

Steam Leak Repairs Savings

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	3/8 TEE W/HOLE #1	1	1	1189	34	1216
2	VALVE OFF NOW BUSTED COIL	1	2	1189	34	2132
3	UNION/VALVE LEAK	1	1	1189	34	1216
4	GATE VALVE LK	1	1	1189	34	1216
5	UNION LEAK	1	1	1189	34	1216
6	UNION LEAK	1	1	1189	34	1216
7	RELIEF VLV LK	1	2	1189	34	2132
8	NIPPLE LEAK	1	2	1189	34	2132
9	PACKING/UNION	1	3	1189	34	3741
10	NIPPLE LEAK	1	1	1189	34	1216
11	BAD RELIEF VLV	1	1	1189	34	1216
12	RELIEF VLV LK	1	1	1189	34	1216
13	UNION LEAK	1	2	1189	34	2132
14	RED BUSH LK	1	1	1189	34	1216
15	UNION / NIP /G	1	3	1189	34	3741
16	STR LEAK	1	1	1189	34	1216
17	BUSTED CHECK V	1	1	1189	34	1216
18	Y-STR BUSTED	1	1	1189	34	1216
19	UNION LK	1	1	1189	34	1216
20	B ROOF STORAGE FREEZER	2	1	1189	34	2431
21	A-PF BUSTED PIPE	1	4	1189	34	6562
22	PREP SAUCE AREA KETTLE RELIEF VALVE LEAK	2	2	1189	34	4,265
23	SOUTH FRYER LINE UNION LEAKS	3	4	1189	34	19,686
Total						64,759

Steam System Thermal Insulation

Pipe Insulation Annual Energy Savings

Entry #	Description	Object to Insulate	Temperature (°F)	Pre Heat Loss	Post Heat Loss	Therms Savings
1	2 " P.5/UN/P.5/STR/P1/UN	Pipe	243	262	37	48
2	2 " P.5/UN/P.5/STR/P1/UN	Valve or Fitting	243	262	37	203
3	2" P.5/UN/P.5/STR/P1/UN	Pipe	243	262	37	48
4	2" P.5/UN/P.5/STR/P1/UN	Valve or Fitting	243	262	37	203
5	2" P1/EL/P1	Pipe	243	262	37	48
6	2" P1/EL/P1	Valve or Fitting	243	262	37	68
7	4" 150lb GV	Valve or Fitting	214	368	46	116
8	4" 150lb GV	Valve or Fitting	214	368	46	116
9	Two 12" 150lb GV v/v Bonnet	Valve or Fitting	250	1477	155	1,198
10	6" P1/6" 300lb FLG/P2	Pipe	250	788	94	220
11	6" P1/6" 300lb FLG/P2	Valve or Fitting	250	788	94	273
12	4" 150lb GV	Valve or Fitting	250	532	65	168
13	1" GV/BV/MK45-1	Valve or Fitting	246	166	28	100
14	4" 150lb GV	Valve or Fitting	237	495	60	156
15	P3/4" 150lb FLG	Pipe	237	495	60	138
16	P3/4" 150lb FLG	Valve or Fitting	237	495	60	156
17	4" 150lb GV Bonnet	Valve or Fitting	237	495	60	156
18	4" 150lb GV Bonnet	Valve or Fitting	237	495	60	156
19	1-1/2" 4Way/Cap	Valve or Fitting	267	256	39	120
20	1" UN/P2	Pipe	267	184	31	32
21	1" UN/P2	Valve or Fitting	267	184	31	37
22	LWCO 10x8	Cylindrical Tank	267	452	45	122
23	1" P.5/UN/P1/4Way/P4/UN/4Way	Pipe	267	184	31	89
24	1" P.5/UN/P1/4Way/P4/UN/4Way	Valve or Fitting	267	184	31	148
25	1" 4Way/CAP/P.5/UN/P1.5	Pipe	267	184	31	32
26	1" 4Way/CAP/P.5/UN/P1.5	Valve or Fitting	267	184	31	111
27	Level Gauge 17x9	Cylindrical Tank	245	382	38	121
28	1" UN/P1/4Way/P.5/TEE/P3	Pipe	245	155	26	62
29	1" UN/P1/4Way/P.5/TEE/P3	Valve or Fitting	245	155	26	94
30	Manway Sight Glass 24"	Cylindrical Tank	217	298	30	15
31	Hand Holds 9.5"	Cylindrical Tank	293	542	54	62
32	6" 300lb GV	Valve or Fitting	304	1061	128	368
33	6" 300lb KingValve	Valve or Fitting	304	1061	128	368

34	8" 300lb FLG spacer	Valve or Fitting	304	1366	154	507
35	3" PRV/Reducer	Valve or Fitting	224	319	42	93
36	2" P/CAP	Pipe	245	266	38	24
37	2" P/CAP	Valve or Fitting	245	266	38	69
38	6" 300lb FLG	Valve or Fitting	245	698	85	242
39	6" 150lb GV	Valve or Fitting	245	698	85	242
40	Boiler Manway 16.5 x 12.5	Cylindrical Tank	245	382	38	272
41	4" 150lb Y Strainer	Valve or Fitting	279	623	76	197
42	4" 150lb PRV	Valve or Fitting	279	623	76	197
43	Four 4" 150lb GV	Valve or Fitting	279	623	76	786
44	10" 300lb FLG	Valve or Fitting	226	943	103	368
46	6" 150lb GV	Valve or Fitting	250	710	86	246
47	6" 150lb GV	Valve or Fitting	250	710	86	246
48	American Marsh Pump	Cylindrical Tank	265	437	44	1,046
49	4" 150lb BV	Valve or Fitting	242	460	57	145
50	4" 150lb BV	Valve or Fitting	242	460	57	145
51	4" SS P1/EL/P3/EL	Pipe	242	460	57	171
52	4" SS P1/EL/P3/EL	Valve or Fitting	242	460	57	290
53	4" 150lb FLG	Valve or Fitting	242	460	57	145
54	Hot Oil Skid	Pipe	310	301	45	920
55	Hot Oil Skid	Valve or Fitting	310	301	45	599
Total						12,297

Steam Trap Replacement

Steam Trap Replacement Savings

Steam Trap #	Discharge Rate (lbs/hr)	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Therms Savings
1	44	1,189	148	2,427

2	112	1,189	148	5,765
3	44	1,189	148	2,693
4	21	1,189	148	811
5	21	1,189	148	695
6	28	1,189	148	772
7	28	1,189	148	540
8	25	1,189	148	552
9	28	1,189	148	1,441
10	28	1,189	148	2,059
11	28	1,189	148	1,853
12	44	1,189	148	1,077
13	44	1,189	148	1,616
14	44	1,189	148	1,616
15	33	1,189	148	2,912
16	28	1,189	148	1,029
17	44	1,189	148	3,235
18	28	1,189	148	2,059
19	44	1,189	148	4,853
20	21	1,189	148	686
21	21	1,189	148	686
22	98	1,189	148	5,765
23	25	1,189	148	1,930
24	17	1,189	148	2,081
25	98	1,189	148	6,486
26	44	1,189	148	3,883
27	98	1,189	148	8,648
28	98	1,189	148	10,809
29	44	1,189	148	4,368
30	98	1,189	148	4,324
31	25	1,189	148	827
32	44	1,189	148	1,456
33	44	1,189	148	4,853
34	44	1,189	148	2,693
35	44	1,189	148	2,184
36	98	1,189	148	7,567
37	98	1,189	148	5,945
38	16	1,189	148	1,412
39	44	1,189	148	1,616
Total				116,224

Measure Cost, Incentive, & Payback

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Leak Repair	64,759	64,759	100%	323,794
Steam System Insulation	12,387	12,297	99%	184,460
Steam Trap Repair	116,225	116,224	100%	581,120
TOTAL	193,371	193,280	98%	1,089,373

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$108,158. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
193,371	\$0.49	\$94,752	\$108,158	\$145,028	\$144,960	0.5	0.9

Program C&I Solutions
Project ID EA-0001545100
Facility SIC Code 8221 - Colleges, Universities, and Professional Schools
 Steam Traps
Measures Steam Leak Repair
 Condensate Return
 Boiler Tune Up
Annual Consumption 510,430 therms

Project Background

The participant is a university that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam Trap Replacement

- ECM #2: Repair Steam Leaks
- ECM #3: Condensate Return
- ECM #4: Boiler Tune Ups

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads. This project is a multiyear project where partial savings were claimed in PY2022 and PY2023. This report shows the total project results.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°F
- Annual operating hours for the on-site steam system are 8,760 hours
- Combustion efficiency is 83% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis

Steam Trap Replacement

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	1/4	34	1	Drip	149	83%	8,760
2	13/83	34	1	Drip	149	83%	8,760
3	1/2	34	1	Process	149	83%	8,760
4	3/8	34	1	Process	149	83%	8,760
5	21/83	34	1	Drip	149	83%	8,760
6	21/83	34	1	Drip	149	83%	8,760
7	3/16	34	1	Drip	149	83%	8,760
8	2/11	34	1	Drip	149	83%	8,760

9	5/16	34	1	Drip	149	83%	8,760
10	1/4	34	1	Drip	149	83%	8,760
11	5/32	34	1	Drip	149	83%	8,760
12	1/4	34	1	Drip	149	83%	8,760
13	9/32	34	1	Drip	149	83%	8,760
14	2/11	34	1	Drip	149	83%	8,760
15	7/32	34	1	Drip	149	83%	8,760
16	1/6	34	1	Drip	149	83%	8,760
17	11/64	34	1	Drip	149	83%	8,760
18	15/61	34	1	Process	149	83%	8,760

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Stream Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 83%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	PRV LEAK	1	1	34	10	83%
2	COND PUMP LEAK	1	1	34	10	83%
3	L/T 138	1	1	34	10	83%
4	VLV PACKING LK	1	1	34	10	83%
5	VALVE LEAK	1	1	34	10	83%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, an alternate method was used. Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equating Steam Plume Length to Flow Rate

$$Leak\ Rate\ \left(\frac{kg}{hr}\right) = 2.5678 \times \exp[1.845 \times Plume\ Length\ (m)]$$

$$Leak\ Rate\ \left(\frac{lb}{hr}\right) = 5.661 \times \exp[0.562 \times Plume\ Length\ (ft)]$$

Calculation for Heat Loss

$$Heat\ Loss\ \left(\frac{Btu}{hr}\right) = Leak\ Rate\ \left(\frac{lb}{hr}\right) \times \left[Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (33.6 BTU/lb)

The following table shows relevant steam leak parameters required for annual energy savings calculations

Condensate Return

The condensate return flow rate was calculated using the following equation:

Calculation for Flow Rate

$$Flow\ rate\ \left(\frac{lb}{hr}\right) = \frac{Cycles * GPC * 8.35\ \left(\frac{lb}{gal}\right)}{Hours}$$

Where:

Cycles = Measured by condensate pump cycle counter at 26,299 cycles

GPC = 7 gallons per cycle, per pump manufacturer specifications

Hours = Time elapsed during 33 day reporting period, equal to 792 hours

8.35 lb/gal = Conversion factor (gal/hr to lb/hr)

System energy recovered from condensate return was calculated as:

Calculation for Heat Recovered

$$\begin{aligned}
 \text{Heat recovered} \left(\frac{\text{Btu}}{\text{hr}} \right) \\
 = \text{Flow Rate} \left(\frac{\text{lb}}{\text{hr}} \right) \times \left[\text{Condensate Enthalpy} \left(\frac{\text{Btu}}{\text{lb}} \right) - \text{MW Enthalpy} \left(\frac{\text{Btu}}{\text{lb}} \right) \right]
 \end{aligned}$$

Where:

Flow Rate = Calculated value from equation 4

Condensate Enthalpy = saturated steam region based on system steam pressure

MW Enthalpy = steam look up table based on makeup water temperature,
 derived from average temperature of water main in each zone (33.68 BTU/lb)

The annual natural gas energy savings from returning condensate to feedwater was calculated by extrapolating from the relationship between heat recovered, period savings, and annual operating hours.

Condensate Annual Energy Savings

$$\begin{aligned}
 \text{Annual Energy Savings (CCF)} \\
 = \frac{\text{Heat Recovered} \left(\frac{\text{Btu}}{\text{hr}} \right) \times \text{Annual Operating Hours (hrs)}}{\text{Boiler Efficiency (\%)} \times 100,000 \left(\frac{\text{Btu}}{\text{CCF}} \right)}
 \end{aligned}$$

Annual Operating Hours = 8,760 hours

Boiler Efficiency = 83% from recent analysis

100,000 Btu/CCF = Conversion factor (BTU/yr to CCF/yr)

Boiler Tune Ups

For all three steam boilers, the following equation was used.

Boiler Tune Up Annual Energy Savings

$$Therm\ Savings = Capacity * EFLH_H * \left(\frac{1}{E_{C_{Eff}}} - \frac{1}{E_{C_{Base}}} \right) * \frac{1}{100,000}$$

Where:

Capacity = Boiler capacity, equal to 6,695,000 Btu/hr for boiler #1, and 13,390,000 Btu/hr for #2 and #3.

EFLH_H = Equivalent Full Load Hours

E_{C-Eff} = Boiler combustion efficiency

E_{C-Base} = Boiler combustion efficiency

100,000 Btu/CCF = Conversion factor (BTU/yr to CCF/yr)

The sum of each was totaled to determine the annual therm savings associated with this ECM.

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years
Repair Steam Leaks	10 years
Condensate Return	15 years
Boiler Tune Ups	3 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Percent Failed</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Latent Heat of Evaporation, H_{fg} (BTU/lb)</i>	<i>Therms Savings</i>
1	81	100%	1,174	33	1,141	9,756
2	31	90%	1,174	33	1,141	3,360
3	208	100%	1,174	33	1,141	19,554
4	117	90%	1,174	33	1,141	9,899
5	83	100	1,174	33	1,141	9,993
6	83	55%	1,174	33	1,141	5,496
7	45	60%	1,174	33	1,141	3,251
8	42	60%	1,174	33	1,141	3,035
9	127	20%	1,174	33	1,141	3,059

10	81	100%	1,174	33	1,141	9,756
11	31	85%	1,174	33	1,141	3,174
12	81	75%	1,174	33	1,141	7,317
13	102	70%	1,174	33	1,141	8,600
14	42	30%	1,174	33	1,141	1,518
15	62	55%	1,174	33	1,141	4,107
16	35	80%	1,174	33	1,141	3,373
17	38	30%	1,174	33	1,141	1,373
18	50	80%	1,174	33	1,141	2,409
Total:						109,050

Repair Steam Leaks

Steam Leak #	Description	Quantity of Leaks	Plume Length (ft)	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Therms Savings
1	PRV LEAK	1	1	1,174	34	1,195
2	COND PUMP LEAK	1	2	1,174	34	1,195
3	L/T 138	1	1	1,174	34	1,195
4	VLV PACKING LK	1	1	1,174	34	1,195
5	VALVE LEAK	1	1	1,174	34	1,195
Total						5,977

Condensate Return

$$\text{Flow rate } \left(\frac{\text{lb}}{\text{hr}}\right) = \frac{\text{Cycles} * \text{GPC} * 8.35 \left(\frac{\text{lb}}{\text{gal}}\right)}{\text{Hours}}$$

$$\text{Flow rate } \left(\frac{\text{lb}}{\text{hr}}\right) = \frac{26,299 \text{ cycles} * 7 \left(\frac{\text{gal}}{\text{cycle}}\right) * 8.35 \left(\frac{\text{lb}}{\text{gal}}\right)}{792 \text{ hrs}}$$

$$\text{Heat recovered } \left(\frac{\text{Btu}}{\text{hr}}\right) = \text{Flow Rate } \left(\frac{\text{lb}}{\text{hr}}\right) * \left[\text{Condensate Enthalpy } \left(\frac{\text{Btu}}{\text{lb}}\right) - \text{MW Enthalpy } \left(\frac{\text{Btu}}{\text{lb}}\right) \right]$$

$$\text{Heat recovered } \left(\frac{\text{Btu}}{\text{hr}}\right) = 1,940.88 \left(\frac{\text{lb}}{\text{hr}}\right) * \left[101.69 \left(\frac{\text{Btu}}{\text{lb}}\right) - 33.68 \left(\frac{\text{Btu}}{\text{lb}}\right) \right]$$

$$\text{Heat recovered } \left(\frac{\text{Btu}}{\text{hr}}\right) = 131,999.21 \left(\frac{\text{Btu}}{\text{hr}}\right)$$

$$\text{Annual Energy Savings (CCF)} = \frac{\text{Heat Recovered } \left(\frac{\text{Btu}}{\text{hr}}\right) * \text{Annual Operating Hours (hrs)}}{\text{Boiler Efficiency (\%)} * 100,000 \left(\frac{\text{Btu}}{\text{CCF}}\right)}$$

Boiler Tune Ups

$$\text{Therm Savings} = \text{Capacity} * \text{EFLH}_H * \left(\frac{1}{E_{C_{Eff}}} - \frac{1}{E_{C_{Base}}} \right) * \frac{1}{100,000}$$

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Trap Repair	109,007	109,050	100%	545,252
Repair Steam Leaks	5,975	5,977	100%	59,772
Condensate Return	13,926	13,931	100%	208,972
Boiler Tune Ups	5,231	5,801	111%	17,403
TOTAL	134,139	134,759	100%	831,399

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$72,500. Measure payback is summarized in the table below.

Table 14. Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
134,759	\$0.49	\$66,032	\$72,500	68,404	\$92,9318	2.19	0.91

Program C&I Solutions
Project ID EA-0001150894
Facility SIC Code 8062 General Medical and Surgical Hospitals
Measures Steam Trap Replacement
Annual Consumption 102,448

Project Background

The participant is a Medical Center that received incentives from Black Hills Energy for:

- ECM #1 - Steam trap replacement

The steam system serves the hospital’s typical systems, including space heat, sanitization, and laundry.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2012 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Supply water temperature is 66°F based on the AR TRM 9.1
- Annual operating hours for the site are 8,760 hours
- Combustion efficiency is 85% (for both pre-retrofit and post-retrofit condition)

Steam Trap Replacement

The following table shows relevant parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	5/32	80	1.0	Drip	65	85%	8760
2	1/8	80	1.0	Process	65	85%	5480
3	5/32	80	1.0	Drip	65	85%	8760
4	1/4	80	1.0	Process	65	85%	5480
5	1/4	80	1.0	Drip	65	85%	8760
6	1/8	60	1.0	Drip	65	85%	8760
7	1/8	60	1.0	Process	65	85%	5480
8	1/8	80	1.0	Drip	65	85%	8760
9	1/8	60	1.0	Drip	65	85%	8760

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Steam Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours the system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 85.0%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Water Savings

In addition to energy savings, water savings were calculated for each of the ECMs. These savings are considered as Non-Energy Benefits (NEBs).

Annual Energy Savings Unit Conversion (therms/year to BTU/year)

$$\text{Annual Energy Savings} \left(\frac{\text{Btu}}{\text{yr}} \right) = \text{Annual Energy Savings} \left(\frac{\text{therm}}{\text{yr}} \right) \times 100,000 \frac{\text{Btu}}{\text{therm}}$$

Calculation for Pounds of Steam Produced per Year

$$\text{Steam}_{\text{Trap}} \left(\frac{\text{lb}}{\text{yr}} \right) = \left(\frac{\text{Annual Energy Savings (Btu)}}{\text{Steam Enthalpy} \left(\frac{\text{Btu}}{\text{lb}} \right) - \text{FW Enthalpy} \left(\frac{\text{Btu}}{\text{lb}} \right)} \right) \times \text{Eff}_{\text{Boiler}} (\%)$$

Annual Water Savings Calculation

$$\text{Annual Water Savings} \left(\frac{\text{gal}}{\text{yr}} \right) = \frac{\text{Steam} \left(\frac{\text{lb}}{\text{yr}} \right)}{8.33 \left(\frac{\text{lb}}{\text{gal}} \right)}$$

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	61	1,187	33	7,255
2	25	1,187	33	1,116
3	61	1,187	33	1,451
4	98	1,187	33	2,917
5	157	1,187	33	14,939
6	31	1,182	33	3,305
7	20	1,182	33	370
8	39	1,187	33	3,479
9	31	1,182	33	1,469
Total:				36,302

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>	<i>Annual Water Gallons Savings</i>
Steam Trap Repair	36,283	36,302	100%	181,508	493,690
TOTAL	36,283	36,302	100%	181,508	493,690

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$25,000. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
36,302	\$0.60	\$21,890	\$25,000	\$25,000	\$25,000	0.0	0.9

Program C&I Solutions
Project ID EA-0001150800
Facility SIC Code 8062 - General Medical and Surgical Hospitals
Measures Steam Traps
Annual Consumption 89,750 therms

Project Background

The participant is general hospital that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam Trap Replacement

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads such as sterilization. Savings will come from repairing the failed steam traps throughout the site’s steam system.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°
- Annual operating hours for the on-site steam system are 8,760 and 5,840 hours
- Combustion efficiency is 85% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis.

Steam Trap Replacement

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	3/4	60	5	Drip	65	85%	8,760
2	1/2	60	5	Process	65	85%	5,480

Calculations for the annual therms savings use the following equation:

Stream Trap Replacement Annual Energy Savings

$$\text{Annual therms Savings} = \frac{\text{Steam Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr) = 8,760 annual hours

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 85%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years

Calculated Savings:

Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Percent Failed</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Latent Heat of Evaporation, H_{fg} (BTU/lb)</i>	<i>Therms Savings</i>
1	80	50%	1,182	33	1,141	2,379
2	77	80%	1,182	33	1,141	4,752
Total:						7,131

Overall project savings are as follows:

Table 15. Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Trap Repair	7,111	7,131	100%	35,655
TOTAL	7,111	7,131	100%	35,655

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$8,000. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
7,131	\$0.71	\$5,063	\$8,000	\$5,333	\$5,348	1.2	1.58

Program C&I Solutions
Project ID EA-0000466121
Facility SIC Code 8062 - General Medical and Surgical Hospitals
 Boiler Replacement
Measures Boiler Blowdown
 Condensate Return
Annual Consumption 235,574,100 therms

Project Background

The participant is a manufacturing facility that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Boiler Replacement
- ECM #2: Boiler Blowdown
- ECM #3: Condensate Return

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Boiler Replacement

The annual energy savings from replacing a boiler is calculated with the following equation:

Boiler Replacement Annual Energy Savings

$$Annual\ Energy\ Savings\left(\frac{CCF}{yr}\right) = Boiler\ Capacity\left(\frac{CCF}{yr}\right) \times \left(1 - \frac{\eta_{pre}}{\eta_{post}}\right)$$

Where:

η_{pre} = Baseline Boiler Efficiency

η_{post} = Post Boiler Efficiency

Boiler Replacement Savings

<i>Boiler Capacity</i>	<i>η_{pre} (%)</i>	<i>η_{post} (%)</i>	<i>EFLH_H</i>	<i>Therms Savings</i>
8,369,000	83%	85%	1,702	3,987
8,369,000	85%	86%	801	663
Total:				4,650

Boiler Blowdown

The annual energy savings boiler blowdown is calculated with the following equation:

Equation 1. Boiler Blowdown Annual Energy Savings

$$\text{Annual Energy Savings} \left(\frac{\text{CCF}}{\text{yr}} \right)_i = \frac{\text{Thermal Energy Savings} \left(\frac{\text{BTU}}{\text{lb}} \right) \times \text{Makeup Water Savings} \left(\frac{\text{lb}}{\text{hr}} \right) \times \text{AOH} \left(\frac{\text{hrs}}{\text{yr}} \right) \times \text{Load Factor}(\%)}{100,000 \left(\frac{\text{BTU}}{\text{CCF}} \right) \times \text{Thermal Efficiency} (\%)}$$

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency

100,000 Btu/CCF = conversion factor (BTU/yr to CCF/yr)

Boiler Blowdown Parameters

Entry #	Description	Operating Hours	Boiler Pressure	Makeup Water Temperature
1	Boiler 1	5,749	66	66
2	Boiler 2	2,688	66	66

Boiler Blowdown Annual Energy Savings

Entry #	Description	Capacity (BTU/hr)	AOH	Makeup Water Savings (lb/hr)	Thermal Energy Savings (BTU/lb)	Therms Savings
1	Boiler 1	8,369,000	5,749	465	249	10,119
2	Boiler 2	8,369,000	2,688	204	249	1,363
Total						11,482

Condensate Return Parameters

Boiler Efficiency	Condensate Flow Rate (GPM)	Condensate Temperature (°F)	Makeup Water Temperature (°F)	Percentage of time Pumps Activate	Pump Annual Hours of Operation
83%	12	210	66	3%	262

The heat loss from the condensate is estimated with the formula:

Equation 2. Calculation for Condensate Heat Loss

$$\frac{Btu}{hr} = \frac{1 Btu}{lb \times F} \times \frac{8.34 lb}{gal} \times \frac{60 min}{hr} \times \frac{gal}{min} \times (T_{makeup\ water} - T_{condensate})$$

The heat loss determined by the flow and temperature difference of the makeup water and condensate temperature is an input to the following equation to determine the boiler gas savings.

Equation 3. Annual Condensate Return Savings Calculation

$$\frac{CCF}{year} = \frac{Heat\ Loss \left(\frac{BTU}{hr}\right) \times AOH}{Boiler\ efficiency\ (\%) \times 100,000 \frac{BTU}{CCF}}$$

Where:

AOH = Annual Operation Hours (8,760 hours)

Eff_{post} = Efficiency of the steam boiler = 83%

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$11,000. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
31,022	\$0.57	\$17,807	\$11,000	\$11,000	\$11,000	0.4	0.6

Program C&I Solutions
Project ID EA-0001408812
Facility SIC Code 8062 - General Medical and Surgical Hospitals
Measures Steam Traps Repair
 Steam Leak Repair
Annual Consumption 640,820 therms

Project Background

The participant is general hospital that received incentives from Black Hills Energy for implementing the following:

- ECM #1: Steam Trap Replacement
- ECM #2: Repair Steam Leaks

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads such as sterilization. Savings will come from replacing the failed steam traps throughout the site’s steam system.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°F
- Annual operating hours for the on-site steam system are 8,760 and 4,380 hours
- Combustion efficiency is 82% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis.

Steam Trap Replacement

The following table shows relevant failed steam traps parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	3/4	60	1	Drip	65	82%	8,760
2	3/4	60	1	Drip	65	82%	8,760
3	3/4	60	1	Drip	65	82%	8,760

4	3/4	15	1	Drip	65	82%	8,760
5	3/4	60	1	Drip	65	82%	8,760
6	1/2	60	1	Drip	65	82%	8,760
7	3/4	60	1	Drip	65	82%	8,760
8	3/4	60	1	Drip	65	82%	8,760
9	1/2	60	1	Process	65	82%	4,380
10	3/4	60	1	Drip	65	82%	8,760
11	3/4	60	1	Drip	65	82%	8,760
12	3/4	60	1	Drip	65	82%	8,760
13	3/4	60	1	Drip	65	82%	8,760
14	3/4	15	1	Process	65	82%	4,380
15	3/4	15	1	Drip	65	82%	8,760
16	3/4	60	1	Process	65	82%	8,760
17	3/4	15	1	Process	65	82%	5,840
18	3/4	60	1	Drip	65	82%	8,760
19	1/2	60	1	Drip	65	82%	8,760
20	1/2	60	1	Process	65	82%	8,760
21	3/4	60	1	Process	65	82%	8,760
22	1/2	60	1	Drip	65	82%	8,760
23	1/2	60	1	Drip	65	82%	8,760
24	1/2	60	1	Process	65	82%	8,760
25	1/2	60	1	Process	65	82%	8,760
26	3/4	15	1	Process	65	82%	5,840
27	3/4	60	1	Drip	65	82%	8,760

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Stream Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Stream Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr)

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 82%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	2" Union Lk Above Trap 011	1	2	60	17	82%
2	2 Union Lks Above Trap 087	2	2	60	17	82%
3	Vlv Lk Abv 135	1	1	60	10	82%
4	Vlv Pack Lk by 162	1	1	60	10	82%
5	E POB basement Mech Rm	1	1	60	10	82%
6	POB Penthouse AUH	1	1	60	10	82%
7	Tower 2 Mech Rm 4" Gate Vlv	1	1	60	10	82%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, an alternate method was used.

Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equating Steam Plume Length to Flow Rate

$$Leak\ Rate\ \left(\frac{kg}{hr}\right) = 2.5678 \times \exp[1.845 \times Plume\ Length\ (m)]$$

$$Leak\ Rate\ \left(\frac{lb}{hr}\right) = 5.661 \times \exp [0.562 \times Plume\ Length\ (ft)]$$

Calculation for Heat Loss

$$Heat\ Loss\ \left(\frac{Btu}{hr}\right) = Leak\ Rate\ \left(\frac{lb}{hr}\right) \times \left[Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (33.6 BTU/lb)

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years
Repair Steam Leaks	10 years

Calculated Savings:

Steam Trap Replacement

Table 16. Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Percent Failed</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	78	80%	1,182	33	7,637
2	28	60%	1,182	33	2,055
3	28	100%	1,182	33	3,425
4	12	100%	1,164	33	1,479
5	24	60%	1,182	33	1,779
6	28	60%	1,182	33	2,055
7	24	100%	1,182	33	2,965
8	78	90%	1,182	33	8,591
9	50	80%	1,182	33	2,455
10	28	80%	1,182	33	2,740
11	78	100%	1,182	33	9,546
12	78	60%	1,182	33	5,727
13	78	50%	1,182	33	4,773
14	24	100%	1,164	33	1,451
15	8	30%	1,164	33	294
16	20	40%	1,182	33	991
17	49	100%	1,164	33	3,962
18	78	100%	1,182	33	9,546
19	125	80%	1,182	33	12,292
20	80	60%	1,182	33	5,926
21	31	40%	1,182	33	1,543
22	125	40%	1,182	33	6,146
23	125	60%	1,182	33	9,219
24	80	50%	1,182	33	4,939

25	80	30%	1,182	33	2,963
26	8	90%	1,164	33	570
27	78	80%	1,182	33	7,637
Total:					122,706

Repair Steam Leaks

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	2" Union Lk Above Trap 011	1	2	1,182	1,149	2,140
2	2 Union Lks Above Trap 087	2	2	1,182	1,149	4,279
3	Vlv Lk Abv 135	1	1	1,182	1,149	1,220
4	Vlv Pack Lk by 162	1	1	1,182	1,149	1,220
5	E POB basement Mech Rm	1	1	1,182	1,149	1,220
6	POB Penthouse AUH	1	1	1,182	1,149	1,220
7	Tower 2 Mech Rm 4" Gate Vlv	1	1	1,182	1,149	1,220
Total						12,519

Overall project savings are as follows:

. Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Trap Repair	121,252	122,706	101%	613,530
Repair Steam Leaks	12,516	12,519	100%	125,190
TOTAL	133,768	135,225	100%	738,720

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$55,000. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
135,225	\$0.49	\$66,260	\$55,000	\$54,387	\$54,387	0.5	0.8

Program C&I Solutions
Project ID EA-0001690933
Facility SIC Code 8062 - General Medical and Surgical Hospitals
Measures Steam Traps Repair
 Steam Leak Repair
Annual Consumption 433,210 therms

Project Background

The participant is general hospital that received incentives from BHE for:

- ECM #1: Steam Trap Replacement
- ECM #2: Repair Steam Leaks

The site uses steam throughout the facility primarily for three process needs: space heating, domestic water heating, and other process heating loads such as sterilization. Savings will come from replacing the failed steam traps throughout the site’s steam system.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2021 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement. Measurement and verification activities are based on the following assumptions:

- Feedwater temperature is 65°F
- Annual operating hours for the on-site steam system are 8,760 and 4,380 hours
- Combustion efficiency is 84% using averaged low, medium, and high fire numbers, based on the most recent and accurate boiler combustion analysis.

Steam Trap Replacement

The following table shows relevant parameters required for annual energy savings.

Steam Trap Parameters

<i>Steam Trap #</i>	<i>Orifice Size (in.)</i>	<i>Inlet Pressure (psig)</i>	<i>Outlet Pressure (psig)</i>	<i>Service (Drip/Process)</i>	<i>Feedwater Temperature (°F)</i>	<i>Boiler Efficiency</i>	<i>Operating Hours</i>
1	1	60	1	Process	65	84%	8,760
2	3/4	60	1	Drip/Tracer	65	84%	8,760
3	3/4	60	1	Drip/Tracer	65	84%	8,760
4	3/4	15	1	Drip/Tracer	65	84%	8,760
5	3/4	60	1	Drip/Tracer	65	84%	8,760
6	3/4	60	1	Drip/Tracer	65	84%	8,760
7	1/2	60	1	Drip/Tracer	65	84%	8,760
8	3/4	60	1	Process	65	84%	8,760
9	1/2	60	1	Drip/Tracer	65	84%	8,760
10	1/2	60	1	Process	65	84%	8,760
11	3/4	60	1	Process	65	84%	4,360

Calculations for the annual therms savings use the following equation:

$$\text{Annual therms Savings} = \frac{\text{Stream Trap Discharge Rate} \times \text{OpHrs} \times h_{fg}}{EC_{Base} \times \text{Therm Conversion Factor}}$$

Where:

Stream Trap Discharge Rate = steam loss from the system (lb/hr)

OpHrs = annual hours system is pressurized (hrs/yr)

H_{fg} = latent heat of evaporation (BTU/lb)

EC_{Base} = combustion efficiency of boiler (%), 82%

Therm Conversion Factor = 100,000 (BTU/therm)

The discharge rate (lb/hr) was calculated using Armstrong’s “Steam Loss Through Failed Trap Calculator” (found here: <https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss>)

Steam Leak Repair

The following table shows relevant steam leak repair parameters required for annual energy savings.

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Pressure (psig)</i>	<i>Leak Rate (lbs/ft)</i>	<i>Boiler Efficiency</i>
1	2" Union Lk Above Trap 011	1	1	15	10	84%
2	2 Union Lks Above Trap 087	1	1	60	10	84%
3	Vlv Lk Abv 135	1	1	60	10	84%

An alternative method was used to calculate the steam loss before steam leak repairs. The more traditional method equates the orifice diameter flow rate, using the orifice diameter of the leak and the system’s absolute pressure. Due to the difficulty in determining the exact diameter of an orifice leak, an alternate method was used. Calculations follow the methods established by G.G. Rajan for a steam leak rate as a function of the length of an active steam plume.

Equating Steam Plume Length to Flow Rate

$$\text{Leak Rate} \left(\frac{kg}{hr} \right) = 2.5678 \times \exp[1.845 \times \text{Plume Length (m)}]$$

$$\text{Leak Rate} \left(\frac{lb}{hr} \right) = 5.661 \times \exp [0.562 \times \text{Plume Length (ft)}]$$

Calculation for Heat Loss

$$Heat\ Loss\ \left(\frac{Btu}{hr}\right) = Leak\ Rate\ \left(\frac{lb}{hr}\right) \times \left[Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right) \right]$$

Where:

Leak Rate = calculated value

Steam Enthalpy = saturated steam region based on system steam pressure

MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (33.6 BTU/lb)

Measure Life

Estimated Useful Life by Measure

<i>Measure</i>	<i>EUL</i>
Steam Trap Replacement	5 years
Repair Steam Leaks	10 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

<i>Steam Trap #</i>	<i>Discharge Rate (lbs/hr)</i>	<i>Percent Failed</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	80	100%	1,182	33	9,543
2	124	60%	1,182	33	8,875
3	109	50%	1,182	33	6,501
4	77	50%	1,182	33	4,593
5	48	70%	1,182	33	4,008
6	31	100%	1,182	33	3,698
7	27	75%	1,182	33	2,416
8	27	75%	1,164	33	2,378
9	12	100%	1,182	33	1,431
10	7	100%	1,164	33	822
11	5	100%	1,164	33	292
Total:					44,557

Repair Steam Leaks

<i>Steam Leak #</i>	<i>Description</i>	<i>Quantity of Leaks</i>	<i>Plume Length (ft)</i>	<i>Steam Enthalpy (BTU/lb)</i>	<i>Feedwater Enthalpy (BTU/lb)</i>	<i>Therms Savings</i>
1	Trap 47 4" Flg Lk	1	1	1,164	1,131	1,165
2	Trap 63 2" Nip Lk	1	1	1,182	1,149	1,184
3	Trap 46 2" Union Lk	1	1	1,182	1,149	1,184
Total						3,533

Overall project savings are as follows:

Overall Project Savings

<i>Measure</i>	<i>Expected Annual therms Savings</i>	<i>Realized Annual therms Savings</i>	<i>Realization Rate</i>	<i>Lifetime therms Savings</i>
Steam Trap Repair	44,557	44,557	100%	222,785
Repair Steam Leaks	3,533	3,533	100%	35,330
TOTAL	48,557	44,587	100%	258,115

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of \$40,000. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

<i>Annual Therms Savings</i>	<i>Cost per Therm</i>	<i>Annual Energy Cost Savings</i>	<i>Incremental Cost</i>	<i>Base Incentive</i>	<i>Adjusted Incentive</i>	<i>Payback w/Incentive</i>	<i>Payback w/o Incentive</i>
48,557	\$0.49	\$26,793	\$40,000	\$36,068	\$36,068	0.6	1.54

8 Appendix B: Deferred Replacement Cost Calculations

This appendix presents the calculations of deferred replacement costs for residential and commercial tankless water heaters as well as residential furnace early retirement.

Inputs		
Measure Type=	Res Tankless (ROB + NC)	
Nominal Discount Rate=	5.62%	
Inflation Rate=	2.04%	
Real Discount Rate=	3.5%	
	Program	Baseline
Equipment Type=	Tankless WH	Storage WH
Effective Useful Life=	20	11
Remaining Useful Life=		
PW(EUL)=	14.21	9.00
PW(RUL)=		
Installed Cost=	\$1,219	\$614
Deferred Replacement Cost=		\$ 355.33
PWF Formula=		\$ 355.33
Incremental Cost=	\$ 249.67	

Figure 8-1: Residential Tankless WH Avoided Replacement Cost Calculation

Inputs		
Measure Type=	C&I Tankless (ROB + NC)	
Nominal Discount Rate=	5.62%	
Inflation Rate=	2.04%	
Real Discount Rate=	3.50%	
	Program	Baseline
Equipment Type=	Tankless WH	Storage WH
Effective UsefulLife=	20	15
Remaining Useful Life=		
PW(EUL)=	14.21	11.51
PW(RUL)=		
Installed Cost=	\$1,219	\$614
Deferred Replacement Cost=		\$ 143.63
PWF Formula=		\$ 143.63
Incremental Cost=	\$ 461.37	

Figure 8-2: C&I Tankless WH Avoided Replacement Cost Calculation

Inputs		
Measure Type=	Furnace Early Replacement	
Nominal Discount Rate=	5.62%	
Inflation Rate=	2.04%	
Real Discount Rate=	3.5%	
	Program	Baseline
Equipment Type=	HE Furnace	SE Furnace
Effective UsefulLife=	20	20
Remaining Useful Life=		7
PW(EUL)=	20.00	20.00
PW(RUL)=		\$6.11
Installed Cost=	\$ 2,548	\$ 2,011
Deferred Replacement Cost=		\$ 1,145.67
PWF Formula=		\$ 1,396

Figure 8-3: Furnace Early Retirement Deferred Replacement Cost Calculation

9 Appendix C: Detailed NTG Tables

Consistent Weatherization Approach: Major Measures

The PY2023 BHE Weatherization survey addressed the entirety of weatherization project major measures in the NTG battery, rather than attempting to single out individual measures in the analysis. Direct install measures were inquired about in a separate battery; limited responses are reported here as scores were calculated only using gas saving measures.

Measure Discussed in Survey	
Duct Sealing	67
Air Infiltration	66
Ceiling Insulation	28
Were you planning to complete the same [Field-MAJ_MEAS] project in [Field-YEAR] before learning about the program?	(n = 76)
Yes	14.5%
No	85.5%
Would your budget for the planned project have accommodated the project's full cost if you had not completed the project through the program?	(n = 11)
Yes	18.2%
No	36.4%
Not sure, had not estimated project cost	45.5%
If the incentive was not available from the program, would you have completed the same project or would you have done something different?	(n=76)
Same	9.2%
Something different	10.5%
Would not have done anything	42.1%
Not sure	38.2%
Would it have been the same level of energy efficiency, higher energy efficiency, or lower energy efficiency?	(n = 8)
Same efficiency	12.5%
Lower efficiency	37.5%
Higher efficiency	25.0%
Not sure	25.0%
Would you have completed the same project or one that made your home even more energy efficient within one year if the program was not available?	(n = 76)
Yes	15.8%
No	35.5%
Not sure	48.7%

Direct Install Measures

Measure Discussed in Survey	
Faucet Aerator	3
Low Flow Showerhead	1
Were you planning to complete the same [Field-MAJ_MEAS] project in [Field-YEAR] before learning about the program?	(n = 3)
Yes	25.0%
No	75.0%
Would your budget for the planned project have accommodated the project's full cost if you had not completed the project through the program?	(n = 1)
Yes	0.0%
No	0.0%
Not sure, had not estimated project cost	100.0%
If the incentive was not available from the program, would you have completed the same project or would you have done something different?	(n = 3)
Same	25.0%
Something different	0.0%
Would not have done anything	50.0%
Not sure	25.0%
Would it have been the same level of energy efficiency, higher energy efficiency, or lower energy efficiency?	(n = 0)
Same efficiency	0.0%
Lower efficiency	0.0%
Higher efficiency	0.0%
Not sure	0.0%
Would you have completed the same project or one that made your home even more energy efficient within one year if the program was not available?	(n = 3)
Yes	25.0%
No	25.0%
Not sure	50.0%

Equipment Rebates

The PY2023 Equipment Rebates survey asked questions about decision-making for smart thermostats, water heaters, and furnaces independently to determine measure-level net-to-gross ratios.

Were you planning to complete the same [MEASURE] project in 2023 before learning about the program?	Water Heater	Smart Thermostat	Furnace
	Response (n = 92)	Response (n = 67)	Response (n = 74)
Yes	66%	57%	55%
No	34%	43%	45%
Would your budget for the planned project have accommodated the project's full cost if you had not completed the project through the program?	Response (n = 61)	Response (n = 38)	Response (n = 41)
Yes	61%	82%	73%
No	21%	11%	15%
I don't know	18%	8%	12%
If the equipment was not available from the program, would you have completed the same project or would you have done something different?	Response (n = 92)	Response (n = 67)	Response (n = 74)
Same project	54%	55%	49%
Something different	26%	16%	26%
Would not have done anything at all	1%	18%	1%
I don't know	18%	10%	24%
Would it have been the same level of energy efficiency, higher energy efficiency, or lower energy efficiency?	Response (n = 24)	Response (n = 11)	Response (n = 19)
Same efficiency	13%	36%	11%
Higher efficiency	4%	9%	5%
Lower efficiency	71%	36%	58%
Not sure	13%	18%	26%
Would you have completed the same project or one that made your home even more energy efficient within one year if the program was not available?	Response (n = 66)	Response (n = 46)	Response (n = 73)
Yes	50%	42%	42%
No	22%	21%	21%
I don't know	28%	37%	37%

10 Appendix D: Cost-Benefit Inputs

Table 10-1: BHE Avoided Cost Values

Year	\$/Therm	\$/kWh	\$/kW	\$/Gallon Water
2022	\$0.4173	\$0.0347	\$95.40	\$0.0094
2023	\$0.4258	\$0.0360	\$97.33	\$0.0097
2024	\$0.4345	\$0.0374	\$99.30	\$0.0102
2025	\$0.4434	\$0.0392	\$101.30	\$0.0107
2026	\$0.4524	\$0.0402	\$103.35	\$0.0114
2027	\$0.4617	\$0.0414	\$105.44	\$0.0118
2028	\$0.4711	\$0.0422	\$107.57	\$0.0123
2029	\$0.4807	\$0.0539	\$109.74	\$0.0124
2030	\$0.4905	\$0.0551	\$111.96	\$0.0129
2031	\$0.5005	\$0.0579	\$114.22	\$0.0133
2032	\$0.5107	\$0.0602	\$116.53	\$0.0135
2033	\$0.5211	\$0.0617	\$118.89	\$0.0138
2034	\$0.5318	\$0.0630	\$121.29	\$0.0142
2035	\$0.5426	\$0.0651	\$123.74	\$0.0146
2036	\$0.5537	\$0.0677	\$126.24	\$0.0150
2037	\$0.5650	\$0.0693	\$128.79	\$0.0160
2038	\$0.5765	\$0.0711	\$131.39	\$0.0164
2039	\$0.5883	\$0.0739	\$134.05	\$0.0170
2040	\$0.6003	\$0.0746	\$136.78	\$0.0185
2041	\$0.6173	\$0.0767	\$140.66	\$0.0189

Table 10-2: BHE Discount Rates

Test	Discount Rate
TRC	5.62%
UCT	5.62%
RIM	5.62%
PCT	9.00%

Table 10-3: Line & Distribution Losses

Line & Distribution Loss Type	Rate
Gas Distribution Losses	2.69%
Line Losses – Energy	6.49%
Line Losses – Demand	10.82%

Comprehensive Energy Efficiency Plan
Program Year 2023
Annual Report
Appendix B – Supplemental Documentation





**This unit may qualify
for a BHE-AR rebate.**

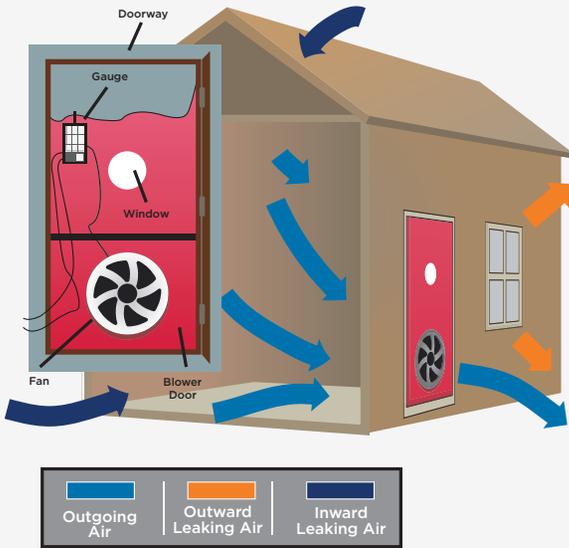


Visit energy-readyarkansas.com
or call 855-350-1563 [BHEA HES]

What else can I expect?

During your initial evaluation, a Home Energy Savings contractor may conduct a blower door test to pinpoint air leaks in your home's duct system and exterior. Sealing these leaks will help prevent drafts and increase your home's comfort and efficiency.

Calibrated blower door test



Blower door used to detect air leakage

Additionally, a carbon monoxide analyzer is used to check combustion appliances (stoves, furnaces and water heaters) for carbon monoxide levels.

Equipment Rebate Pathway

Rebates are available through the Equipment Rebate Pathway to help replace old, outdated residential equipment with new energy- and natural gas-saving equipment, which can significantly reduce your home's monthly utility bill and improve comfort.

Rebates are available to help offset the cost of energy-saving equipment upgrades and products for your home, including:

- **\$300 rebate** for a tankless water heater¹
- **\$400 rebate** for a natural gas forced-air furnace²
- **\$50 rebate** for an ENERGY STAR® certified smart thermostat³

¹Limit one unit per account.

²If applying for furnace rebates in a newly constructed home, rebates are available for **NO MORE THAN** two units per account.

³Limit two per household.

OVER \$1.5 MILLION

**How much our customers
received in rebates last year.**

Ready to get started?

Visit energy-readyarkansas.com
or call **855-350-1563** or email
bheahes@clearResult.com.

Black Hills Energy Arkansas Residential Solutions Program

Discover how Black Hills Energy Arkansas can help you use less natural gas in your home and start saving energy and money today.



Enjoy benefits such as:

- A healthier, more energy-efficient home
- Long-term money savings
- Improved comfort and air quality
- Increased home value
- Reduced carbon footprint



Saving energy begins at home.

Making energy-efficient choices is important to the environment, as well as your wallet. Through the Black Hills Energy Arkansas Residential Solutions Program, qualifying customers can begin their journey to saving energy and money through two easy pathways: the **Home Energy Savings Pathway** and **Equipment Rebate Pathway**.

PLEASE NOTE: The Residential Solutions Program has limited funding. Home Energy Assessments and rebate applications will be provided and processed on a first-come, first-served basis until funds are depleted. To check the availability of program offerings and funding, please visit energy-readyarkansas.com or call **855-350-1563**.

Home Energy Savings Pathway

Not sure where to begin when it comes to saving energy? Start with the Home Energy Savings Pathway, where you can get a no-cost Home Energy Assessment. During an assessment, a professional Home Energy Savings contractor will help you discover how and where you can save energy costs while increasing the comfort of your home.

You could qualify for no-cost energy-saving upgrades such as aerators and showerheads, plus potential home improvements such as:

- Air sealing
- Duct sealing
- Ceiling insulation

Not ready for an in-home visit? Go virtual.

Virtual Home Energy Assessments are also offered. Through a smartphone or tablet, an energy advisor will analyze various areas in your home including your heating, cooling and water heating equipment, appliances, lighting and attic insulation to determine where you can save the most energy. After your Virtual Assessment, you may decide to schedule a no-cost in-home assessment conducted by one of our professional Home Energy Savings contractors.



Who's eligible?

To qualify for a no-cost professional in-home energy assessment, your home must:

- Have a valid Black Hills Energy Arkansas residential account (new homes under one year old are not eligible)
- Be at least 10 years old OR have monthly usage (as shown on the bill) of five cents per square foot or higher*
- Have had continuous gas service for the previous 12 months (If less than 12 months, contact us at **855-350-1563**)
- Have not participated in a weatherization program offered either through a utility or the government in the past five years
- Be corrected for any health and safety issues we may discover upon initial inspection

***How to calculate cost per square foot:**

Divide your highest Black Hills Energy Arkansas bill by the square footage of your home. This will give you your energy cost per square foot.

Equation:
$$\frac{\$ \text{ (bill amt.)}}{\text{ (sq. ft.)}} = \$/\text{sq. ft.}$$

Example:
$$\$200 \div 2,000 = \$0.10/\text{sq. ft.}$$

What no-cost energy-saving upgrades are available?

When you participate in a Home Energy Assessment, your Home Energy Savings contractor may install some or all of the following upgrades in your home at no cost:



AIR SEALING – Typical houses lose 20% or more of their conditioned air through leaks, holes and poorly connected air ducts. Sealing these leaks will help prevent drafts and increase your home's comfort and efficiency.



DUCT SEALING – Like air sealing, sealing ducts can lead to improvements in comfort and indoor air quality and life of equipment.



CEILING INSULATION – When coupled with air sealing, you can potentially save up to 20% on heating and cooling costs. Insulation helps keep your home cool in the summer and warm in the winter.



DIRECT INSTALL MEASURES – Energy-saving items such as showerheads and faucet aerators are installed by the contractor in your home where needed.

Ready to get started?

Visit energy-readyarkansas.com or call **855-350-1563** or email bheahes@clearesult.com.





Welcome home more savings.

Our no-cost Home Energy Assessment puts you on the path to a more comfortable, energy-efficient home. Schedule yours today to receive expert energy-saving recommendations. Your home could qualify for on-the-spot upgrades and additional improvements at no cost to you.

During the assessment

Conducted by a Building Performance Institute (BPI) or Residential Energy Services Network® (RESNET) certified Home Energy Savings contractor, the assessment may include:

Potential benefits:

- Long-term cost savings
- Improved comfort and air quality
- Increased home value
- Reduced carbon footprint



A walkthrough evaluation

Your Home Energy Savings contractor will evaluate your home for energy-saving opportunities and make recommendations for future improvements.



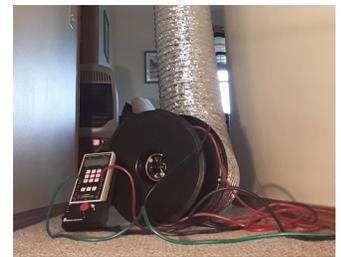
Energy-efficient products

Your Home Energy Savings contractor may also install upgrades like high-efficiency showerheads and faucet aerators.



Blower door testing

Your professional Home Energy Savings contractor will conduct a blower door test. A blower door is a powerful fan that mounts to the frame of an exterior door. The fan pulls air out of the house, lowering the air pressure inside. Outside air then flows in through unsealed openings, revealing areas where air sealing may be most beneficial.



Duct blaster testing

Similar to the blower door test, your Home Energy Savings contractor will use a duct blaster to pinpoint air leaks in your duct system.



After the assessment

You will receive a detailed report outlining what your trade ally learned about your home's energy efficiency including recommended updates. Completing a Home Energy Assessment will determine if your home is eligible for additional no-cost improvements, including:



Air sealing

Typical homes lose 20% or more of their conditioned air through leaks, holes and poorly connected air ducts. Sealing these leaks will help prevent drafts and increase your home's comfort.



Duct sealing

Like air sealing, sealing ducts improve comfort, indoor air quality and life of equipment.



Ceiling insulation

Insulation helps keep you cool all summer and warm all winter. When coupled with air sealing, you can potentially save up to 20% on heating and cooling costs.

Eligibility

To qualify for a no-cost assessment, your home must:

- Have a valid Black Hills Energy Arkansas residential account. New homes under a year old are not eligible.
- Be at least 10 years old OR have monthly energy usage (as shown on your bill) of \$0.05 per square foot or higher.
- Have had continuous gas service for the previous 12 months.
- Not have participated in a weatherization program offered either through a utility or the government in the past five years.
- Be corrected for any health and safety issues we may discover upon initial inspection.



GET STARTED.

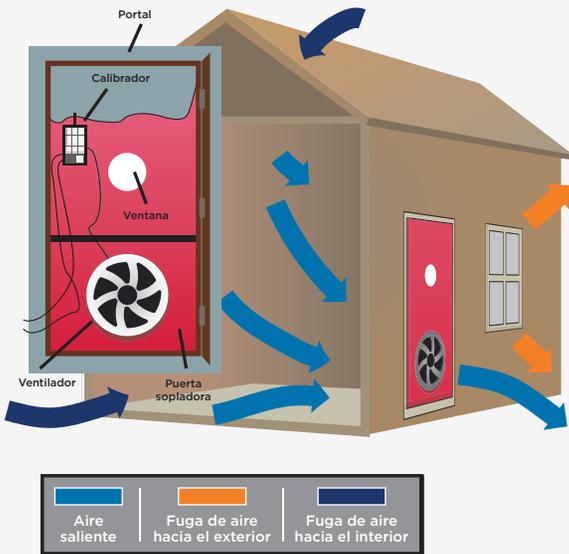
See if you qualify at energy-readyarkansas.com/eligibility, or contact Black Hills Energy Arkansas at **855-350-1563** or bheahe@clearesult.com.



¿Qué más puedo esperar?

Durante su evaluación inicial, un contratista de Home Energy Savings puede que lleve a cabo una prueba de puerta sopladora para ver en detalle las fugas de aire en el sistema de ductos de su hogar y en el exterior. Al sellar estas fugas se previenen las corrientes de aire y se mejoran la comodidad y la eficiencia dentro de su hogar.

Prueba calibrada de puerta sopladora



La puerta sopladora se usa para detectar fugas de aire

Adicionalmente, se utiliza un analizador de monóxido de carbono para revisar sus niveles en los enseres de combustión (hornos, hornos de calor y calentadores de agua).

Ruta de Reembolsos de Equipo

Los reembolsos están disponibles a través de la Ruta de Reembolsos de Equipo para reemplazar equipos residenciales antiguos con equipos nuevos que ahorran energía y gas natural, lo cual puede reducir de manera significativa la factura mensual de energía de su hogar y aumentar la comodidad.

Los reembolsos están disponibles para ayudar a compensar por el costo de actualizaciones a equipos que ahorran energía y productos para su hogar, incluso:

- **Reembolso de \$300** por un calentador de agua sin tanque¹
- **Reembolso de \$400** por un horno de calor de gas natural forzado²
- **Reembolso de \$50** por un termostato inteligente con certificación de ENERGY STAR^{®3}

¹Límite de una unidad por cuenta.

²Si solicita reembolsos para horno de calor en una casa recientemente construida, los reembolsos están disponibles para NO MÁS DE dos unidades por cuenta.

³Límite de dos por vivienda.

MÁS DE \$1.5 MILLONES

La cantidad que fueron reembolsados nuestros clientes el año pasado.

¿Listo para comenzar?

Visite energy-readyarkansas.com o llame al **855-350-1563** o envíe un correo electrónico a bheahes@clearesult.com.

Programa de Soluciones Residenciales de Black Hills Energy Arkansas

Descubra cómo Black Hills Energy Arkansas puede ayudarle a consumir menos gas natural en su hogar y comience a ahorrar energía y dinero hoy.



Disfrute de beneficios como:

- Un hogar más saludable y eficiencia energética
- Ahorros de dinero a largo plazo
- Mayor comodidad y mejor calidad del aire
- Aumento de valor de su hogar
- Reducción de huella de carbono



Ahorrar energía comienza en casa.

Al tomar las opciones de eficiencia energética usted está ayudando el medio ambiente y también a su bolsillo. A través del Programa de Soluciones Residenciales de Black Hills Energy Arkansas, los clientes que califiquen pueden comenzar el camino hacia los ahorros de energía y dinero por medio de dos rutas sencillas: la **Ruta de Ahorros de Energía del Hogar** y la **Ruta de Reembolsos de Equipo**.

AVISO: El Programa de Soluciones Residenciales tiene fondos limitados. Las Evaluaciones de Energía del Hogar y las solicitudes de reembolso serán proporcionadas y procesadas según el orden de llegada hasta agotar los fondos. Para verificar la disponibilidad de lo que ofrece el programa y los fondos, visite energy-readyarkansas.com o llame al **855-350-1563**.

Ruta de Ahorros de Energía del Hogar

¿No sabe dónde comenzar cuando se trata de ahorrar energía? Comience con la Ruta de Ahorros de Energía del Hogar, donde usted puede recibir una Evaluación de Energía del Hogar sin costo. Durante la evaluación, un contratista profesional de Ahorros de Energía del Hogar le ayudará a descubrir cómo y dónde puede ahorrar en costos de energía mientras hace que su hogar sea más cómodo.

Usted también puede calificar para mejoras sin costo de ahorros de energía sin costo como aireadores y cabezales de regaderas, además de mejoras posibles a su hogar como:

- Sellado del aire
- Sellado de ductos
- Aislado del techo

¿No está listo para una visita en casa? Pruebe una visita virtual.

También ofrecemos Evaluaciones de Energía del Hogar virtuales. A través de un smartphone o una tableta, un Asesor de Energía analizará varias áreas de su hogar incluyendo su equipo de calefacción, aire acondicionado, enseres eléctricos, iluminación y aislado del ático para determinar dónde se puede ahorrar la mayor cantidad de energía. Una vez se complete su Evaluación Virtual, usted podrá decidir si quiere programar una evaluación sin costo en el hogar, llevada a cabo por uno de nuestros contratistas profesionales de Ahorros de Energía del Hogar.



¿Quién es elegible?

Para calificar para una evaluación profesional en su casa de energía del hogar sin costo, su hogar debe:

- Tener una cuenta residencial válida de Black Hills Energy Arkansas (casas nuevas de menos de un año no son elegibles)
- Tener al menos 10 años O tener consumo mensual (tal como se ve en la factura) de cinco centavos por pie cuadrado o mayor*
- Haber tenido servicio de gas continuo por los 12 meses previos (si menos de 12 meses, comuníquese con nosotros al **855-350-1563**)
- No haber participado en un programa de climatización ofrecido a través de una compañía de servicios públicos o el gobierno en los últimos cinco años
- Recibir remedio por problemas que presenten riesgos a la salud y la seguridad que descubramos durante la inspección inicial

*Cómo calcular pies cuadrados:

Divida el monto de su factura más alta de Black Hills Energy Arkansas por los pies cuadrados de su hogar. Esto le dará el costo de energía por pie cuadrado.

Ecuación:
$$\frac{\$}{\text{(cantidad de factura)}} \div \frac{\text{pie}^2}{\text{(pie}^2\text{)}} = \$/\text{pie}^2$$

Ejemplo:
$$\$200 \div 2,000 = \$0.10/\text{pie}^2$$

¿Cuáles son las mejoras de ahorros de energía sin costo disponibles?

Cuando usted participa en una Evaluación de Energía del Hogar, su contratista de Ahorros de Energía del Hogar puede instalar algunas o todas de las siguientes mejoras en su hogar sin costo:



SELLADO DEL AIRE – Las casas típicas pierden un 20% o más del aire acondicionado a través de fugas, agujeros o ductos de aire con conexiones inadecuadas. Al sellar estas fugas se previenen las corrientes de aire y se mejoran la comodidad y la eficiencia en su hogar.



SELLADO DE DUCTOS – Al igual que con el sellado del aire, al sellar ductos se pueden mejorar la comodidad, la calidad del aire interior y la vida útil del equipo.



AISLADO DEL TECHO – Al combinarse con el sellado del aire, usted puede potencialmente ahorrar hasta un 20% en costos de calefacción y aire acondicionado. El aislado le permite mantener su hogar fresco en el verano y cálido en el invierno.



MEDIDAS DE INSTALACIÓN DIRECTA – Los artículos de ahorros de energía tales como cabezales de regaderas y aireadores de grifos se instalan por el contratista en su hogar donde sean necesarios.

¿Listo para comenzar?

Visite energy-readyarkansas.com o llame al **855-350-1563** o envíe correo electrónico a bheahes@clearesult.com.



A no-cost home energy assessment leads to more comfort in Fayetteville, Arkansas

APSC FILED Time: 5/1/2024 1:22:28 PM: Recvd 5/1/2024 1:18:45 PM: Docket 07-078-TF-Doc. 433

Project at a glance

\$717

Incentives paid to the contractor

769

Total CCF savings

\$0

Out-of-pocket cost to the homeowner

The opportunity

When Andrew bought his home in Fayetteville, Arkansas, two home inspections unfortunately overlooked that the ducts were improperly sealed. As a result, it took a long time to heat up and cool down the 33-year-old, 3,100-square-foot home. Luckily, a no-cost home energy assessment from Black Hills Energy Arkansas spotted the air and duct sealing problems the home inspectors missed. Black Hills Energy Arkansas was even able to provide weatherization upgrades to the house at no out-of-pocket cost.



The project

To keep Andrew's house at desired temperatures, contractors completed air and duct sealing upgrades. They re-weatherstripped all the exterior doors and foam sealed everything from bathroom exhaust fans and plumbing to the kitchen and vent pipes. They also weatherstripped two attic accesses. All the duct connection points of the house's two HVAC systems were sealed and five disconnected ducts were repaired. Now the air from the heating and cooling system can circulate throughout the house and, thanks to the improved weatherization, it stays inside.

The results

For Andrew, the results of this no-cost service were great on paper and in practice. The air sealing reduced air infiltration by 30 percent, while the duct sealing reduced duct losses by 44 percent in one of the HVAC systems and by 36 percent in the other one. Andrew is saving on energy costs each year and living in a more comfortable house.

To see how much Black Hills Energy Arkansas could save you, call 855-350-1563, or visit Energy-ReadyArkansas.com today.



Fewer drafts, more savings

Project at a glance

65%

Reduction in duct leakage

30%

Reduction in air leakage

\$720

Incentives paid to contractor

\$0

Out-of-pocket cost to customer



The opportunity

John, a Black Hills Energy Arkansas customer in Siloam Springs, was looking for ways to save energy and reduce drafts in his 22-year-old, 1,055-square-foot home. Taking advantage of our no-cost Virtual Home Energy Assessment, John received expert recommendations through our video streaming tool and a complimentary smart thermostat to help control his energy costs and comfort. A follow-up in-person Home Energy Assessment was scheduled to determine if his home could benefit from no-cost air and duct sealing.

The project

During John's in-person assessment, a blower door test confirmed there were significant air leaks in the furnace duct system and home's exterior. A Home Energy Savings contractor sealed all the leaks at no cost to John, reducing exterior air loss by around 30% and duct leaks by an impressive 65%. The contractor also installed additional energy-saving products throughout the house, including weatherstripping, caulk and sealant.

The results

The air and duct sealing had an immediate effect on the home's comfort. In addition to reducing drafts from the outside, the circulation of heated air was also greatly improved throughout the home. Now, John's furnace doesn't have to use as much energy to keep his home cozy.

"Both assessments were very straightforward and easy to participate in," said John. "They evaluated my home using diagnostic equipment, then proceeded to reduce the air leakage in my home. I was impressed by the crew's work."



To see how much Black Hills Energy Arkansas could save you, call **855-350-1563** or visit **energy-readyarkansas.com** today.



Project at a glance

30%

reduction in air leakage

24%

reduction in duct leakage

\$1,496

incentives paid to
the contractor

\$0

out-of-pocket cost
to the homeowner

“The upgrades have been amazing, and didn’t cost me a thing. It’s great that both energy providers can work together to provide these opportunities.”

Scott, Springdale homeowner



The opportunity

Scott, a Springdale homeowner, is a happy customer of both SWEPCO and Black Hills Energy Arkansas. After noticing his 56-year-old home was having issues with drafts and air quality, he contacted a utility representative to see what home improvement opportunities were available to him.

Due to his income qualifications, Scott was able to take advantage of a free assessment and home upgrades from the Black Hills Energy Arkansas Low Income Pilot Program and the SWEPCO Income Qualified Weatherization Program.

The project

An initial energy assessment identified several key upgrades to address the issues and lower Scott’s energy costs. A participating contractor then installed the following at no cost to Scott:

- Bathroom exhaust fan
- Air purifier
- Carbon monoxide and smoke detectors
- Smart thermostat
- Air and duct sealing
- Ceiling insulation

The results

Thanks to the upgrades, Scott’s annual duct leakage has dropped by an estimated 24 percent. The extra insulation and air sealing have also reduced drafts and outside noise, while the new exhaust fan and air purifier have significantly improved air quality and will help prevent future moisture issues.

Now, Scott enjoys a safer, more energy-efficient and comfortable home.



Ready to save?

Call Black Hills Energy Arkansas at **855-350-1563** or SWEPCO at **888-266-3130** to discover your energy-saving opportunities.

NEW HOME CONSTRUCTION Package rebate

Receive a **\$1,000 rebate** for installing a qualifying **natural gas forced-air furnace, natural gas tankless water heater and smart thermostat** in your newly constructed home.

PLEASE NOTE: This is a program with limited funding. Rebates will be limited to the first 200 applicants or until funds are depleted. To check the current status of funds, please call 855-350-1563.

To receive your rebate, please submit all requested information, **including copies of the dated invoice from your equipment retailer/installer**, along with all requested signatures. The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas **AND** emailed or postmarked by **December 31, 2023**. See other side for more information or visit **energy-readyarkansas.com**. **Please send completed application to: Energy Ready, P.O. Box 9567, Fayetteville, AR 72702 or bheahes@clearesult.com.**

Installation location

Account holder's name _____

Black Hills Energy Arkansas Account # (required) _____

Phone () _____

Email _____

Account physical address _____

City/State/ZIP _____

Mailing address _____

City/State/ZIP _____

Electric provider:

Entergy Arkansas SWEPCO Other _____

Purchaser's information

(if different from above)

Name _____

Mailing address _____

City/State/ZIP _____

Email _____

Purchaser is: Owner Landlord Renter Agency

Installer

(To be completed by installer. An additional rebate of **\$100** will be paid to the installer shown below.)



Company name _____

First name _____

Last name _____

Address _____

City/State/ZIP _____

Phone () _____

Email _____

Installer signature _____

License # _____

All installers must submit a copy of a completed W-9 to the Black Hills Energy Arkansas Residential Solutions Program in order to be paid. If you have questions about how to submit a W-9, please call **855-350-1563** or email **bheahes@clearesult.com**.

It is not the responsibility of the installer to ensure that program requirements are met. If program requirements are not met, no rebate will be paid.

Send rebate check to:

Purchaser's address Installation mailing address

Assigned installer*

**Rebate assignment requires documentation on invoice discounting final invoice by the amount of the rebate. If assigned retailer or installer box is checked above, customer signature is required here:*

Building type:

Single-family home Multi-family home

Square footage (required): _____ square feet

Year of construction: _____

Customer signature

Signature _____

Print first and last name _____

Date _____

By signing this application, you certify that the information provided is accurate to the best of your ability.

Furnace information

(To be completed by installer.)

Brand _____

Complete model # _____

BTU/Hr. input _____

BTU/Hr. input _____

Serial # _____

Date of installation _____

Rebate offer applies only to new natural gas forced-air furnaces. Black Hills Energy Arkansas uses Air Conditioning, Heating, and Refrigeration Institute listings to determine the efficiency of the equipment.



Water heater information

Brand _____
 Complete model # _____
 BTU/Hr. input _____
 Size or capacity/gallons _____
 Energy factor/thermal efficiency _____
 Serial # _____
 Date of installation _____

Rebate offer applies only to new natural gas tankless water heaters. Black Hills Energy Arkansas uses Air Conditioning, Heating, and Refrigeration Institute listings to determine the efficiency of the equipment.

Thermostat information

Brand _____
 Complete model # _____
 Serial # _____
 Date of installation _____

Rebate offer applies only to new ENERGY STAR® certified smart thermostats with the following features:

1. Successful connection to existing Wi-Fi
2. Remote adjustment via smartphone or online
3. Automatic scheduling
4. Energy history

Efficiency qualifications

EQUIPMENT	QUALIFICATIONS
Natural gas forced-air furnace	95% AFUE or higher
Natural gas tankless water heater	.90 uniform energy factor (UEF) or higher
Smart thermostat	ENERGY STAR certified

If applying for units in a newly constructed home, rebates are available for NO MORE THAN TWO (2) units per account. If sending rebates for multiple accounts or multiple units on one account, please call to check availability of funding.

Installers are only eligible to receive their customer's rebate if the customer has assigned the rebate to the installer, and there is a discount for the full amount of the rebate shown on the final invoice.

Application requirements

Application must be completely filled out with installation location information, purchaser information (if applicable), equipment information (including brand, complete model and serial number and installation date) and retailer/installer information (if applicable). Black Hills Energy Arkansas is unable to accept applications that do not include all of this information. Copies of the dated invoices or sales receipts must accompany the completed rebate application and must include the customer's name, unit brand, model and serial numbers and unit cost. It is the responsibility of the account holder or purchaser to ensure that the installed equipment qualifies for the rebate. If it does not qualify, no rebate will be paid.

Black Hills Energy Arkansas reserves the right to inspect the installed equipment.

Rebate qualifications and amounts are subject to change.

The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas AND emailed or postmarked by December 31, 2023. To avoid delays in rebate processing, please submit your completed paperwork as soon as possible. Any applications with missing or incomplete information can jeopardize the chance of receiving rebate funds. Rebates are awarded on a first-come, first-served basis until funds are depleted.

Rebate details

Black Hills Energy Arkansas issues cash rebates in the form of checks, not utility bill credits. Black Hills Energy Arkansas is not responsible if the retailer/installer does not provide accurate information on the rebate amount or equipment eligibility. Rebate checks will be mailed within 6-8 weeks.

Application checklist

- Dated sales invoice must include customer name, equipment brand, model and serial number and unit cost. If rebate has been assigned to the installer by the Black Hills Energy Arkansas customer, the deduction for the rebate must be shown on the invoice.
- Customer signature
- Black Hills Energy Arkansas Account #

Options to submit rebate

1. **Email** (preferred):
bheahes@clearesult.com
2. **Mail:** Energy Ready
P.O. Box 9567
Fayetteville, AR 72702

Questions?

For information pertaining to your rebate call **855-350-1563** or email **bheahes@clearesult.com**.



RESIDENTIAL HEATING Equipment Rebate

Program dates: January 1, 2023 through December 31, 2023. PLEASE NOTE: This is a program with limited funding. Applications will be processed on a first-come, first-served basis until funds are depleted. To check the current status of funds, please call 855-350-1563.

To receive your rebate, please submit all requested information, including a copy of the dated invoice from your equipment installer, along with all requested signatures. The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas **AND** emailed or postmarked by **December 31, 2023**. See other side for more information or visit energy-readyarkansas.com. **Please send completed application to: Energy Ready, P.O. Box 9567, Fayetteville, AR 72702 or bheahes@clearesult.com.**

INSTALLATION LOCATION

Account holder's name _____

Black Hills Energy Arkansas Account # (required) _____

Phone () _____

Email _____

Account location address _____

City/State/ZIP _____

Mailing address _____

City/State/ZIP _____

Electric provider:

Entergy Arkansas SWEPCO Other _____

PURCHASER'S INFORMATION

(if different from above)

Business name _____

Mailing address _____

City/State/ZIP _____

Email _____

Is purchaser: Owner Landlord Renter Agency

INSTALLER

(To be completed by installer. An additional rebate of \$50 will be paid to the installer show below.)

Company name _____

First name _____

Last name _____

Address _____

City/State/ZIP _____

Phone () _____

Email _____

Installer signature _____

License # _____

*All suppliers must submit a copy of a completed W-9 to the Black Hills Energy Arkansas Residential Solutions Program in order to be paid. If you have questions about how to submit a W-9, please call **855-350-1563** or email bheahes@clearesult.com.*

It is not the responsibility of the installer to ensure that the program requirements are met. If program requirements are not met, no rebate will be paid.

Send rebate check to:

Purchaser's address Installation address

Assigned installer*

**Rebate assignment requires documentation on invoice discounting final invoice by the amount of the rebate. If assigned installer box is checked above, customer signature is required here:*

Type of installation:

New construction Replacement (failure)

Replacement (upgrade)

If furnace replacement is due to air conditioning failure, please select Replacement (upgrade).

Building type:

Single-family home

Multi-family home

Square footage (required): _____ square feet

Year of construction (required): _____

CUSTOMER SIGNATURE

Signature _____

Print first and last name _____

Date _____

By signing this application, you certify that the information provided is accurate to the best of your ability.



HEATING EQUIPMENT INFORMATION

(To be completed by installer.)

Brand _____

Complete model # _____

BTU/Hr. input _____

AFUE % _____

Date of installation _____

Serial # _____

QUALIFICATIONS

The qualifying equipment must be installed in an Arkansas home served with natural gas from Black Hills Energy Arkansas and must meet the following efficiencies:

TECHNOLOGY	REBATE AMOUNT
Natural gas forced-air furnaces	\$400 (95% AFUE or higher)

Rebate offer applies only to new natural gas furnaces. If the furnace being replaced is electric or is a heat pump, no rebate is available. Black Hills Energy Arkansas uses Air Conditioning, Heating, and Refrigeration Institute listings to determine the efficiency of the equipment.

If applying for units in a newly constructed home, rebates are available for NO MORE THAN 2 units per account.

If sending rebates for multiple accounts or multiple units on one account, please call to check availability of funding.

Installers are only eligible to receive their customer's rebate if the customer has assigned the rebate to the installer, and there is a discount for the full amount of the rebate shown on the final invoice.

Equipment installed under warranty replacement does not qualify for the rebate.

REQUIREMENTS

Application must be completely filled out with installation location information, purchaser information (if applicable), equipment information (including brand, complete model and serial number, installation date and AFUE rating) and installer information (if applicable). Black Hills Energy Arkansas is unable to accept applications that do not include all this information. A copy of the

rebate application and must include the customer name, unit brand, model and serial numbers and unit cost. It is the responsibility of the account holder or purchaser to ensure that the installed equipment qualifies for the rebate. If it does not qualify, no rebate will be paid.

Black Hills Energy Arkansas reserves the right to inspect the installed equipment.

Rebate qualifications and amounts are subject to change.

The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas AND emailed or postmarked by December 31, 2023. To avoid delays in rebate processing, please submit your completed paperwork as soon as possible. Any applications with missing or incomplete information can jeopardize the chance of receiving rebate funds. Rebates are awarded on a first-come, first-served basis until funds are depleted.

REBATE DETAILS

Rebate amounts will be issued for equipment installed between January 1, 2023 and December 31, 2023 only. Black Hills Energy Arkansas issues cash rebates in the form of checks, not utility bill credits. Black Hills Energy Arkansas is not responsible if the installer does not provide accurate information on the rebate amount or equipment eligibility. Rebate checks will be mailed within 6-8 weeks.

APPLICATION CHECKLIST

- Dated sales invoice must include customer name, equipment brand, model and serial number and unit cost. If rebate has been assigned to the installer by the Black Hills Energy Arkansas customer, the deduction for the rebate must be shown on the invoice.
- Customer signature
- Black Hills Energy Arkansas Account #

OPTIONS TO SUBMIT REBATE

1. **Email** (preferred):
bheahes@clearesult.com
2. **Mail:** Black Hills Energy Arkansas Rebates
C/O CLEAResult
P.O. Box 9567
Fayetteville, AR 72702

QUESTIONS?

For information pertaining to your rebate, call **855-350-1563** or email **bheahes@clearesult.com**.

RESIDENTIAL SMART THERMOSTAT Equipment Rebate

Program dates: January 1, 2023 through December 31, 2023
PLEASE NOTE: This is a program with limited funding. Applications will be processed on a first-come, first-served basis until funds are depleted. To check the current status of funds, please call 855-350-1563.

To receive your rebate, please submit all requested information, **including a copy of the dated invoice from your equipment retailer/installer**, along with all requested signatures. The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas **AND** emailed or postmarked by **December 31, 2023**. See other side for more information or visit energy-readyarkansas.com. **Please send completed application to: Energy Ready, P.O. Box 9567, Fayetteville, AR 72702 or bheahes@clearesult.com.**

INSTALLATION LOCATION

Account holder's name _____

Black Hills Energy Arkansas Account # (required)

Phone () _____

Email _____

Account physical address _____

City/State/ZIP _____

Mailing address _____

City/State/ZIP _____

Electric provider:

Entergy Arkansas SWEPCO Other _____

PURCHASER'S INFORMATION

(if different from above)

Name _____

Mailing address _____

City/State/ZIP _____

Email _____

Purchaser is: Owner Landlord Renter Agency

RETAILER

(where purchased / if applicable)

Company name _____

First name _____

Last name _____

Phone () _____

Email _____

INSTALLER

(if applicable)

Company name _____

First name _____

Last name _____

Address _____

City/State/ZIP _____

Phone () _____

Email _____

Installer signature _____

License # _____

It is not the responsibility of the retailer/installer to ensure that the program requirements are met. If program requirements are not met, no rebate will be paid.

Send rebate check to:

Purchaser's address Installation mailing address

Assigned retailer or installer*

**Rebate assignment requires documentation on invoice discounting final invoice by the amount of the rebate. If assigned retailer or installer box is checked above, customer signature is required here:*

Type of installation:

New construction

Replacement (non-repairable thermostat)

Replacement (upgrade of functioning thermostat)

Type of old thermostat:

Programmable - Set as needed

Programmable - On set schedule

Manual

Smart thermostat

Was your old thermostat properly programmed?

Yes

No

Is there a natural gas furnace present?

Yes

No



Building type:

- Single-family home
- Multi-family home

Square footage (required): _____ square feet

Year of construction (required): _____

CUSTOMER SIGNATURE

Signature _____

Print first and last name _____

Date _____

By signing this application, you certify that the information provided is accurate to the best of your ability.

EQUIPMENT INSTALLED

What ENERGY STAR® certified smart thermostat is being installed?

Brand _____

Complete model # _____

Date of installation _____

Serial # _____

QUALIFICATIONS

The qualifying equipment must be installed in an Arkansas home served with natural gas from Black Hills Energy Arkansas and must meet the following efficiency:

TECHNOLOGY	REBATE AMOUNT
ENERGY STAR® certified smart thermostat	\$50

Rebate offer applies only to new ENERGY STAR certified smart thermostats with the following features:

1. Successful connection to existing WI-FI
2. Remote adjustment via smartphone or online
3. Automatic scheduling
4. Energy history

Only two rebates available per account. If sending rebates for multiple accounts, please call to check availability of funding.

Retailers/Installers are only eligible to receive their customer's rebate if the customer has assigned the rebate to the retailer/installer and there is a discount for the full amount of the rebate shown on the final invoice.

Equipment installed under warranty replacement does not qualify for the rebate. Factory refurbished or remanufactured units ARE NOT eligible.

REQUIREMENTS

Application must be completely filled out with installation location information, purchaser information (if applicable), equipment information (including brand, complete model and serial number and installation date) and retailer/installer information (if applicable). Black Hills Energy Arkansas is unable to accept applications that do not include all this information. A copy of the dated invoice or sales receipt must accompany the completed rebate application and must include the customer name, unit brand, model and serial numbers and unit cost. It is the responsibility of the account holder or purchaser to ensure that the installed equipment qualifies for the rebate. If it does not qualify, no rebate will be paid.

Black Hills Energy Arkansas reserves the right to inspect the installed equipment.

Rebate qualifications and amounts are subject to change.

The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas AND emailed or postmarked by December 31, 2023.

To avoid delays in rebate processing, please submit your completed paperwork as soon as possible. Any applications with missing or incomplete information can jeopardize the chance of receiving rebate funds. Rebates are awarded on a first-come, first-served basis until funds are depleted.

REBATE DETAILS

Rebate amounts will be issued for equipment installed between January 1, 2023 and December 31, 2023 only. Black Hills Energy Arkansas issues cash rebates in the form of checks, not utility bill credits. Black Hills Energy Arkansas is not responsible if the retailer/installer does not provide accurate information on the rebate amount or equipment eligibility. Rebate checks will be mailed within 6-8 weeks.

APPLICATION CHECKLIST

- Dated sales invoice must include customer name, equipment brand, model and serial number and unit cost. If rebate has been assigned to the retailer/installer by the Black Hills Energy Arkansas customer, the deduction for the rebate must be shown on the invoice.
- Customer signature
- Black Hills Energy Arkansas Account #

OPTIONS TO SUBMIT REBATE

1. **Email** (preferred):
bheaehes@clearesult.com
2. **Mail:** Energy Ready
P.O. Box 9567
Fayetteville, AR 72702

QUESTIONS?

For information pertaining to your rebate call **855-350-1563** or email **bheaehes@clearesult.com**.



RESIDENTIAL TANKLESS WATER HEATER Equipment Rebate

Program dates: January 1, 2023 through December 31, 2023
PLEASE NOTE: This is a program with limited funding. Applications will be processed on a first-come, first-served basis until funds are depleted. To check the current status of funds, please call 855-350-1563.

To receive your rebate, please submit all requested information, including a copy of the dated invoice from your equipment installer, along with all requested signatures. The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas **AND** emailed or postmarked by **December 31, 2023**. See other side for more information or visit energy-readyarkansas.com. **Please send completed application to: Energy Ready, P.O. Box 9567, Fayetteville, AR 72702 or bheahes@clearesult.com.**

INSTALLATION LOCATION

Account holder's name _____

Black Hills Energy Arkansas Account # (required) _____

Phone () _____

Email _____

Account physical address _____

City/State/ZIP _____

Mailing address _____

City/State/ZIP _____

Electric provider:

Entergy Arkansas SWEPCO Other _____

PURCHASER'S INFORMATION

(if different from above)

Name _____

Mailing address _____

City/State/ZIP _____

Email _____

Is purchaser: Owner Landlord Renter Agency

INSTALLER

(To be completed by installer. An additional rebate of \$50 will be paid to the installer show below.)

Company name _____

First name _____

Last name _____

Address _____

City/State/ZIP _____

Phone () _____

Email _____

Installer signature _____

License # _____

*All installers must submit a copy of a completed W-9 to the Black Hills Energy Arkansas Residential Solutions Program in order to be paid. If you have questions about how to submit a W-9, please call **855-350-1563** or email bheahes@clearesult.com.*

It is not the responsibly of the installer to ensure that the program requirements are met. If program requirements are not met, no rebate will be paid.

Send rebate check to:

Purchaser's address Installation mailing address

Assigned installer*

**Rebate assignment requires documentation on invoice discounting final invoice by the amount of the rebate. If assigned installer box is checked above, customer signature is required here:*

Type of installation:

New construction Replacement (non-repairable water heater) Replacement upgrade of functioning equipment

Square footage (required): _____ square feet

Year of construction (required): _____

CUSTOMER SIGNATURE

Signature _____

Print first and last name _____

Date _____

By signing this application, you certify that the information provided is accurate to the best of your ability.



NEW EQUIPMENT INFORMATION

Brand _____
Complete model # _____
BTU/Hr. input _____
Serial # _____
Size or capacity/gallons _____
Energy factor/thermal efficiency _____
Date of installation _____

EXISTING EQUIPMENT INFORMATION

Existing unit brand _____
Replaced unit's tank capacity/gallons (required)

QUALIFICATIONS

The qualifying equipment must be installed in an Arkansas home served with natural gas from Black Hills Energy Arkansas and must meet the following efficiencies:

Rebate offer applies only to new equipment. If the equipment replaced is electric, no rebate is available. Black Hills Energy Arkansas uses Air Conditioning, Heating, and Refrigeration Institute listings to determine the efficiency of the equipment.

NATURAL GAS EQUIPMENT	REBATE AMOUNT
Tankless water heater	\$300 (.90 uniform energy factor or higher)

Only one rebate available per account. If sending rebates for multiple accounts or multiple units on one account, please call to check availability of funding.

Installers are only eligible to receive their customer's rebate if the customer has assigned the rebate to the installer, and there is a discount for the full amount of the rebate shown on the final invoice.

Equipment installed under warranty replacement does not qualify for the rebate.

REQUIREMENTS

Application must be completely filled out with installation location information, purchaser information (if applicable), equipment information (including brand, complete model and serial numbers, installation date and AFUE rating) and installer information (if applicable). Black Hills Energy Arkansas is unable to accept

APSC FILED Time: 5/1/2024 1:22:28 PM: Reply: 5/1/2024 1:25 PM: Public Comment Information. A copy of the dated invoice or sales receipt must accompany the completed rebate application and must include the customer name, unit brand, model and serial numbers and unit cost. It is the responsibility of the account holder or purchaser to ensure that the installed equipment qualifies for the rebate. If it does not qualify, no rebate will be paid.

Black Hills Energy Arkansas reserves the right to inspect the installed equipment.

Rebate qualifications and amounts are subject to change.

The rebate application must be submitted within 90 days of installation date or within 90 days of connection of natural gas AND emailed or postmarked by December 31, 2023. To avoid delays in rebate processing, please submit your completed paperwork as soon as possible. Any applications with missing or incomplete information can jeopardize the chance of receiving rebate funds. Rebates are awarded on a first-come, first-served basis until funds are depleted.

REBATE DETAILS

Rebate amounts will be issued for equipment installed between January 1, 2023 and December 31, 2023 only. Black Hills Energy Arkansas issues cash rebates in the form of checks, not utility bill credits. Black Hills Energy Arkansas is not responsible if the installer does not provide accurate information on the rebate amount or equipment eligibility. Rebate checks will be mailed within 6-8 weeks.

APPLICATION CHECKLIST

- Dated sales invoice must include customer name, equipment brand, model and serial number and unit cost. If rebate has been assigned to the installer by the Black Hills Energy Arkansas customer, the deduction for the rebate must be shown on the invoice.
- Customer signature
- Black Hills Energy Arkansas Account #

OPTIONS TO SUBMIT REBATE

1. **Email** (preferred):
bheahes@clearesult.com
2. **Mail:** Energy Ready
P.O. Box 9567
Fayetteville, AR 72702

QUESTIONS?

For information pertaining to your rebate, call **855-350-1563** or email **bheahes@clearesult.com**.