BEFORE THE

ARKANSAS PUBLIC SERVICE COMMISSION

IN THE MATTER OF THE APPLICATION OF ARKANSAS OKLAHOMA GAS CORPORATION FOR APPROVAL OF QUICK START ENERGY EFFICIENCY PROGRAMS	**)**	**DOCKET NO. 07-077-TF**

COMPREHENSIVE ENERGY EFFICIENCY PLAN

PROGRAM YEAR 2021

ANNUAL REPORT

APRIL 29, 2022

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1.0 Executive Summary

This document is provided to the Arkansas Public Service Commission ("Commission") as the annual review of Arkansas Oklahoma Gas Corporation's ("AOG" or "Company") Comprehensive Energy Efficiency Plan ("CEE Plan" or "Plan") for the 2021 Program Year ("Program Year"), pursuant to Order No. 18 in Docket No. 06-004-R.

Historical Background

In the *Application of Arkansas Oklahoma Gas Corporation for Approval of its 2020-2022 Energy Efficiency Program Plans and Budgets* filed on March 15, 2019 in Docket No. 07-077-TF, AOG proposed the continuation of the following four programs previously approved by the Commission:

1. AOG Weatherization Program ("AOGWP");
2. Commercial/Industrial Solutions ("CIS") Program;
3. Equipment Rebate Program ("ERP"); and
4. Energy Efficiency Arkansas ("EEA").

AOG also proposed the establishment of a fifth program within the Plan:

5. Low-Income Pilot Program ("LIPP").

This CEE Plan was designed to achieve an annual energy savings target of 0.50% of 2018 retail sales in program years 2020 - 2022, per Order No. 43 in Docket No. 13-002-U. The Plan was deemed comprehensive, pursuant to Order No. 17 in Docket No. 08-144-U and approved by the Commission on June 17, 2019 in Order No. 88 in Docket No. 07-077-TF.

To maximize both consistency and efficiency in program plan design and implementation, AOG continued a longstanding collaboration with Oklahoma Gas and Electric Company ("OG&E"), CenterPoint Energy Arkansas Gas, and Black Hills Energy Arkansas, Inc. to plan, implement, and analyze many of the programs in AOG's 2020 - 2022 CEE Plan. As a small company, this collaboration expanded the options available to AOG and decreased administrative costs. This saved AOG ratepayers money while offering a diverse, comprehensive portfolio of EE programs. AOG would also like to recognize the achievements of the active participants of the Parties Working Collaboratively ("PWC"). This collaborative effort has been of benefit to AOG in complying with the regulatory requirements of EE programs.

Major Accomplishments and Milestones

The 2021 Program Year represents AOG's best efforts to develop and implement a portfolio of comprehensive energy efficiency programs designed to meet or exceed the Commission's energy savings goals in Arkansas. AOG is proud to report that the 2021 Program Year results exceeded the energy savings target set by the Commission. Overall, AOG captured 133% of its Commission-ordered net energy savings target while expending 57% of the 2021 CEE Plan budget. Additionally, AOG's portfolio of programs achieved a Total Resource Cost (TRC) ratio of 2.00. AOG's historical portfolio TRC ratios are as follows:

2012	2013	2014	2015	2016	2017	2018	2019	2020
1.60	1.72	2.67	2.24	2.67	1.98	1.77	2.07	1.50

Goals and Objectives for the EE Portfolio

As presented in the CEE Plan, AOG had the following objectives for its portfolio of EE programs in 2021:

1. Reduce end-use natural gas consumption in a cost-effective manner to save money for consumers and conserve nonrenewable resources;
2. Protect the environment by encouraging installation of efficiency measures that help reduce carbon dioxide emissions and air pollutants;
3. Increase residential and commercial customer awareness of available energy efficiency opportunities by encouraging equipment upgrades and behavioral changes;
4. Generate greater customer awareness of the energy efficiency programs available through AOG to support their energy efficiency objectives;
5. Identify cost-effective natural gas saving measures for program participants;
6. Improve relationships with customers, trade allies, and stakeholders by providing value-added energy efficiency services, training and education, hardware, verification and support;
7. Support a more robust local and statewide economy by utilizing local labor and helping Arkansas residents reduce their monthly energy expenses.

In AOG's CEE Plan, energy savings goals were set for each program. These goals were developed to ensure that the successful implementation of each individual program would result in the total portfolio of AOG programs meeting the Commission-ordered savings target. AOG's Commission-ordered net energy savings target for 2021 was 457,858 therms.

Progress Achieved Versus Goals and Objectives

AOG captured net annual energy savings of 458,151 therms during the 2021 Program Year. This represents 133% of the net energy savings that AOG was tasked with obtaining by order of the Commission. In addition to exceeding the Commission's energy savings target, AOG's CEE Plan was successful in increasing energy efficiency awareness in all markets and developing positive relationships with customers, trade allies, and stakeholders.

Portfolio Savings, Participation Levels, and Prior Year Comparison

AOG's historical net energy savings (therms) has been impressive:

2012	2013	2014	2015	2016	2017	2018	2019	2020
378,230	559,136	591,591	535,479	534,421	536,202	500,829	492,071	459,387

Customer participation is critical to the success of AOG's EE programs. Participation levels were consistent with the net energy savings performance of each individual program in AOG's 2021 EE portfolio.

Training Achievements

AOG personnel attended several seminars covering energy efficiency-related topics. These trainings were provided by Arkansas Gas Association, Southern Gas Association, Ionix Gas Technologies, and Energy

Solutions Center. AOG also participated in trainings conducted by CLEAResult, the implementer for both AOGWP and LIPP, designed to instruct trade allies in program procedures and ensure quality performance.

EE Portfolio Summary

2021 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	458,151	$ 1,627,031	$ 1,104,307	$ 195,560	$ 1,955,599	2.00	1.71	0.50%	0.67%	133%

EE Portfolio Summary by Program

EE Portfolio Expenditures by Program

Program Name	Target Sector	Program Type	2021 Budget ($)	2021 Actual ($)	% of Budget
AOG Weatherization	Residential	Whole Home	1,754,746	770,478	44%
Low Income Pilot Program	Residential	Whole Home	80,003	61,679	77%
Equipment Rebate	Res/Small Business	Prescriptive/Standard Offer	466,605	316,438	68%
Commercial/Industrial	Small Business/C&I	Other	428,492	399,356	93%
EEA	All Classes	Behavior/Education	14,021	3,505	25%
Regulatory	-	-	89,746	75,575	84%
		Total	**2,833,613**	**1,627,031**	**57%**

EE Portfolio Summary by Cost Type

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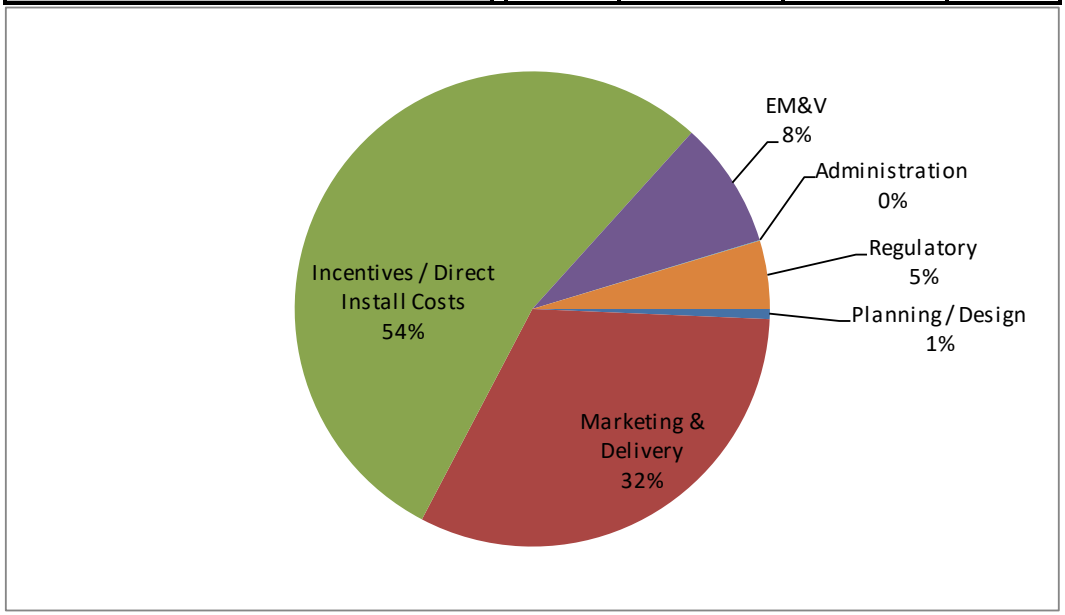
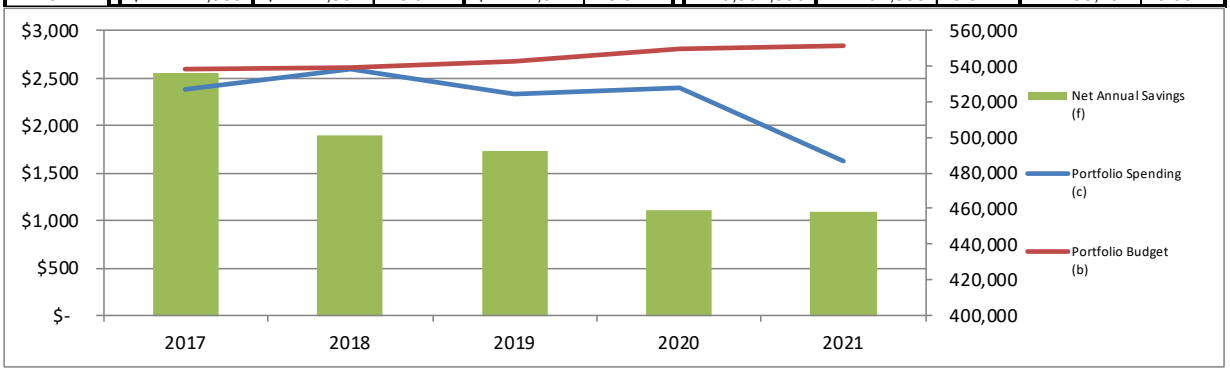
EE Portfolio Expenditure Summary by Cost Type

Cost Type	2021 Total Expenditures			
	% of Total	Budget ($)	Actual ($)	% of Total
Planning / Design	1%	17,350	11,110	1%
Marketing & Delivery	17%	486,915	520,788	32%
Incentives / Direct Install Costs	73%	2,071,660	878,646	54%
EM&V	5%	151,098	140,287	9%
Administration	1%	16,844	625	0%
Regulatory	3%	89,746	75,575	5%
	100%	**2,833,613**	**1,627,031**	100%



Company Statistics

Company Statistics											
Program Year	Revenue and Expenditures					Energy					
		Budget		Actual			Plan		Evaluated		
	Total Revenue (a) ($000's)	Portfolio Budget (b) ($000's)	% of Revenue (%=b/a)	Portfolio Spending (c) ($000's)	% of Revenue (%=c/a)	Total Annual Energy Sales (d) (Therms)	Net Annual Savings (e) (Therms)	% of Energy Sales (%=e/d)	Net Annual Savings (f) (Therms)	% of Energy Sales (%=f/d)
2017	$ 41,494	$ 2,589	6.2%	$ 2,377	5.7%	64,156,960	444,944	0.69%	536,202	0.84%
2018	$ 45,924	$ 2,603	5.7%	$ 2,588	5.6%	77,576,730	444,944	0.57%	500,829	0.65%
2019	$ 46,245	$ 2,681	5.8%	$ 2,332	5.0%	75,814,290	444,944	0.59%	492,071	0.65%
2020	$ 43,990	$ 2,805	6.4%	$ 2,404	5.5%	70,319,580	454,245	0.65%	459,387	0.65%
2021	$ 47,089	$ 2,834	6.0%	$ 1,627	3.5%	73,302,890	457,858	0.62%	458,151	0.63%



2.0 Portfolio Programs

AOG's portfolio of programs is designed to comply with the definition of "comprehensive" and to achieve the energy savings targets directed by the Commission in Order No. 17 in Docket No. 08-144-U. These programs allow AOG to achieve energy savings by enabling consumers to change their behaviors, attitudes, awareness, and knowledge about energy savings and the utilization of energy efficient technologies.

2.1 AOG Weatherization Program

2.1.1 Program Description

The AOG Weatherization Program targets energy-inefficient homes for weatherization. The program improves comfort and reduces energy costs by upgrading the thermal envelope of qualified homes. By partnering with electric utilities including OG&E and SWEPCO, this program exhibits cross-fuel cooperation that results in a comprehensive program offering to residential customers, with lower administrative costs.

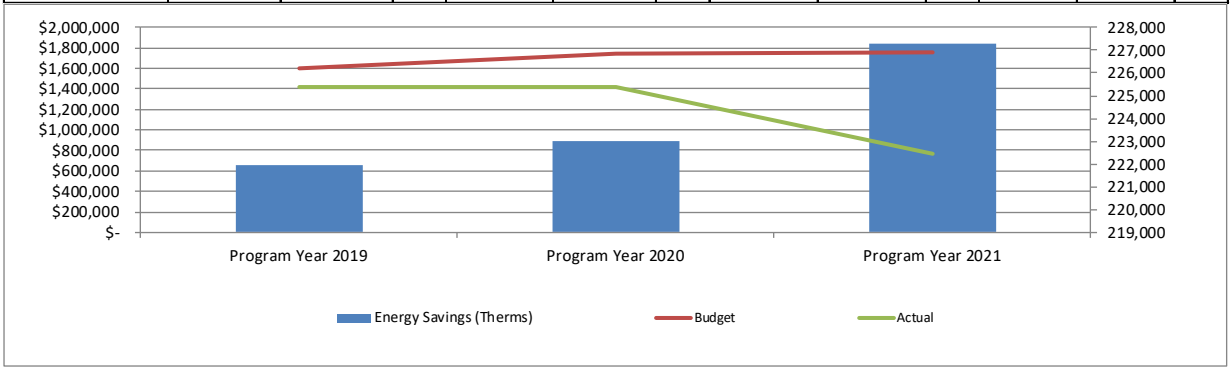
2.1.2 Program Highlights

- This program began on July 1, 2011 and has continued through the 2021 Program Year.
- The program has grown to become the cornerstone of the residential portion of AOG's CEE Plan.
- On December 9, 2014 in Order No. 22 in Docket No. 13-002-U, the Commission approved the *Recommended Weatherization Approach to Provide Consistent Weatherization Programs across All Utilities in Arkansas*. This Core Program was modeled after the thriving AOG/OG&E Weatherization Program.
- The program was implemented by CLEAResult, a contractor for other utilities adhering to the state's Consistent Weatherization Approach (CWA) including Black Hills Energy, SWEPCO, OG&E, and Summit Utilities Arkansas (formerly CenterPoint Energy). Utilizing CLEAResult provided additional benefits to AOG customers including cost sharing with an additional overlapping electric utility and significantly increased quality assurance inspections of weatherized homes by BPI-certified personnel. AOG also benefited by engaging CLEAResult's network of trade allies, experienced across multiple weatherization programs in Arkansas. Trade allies within this network are well-versed in building performance science and receive rigorous training adhering to best practices according to Factor 1 as designated by the Arkansas Public Service Commission. Through the efforts of these highly skilled contractors, AOG was able to increase the average air sealing and duct sealing savings by 87% and 238%, respectively.
- AOGWP is very successful. In 2021, the program weatherized 705 homes and captured net energy savings of 227,257 therms.
- The program is cost beneficial as evidenced by a Total Resource Cost Ratio of 3.01.
- The program is remarkably popular and requires a minimal marketing budget.
- AOG receives a considerable amount of solicited and unsolicited positive feedback from participants of this program.

2.1.3 Program Budget, Savings, and Participants

AOG Weatherization

	Expenditures			Energy Savings (Therms)			Demand Savings (Therms)			Participants		
Program	Budget	Actual	%	Plan	Evaluated	%	Plan	Evaluated	%	Plan	Actual	%
Program Year 2019	$ 1,600,745	$ 1,424,485	89%	158,145	221,942	140%	n/a	n/a	-	750	825	110%
Program Year 2020	$ 1,741,200	$ 1,416,748	81%	216,543	223,009	103%	n/a	n/a	-	857	838	98%
Program Year 2021	**$ 1,754,746**	**$ 770,478**	**44%**	**216,543**	**227,257**	**105%**	**n/a**	**n/a**	**-**	**857**	**705**	**82%**



2.1.4 Description of Participants

Participants of the AOGWP include homeowners or leaseholders of a single-family home, duplex, or manufactured home constructed prior to 2011 or have monthly usage (as shown on the bill) of five centers per square foot or higher. The eligible dwelling must have been occupied for the previous 12 months and not received weatherization services through a utility weatherization program in the past five years.

2.1.5 Challenges and Opportunities

Per ADM's recommendations, AOG will ensure all requested tracking fields are provided in the future.

AOG will also continue to monitor all projects for comprehensiveness. AOG is proud to report that while the quantity of measures installed per home decreased over previous years, the number of therms saved per home drastically increased. AOG maintains this facet of comprehensiveness is more substantial than the number of measures installed as measures installed indicates a high volume of direct install measures. These direct install measures, while effective and efficient, are not large contributors to energy savings in the home. AOG will continue to seek to install all measures wherever applicable but will also continue to focus on the greatest energy savings potential.

AOG would also like to address the lower customer satisfaction rating found by ADM. AOG strives to serve its customers with the utmost attention and consideration and will certainly make every effort to determine why satisfaction may have decreased from its standard 90% - 100% to 70%. In our initial investigation into this metric, program staff discovered AOG's overall Net Promoter Score also decreased by the same margin. Moreover, ADM's data demonstrates much of the dissatisfaction may be caused by energy bills being higher than expected post-weatherization. With this information, it is unsurprising that customer satisfaction with their energy provider is decreasing. Within the 2021 Program Year, the

commodity cost of natural gas has more than doubled. In many cases, this cost increase countered the substantial energy savings garnered through the program. AOG does not claim this is the only factor in a decreased customer satisfaction score, but it could be a significant component. AOG will carefully monitor customer satisfaction through additional monthly surveys performed by CLEAResult personnel.

2.2 Commercial/Industrial Solutions Program

2.2.1 Program Description

The primary goal of the Commercial/Industrial Solutions Program is to produce cost-effective natural gas energy savings by offering incentives for installation of energy efficiency measures in commercial and industrial facilities. The program is implemented by CLEAResult and consists of three major components, which provide multiple opportunities for customers to participate and capture energy savings:

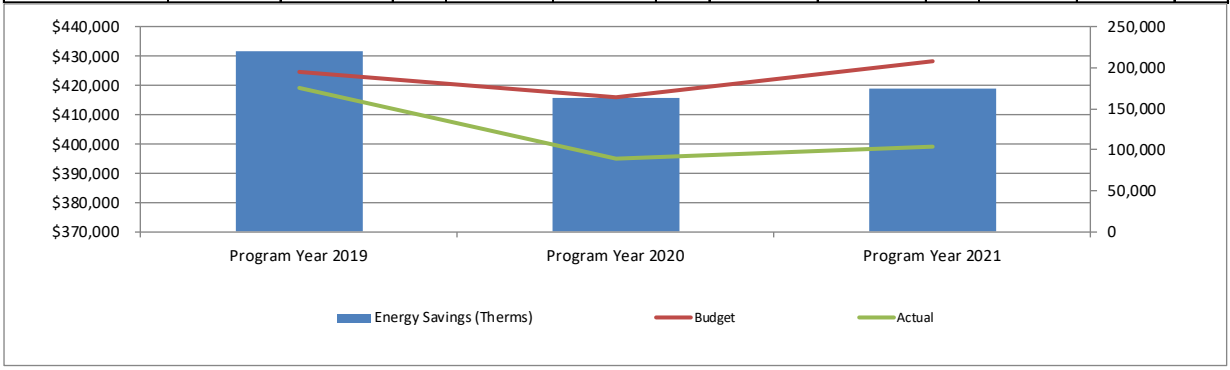
1. Direct Install – Primarily targets commercial customers. Energy efficiency measures include pre-rinse spray valves, faucet aerators, low-flow showerheads, and door sweeps. This program component provides convenient delivery of EE measures at no cost to the customer.
2. Prescriptive – Targets both commercial and smaller industrial customers. The program offers prescriptive rebates for a wide variety of high-efficiency commercial natural gas equipment. This includes, but is not limited to, ENERGY STAR® commercial kitchen equipment, commercial boilers, and boiler controls.
3. Custom – Targets both commercial and industrial customers. This program offers custom incentives for installation of energy efficiency measures in a variety of categories. This includes, but is not limited to, boiler upgrades, HVAC systems, steam system insulation, and steam trap replacements. The value of each custom incentive varies according to project scope and is calculated based on the verified energy savings of each measure installed. This allows AOG and CLEAResult to adapt the offering of the CIS Program to accommodate commercial and industrial customers of any size.

2.2.2 Program Highlights

- This program began on July 1, 2011 and has continued through the 2021 Program Year.
- The program targets AOG's larger customers, ensuring comprehensiveness of the CEE Plan.
- The program is managed by AOG and is implemented by CLEAResult.
- The program captured net energy savings of 174,241 therms in 2021.
- The program is cost beneficial as evidenced by a Total Resource Cost Ratio of 1.63.
- Satisfaction with the program operation is very high. The program builds goodwill with both trade allies and customers.

2.2.3 Program Budget, Savings, and Participants

Commercial/Industrial												
	Expenditures			Energy Savings (Therms)			Demand Savings (Therms)			Participants		
Program	Budget	Actual	%	Plan	Evaluated	%	Plan	Evaluated	%	Plan	Actual	%
Program Year 2019	$ 424,435	$ 419,003	99%	194,360	220,683	114%	n/a	n/a	-	1,855	3,548	191%
Program Year 2020	$ 415,881	$ 395,147	95%	161,132	162,821	101%	n/a	n/a	-	1,484	1,741	117%
Program Year 2021	**$ 428,492**	**$ 399,356**	**93%**	**160,923**	**174,241**	**108%**	**n/a**	**n/a**	**-**	**1,424**	**1,001**	**70%**



2.2.4 Description of Participants

The CIS Program is offered to all AOG commercial and industrial customers.

2.2.5 Challenges and Opportunities

Per ADM's recommendations, AOG will continue to explore opportunities to expand upon the success in building optimization projects through further coordination with OG&E.

2.2.6 Planned or Proposed Changes to Program and Budget

AOG has no planned changes to its programs or budgets at this time.

2.3 Equipment Rebate Program

2.3.1 Program Description

The Equipment Rebate Program is designed to encourage the installation of high-efficiency natural gas heating and water heating equipment as well as smart thermostats. The program targets residential and commercial customers in both new and existing homes and businesses. AOG offers a financial incentive in the form of a cash rebate to customers who purchase and install qualifying equipment.

AOG relies heavily on trade allies to assist in promoting the ERP to participants. AOG recognizes that HVAC and plumbing contractors play a significant role in helping many customers select their heating and water heating equipment, both in new construction and equipment replacements. To acknowledge this important role, and further promote the use of high-efficiency natural gas heating equipment, AOG also offers an incentive to installers of qualifying equipment.

To encourage the installation of high-efficiency natural gas heating equipment, the following tiered rebates/incentives were offered:

Equipment	Efficiency	Customer Rebate	Trade Ally Incentive
Natural Gas Furnace	90-94.9% AFUE[1]	$300	$50
	95% or higher AFUE[1]	$500	$50
Natural Gas Water Heaters	0.90 UEF[2] or higher	$500	$50
Smart Thermostats	ENERGY STAR-certified	$100	-

[1] Annual Fuel Utilization Efficiency, [2] Uniform Energy Factor

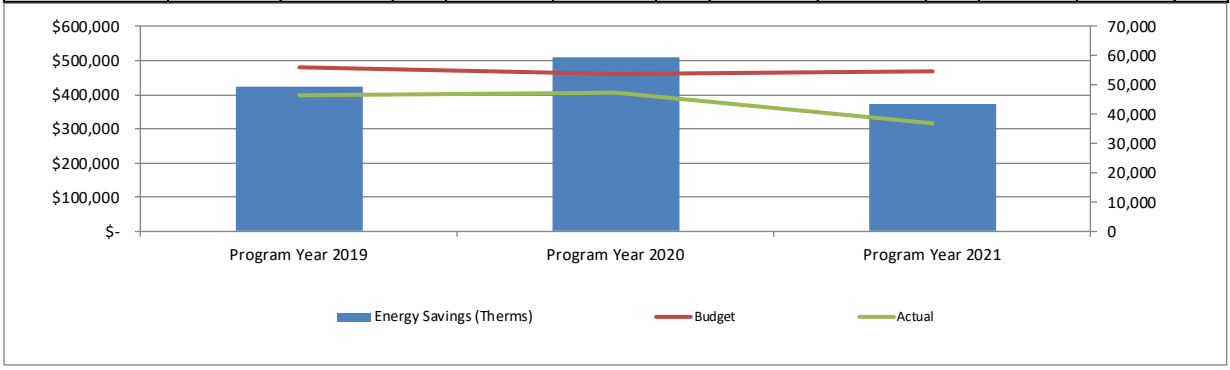
2.3.2 Program Highlights

- This program began in 2010 and has continued through the 2021 Program Year.
- This program was implemented by AOG, with the assistance of local trade allies.
- The ERP captured net energy savings of 43,551 therms in 2021.
- The program is cost beneficial as evidenced by a Total Resource Cost Ratio of 1.17.
- Customer satisfaction with the program is very high. This includes interactions with AOG employees, rebate processing times, savings realized from program participation, and ease of the application process.
- AOG expanded smart thermostat eligibility from Nest and Ecobee models to include all ENERGY STAR-certified smart thermostats. While this expansion allowed customers to choose lower cost options and receive the same energy savings benefits, it also increased trade ally satisfaction by allowing them to sell packaged units of furnaces and smart thermostats that may not have been previously incentivized.

2.3.3 Program Budget, Savings, and Participants

Equipment Rebate

	Expenditures			Energy Savings (Therms)			Demand Savings (Therms)			Participants		
Program	Budget	Actual	%	Plan	Evaluated	%	Plan	Evaluated	%	Plan	Actual	%
Program Year 2019	$ 481,948	$ 397,456	82%	92,439	49,446	53%	n/a	n/a	-	829	796	96%
Program Year 2020	$ 460,479	$ 407,599	89%	66,482	59,606	90%	n/a	n/a	-	969	824	85%
Program Year 2021	**$ 466,605**	**$ 316,438**	**68%**	**70,304**	**43,551**	**62%**	**n/a**	**n/a**	**-**	**1,004**	**678**	**68%**



2.3.4 Description of Participants

The ERP is offered to all AOG residential and small commercial natural gas heating and water heating customers for both new construction and existing homes and businesses.

2.3.5 Challenges and Opportunities

Per ADM's recommendations, AOG will review limiting participation in commercial water heating to cost-effective facility types for the 2024 – 2026 program planning cycle. Historically, AOG has chosen to forgo limiting participation to remain comprehensive to all customers and facility types, however, the company may choose to review this as cost-effectiveness of the Equipment Rebate Program continues to decrease.

As AOG receives a large amount of early retirement water heaters through the ERP, the Company would be willing to collaborate in a process with the PWC to develop savings specific to this measure.

AOG has already begun developing a bulk-order rebate form in conjunction with CLEAResult, AOG's future rebate processing services provider (see 2.3.6).

2.3.6 Planned or Proposed Changes to Program and Budget

Beginning in October 2022, AOG will begin employing CLEAResult for rebate processing services. This decision was made upon the Company's acquisition of the Arkansas and Oklahoma assets of CenterPoint Energy. Naturally, this resulted in a large increase in the number of rebates received. By retaining CLEAResult as the processor for rebates, internal program staff will have the bandwidth to focus on other key aspects of program implementation including engaging new trade allies and customers to participate.

2.4 Energy Efficiency Arkansas

2.4.1 Program Description

The Energy Efficiency Arkansas program provides energy efficiency education and information to all customers, of all classes. This allows customers to make more informed decisions on how they are using energy and explore ways to lower their energy consumption, thereby decreasing demand and energy usage.

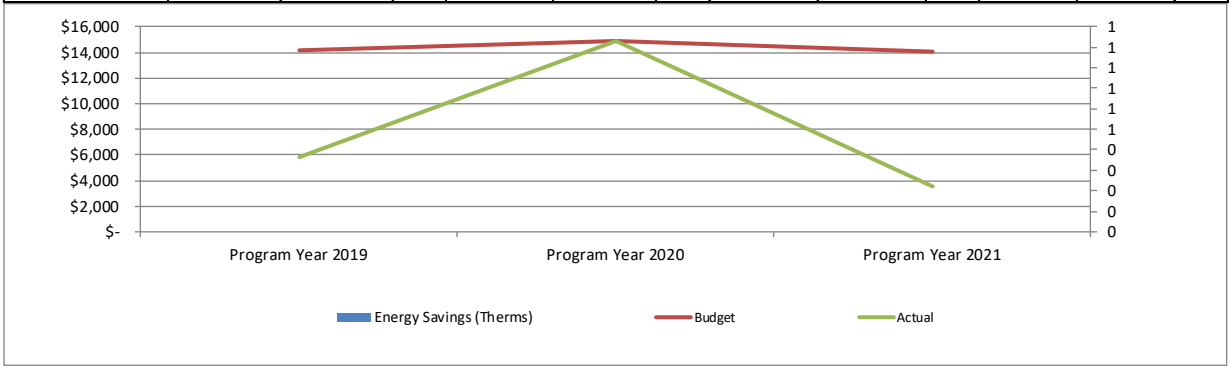
2.4.2 Program Highlights

- AOG's participation in this program was approved on March 31, 2010 and has continued through 2022.
- As the program administrator, the Arkansas Energy Office was able to accomplish a successful EE education campaign, utilizing funds from the participating utilities.

2.4.3 Program Budget, Savings, and Participants

EEA

	Expenditures			Energy Savings (Therms)			Demand Savings (Therms)			Participants		
Program	Budget	Actual	%	Plan	Evaluated	%	Plan	Evaluated	%	Plan	Actual	%
Program Year 2019	$ 14,169	$ 5,796	41%	0	0	-	n/a	n/a	-	0	0	-
Program Year 2020	$ 14,914	$ 14,914	100%	0	0	-	n/a	n/a	-	0	0	-
Program Year 2021	**$ 14,021**	**$ 3,505**	**25%**	**0**	**0**	**-**	**n/a**	**n/a**	**-**	**0**	**0**	**-**



2.4.4 Description of Participants

The Energy Efficiency Arkansas program targets all utility customers in Arkansas.

2.4.5 Challenges and Opportunities

The challenges and opportunities of the Energy Efficiency Arkansas program are better addressed by the Arkansas Energy Office.

2.4.6 Planned or Proposed Changes to Program and Budget

Any planned changes to the program or budget are better addressed by the Arkansas Energy Office.

2.5 Low-Income Pilot Program

2.5.1 Program Description

The Low-Income Pilot Program is a comprehensive long-term energy efficiency program targeting severely energy-inefficient homes for customers who meet the income eligibility requirements of the Low Income Home Energy Assistance Program (LIHEAP) to improve comfort and reduce energy costs by upgrading the thermal envelope and installing water conservation measures in qualified homes at no cost to the participants.

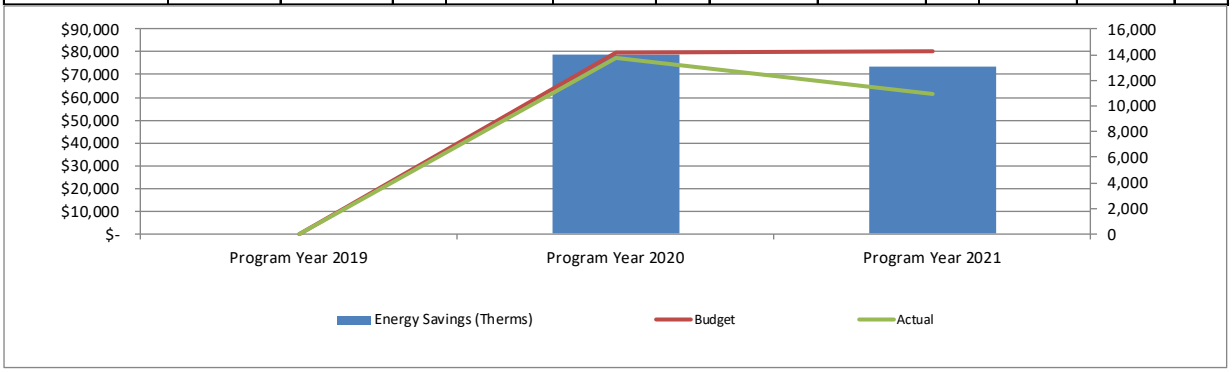
2.5.2 Program Highlights

- The program was developed to be compliant with Act 1102 of the 91st Arkansas General Assembly.
- This program began on January 1, 2020.
- The program was implemented by CLEAResult.
- LIPP is very successful. In 2021, the program weatherized 48 homes and captured net energy savings of 13,102 therms.
- The program is cost beneficial as evidenced by a Total Resource Cost Ratio of 2.09.
- The program is popular and requires a minimal marketing budget.
- 2021 was the first Program Year in which the LIPP was implemented by CLEAResult. As CLEAResult also implemented the AOGWP, many of the benefits realized in that program were also garnered within the LIPP. A notable improvement is the increase in average savings per home in respective measure categories. Duct sealing savings, air sealing savings and ceiling insulation savings increased by 154%, 35% and 152% respectively.

2.5.3 Program Budget, Savings, and Participants

Low Income Pilot Program

	Expenditures			Energy Savings (Therms)			Demand Savings (Therms)			Participants		
Program	Budget	Actual	%	Plan	Evaluated	%	Plan	Evaluated	%	Plan	Actual	%
Program Year 2019	$ -	$ -	-	0	0	-	n/a	n/a	-	0	0	-
Program Year 2020	$ 79,689	$ 77,255	97%	10,088	13,951	138%	n/a	n/a	-	35	48	137%
Program Year 2021	**$ 80,003**	**$ 61,679**	**77%**	**10,088**	**13,102**	**130%**	**n/a**	**n/a**	**-**	**35**	**48**	**137%**



2.5.4 Description of Participants

Participants of the LIPP include homeowners or leaseholders of a single-family home, duplex, or manufactured home constructed prior to 2011 or have monthly usage (as shown on the bill) of five centers per square foot or higher. The eligible dwelling must have been occupied for the previous 12 months and not received weatherization services through a utility weatherization program in the past five years. Additionally, an eligible customer must meet the income eligibility requirements of LIHEAP.

LIHEAP Annual Household Income Eligibility Requirements

Household Size	Maximum Income Level (Per Year)
1	$17,820
2	$24,030
3	$30,240
4	$36,450
5	$42,660
6	$48,870
7	$55,095
8	$61,335

2.5.5 Challenges and Opportunities

AOG will consider increasing funding for LIPP per ADM's recommendation. However, it is important to recognize the high prevalence of Act 1102-eligible customers in AOG's service territory. ADM's 2019 evaluation of AOG found that 35% of survey respondents have a household member at least 65 years of age and that 15% of survey respondents had household income lower than 150% of the federal poverty line. In total, 40% of survey respondents were eligible for Act 1102 programs under at least one criterion. While these customers still qualify for the AOGWP and will receive many of the same services they would have in the LIPP, AOG understands the key difference is the Health & Safety spending. AOG will investigate how to best serve this community while planning the budget for the 2024 – 2026 program cycle.

The LIPP currently provides appliance combustion safety testing, however, AOG will separate this cost from the overall assessment cost and assign the Health & Safety label in the future. Furthermore, AOG understands the gravity of Health & Safety investments in LIHEAP-qualified households. AOG did not devote enough actual spending to Health & Safety or conduct enough installations and the program team seeks to remedy this issue as soon as possible. In conjunction with CLEAResult, AOG is investigating the installation of air purifiers and additional bathroom ventilation to be completed in homes as soon as

possible in PY 2022. The program team will further investigate innovative Health & Safety measures to further the ensure the well-being of our customers and the security of their homes.

Additionally, AOG will ensure that all requested tracking fields for LIPP projects are provided as well as correct calculation issues for ceiling insulation in project tracking.

2.5.6 Planned or Proposed Changes to Program and Budget

There are no planned changes to the program or budget at this time other than the investigation of increasing goals.

3.0 Supplemental Requirements

3.1 Staffing

The current CEE Program includes two employees with regulatory, implementation, engineering, financial, and energy efficiency expertise to plan, implement, and assist in the evaluation of the individual programs in the CEE Plan. These employees also supervise the contractors who work with AOG to deliver and evaluate the EE programs. Additionally, there are several other employees who are involved in AOG's EE efforts. These efforts include contributions to program development, marketing, engineering, regulatory compliance, education, training, delivery, and evaluation on an as-needed basis.

3.2 Stakeholder Activities

AOG personnel attended and provided numerous training and outreach events throughout the 2020 Program Year. AOG personnel attended several seminars covering energy efficiency topics and also conducted training sessions both internally and externally. Training was implemented to educate AOG personnel about the EE programs, and external training was provided to EE program participants, trade allies, and stakeholders to raise awareness and ensure that program procedures are followed. Due to continued COVID-19 protocols, many of the recurring events AOG participates in were cancelled.

AOG personnel attended several seminars covering energy efficiency-related topics. These trainings were provided by Arkansas Gas Association, Southern Gas Association, Ionix Gas Technologies, and Energy Solutions Center. AOG also participated in trainings conducted by CLEAResult, the implementer for both AOGWP and LIPP, designed to instruct trade allies in program procedures and ensure quality performance.

Internal Training

Event No.	Start Date	Class	Class Description	Training Location	Sponsor	No. of Attendees (A)	Length of Session (B)	Training Session Man-Hours (A x B)	Any Certificates Awarded? (Y or N)	# of Certificates Awarded
1.	2/23/21	Energy Solutions Center Webathon	Various Utility Industry Topics discussed including COVID-19 Impacts, RNG Production, Biogas, Humidity Control, Customer Ratings Boost	Virtual	Energy Solutions Center	1	6	6	N	0
2.	3/2/21	Natural Gas Champions	Navigating a Constructive Conversation on Natural Gas	Virtual	SGA	1	4	4	Y	1
3.	4/13/21	What LDCS Need to Know About Upcoming Methane Emissions Guidelines	What LDCS Need to Know About Upcoming Methane Emissions Guidelines	Virtual	Ionix Gas Technologies	1	1	1	N	0
4.	7/6/21	Hydrogen 101	An high-level introduction to hydrogen and it's current and future uses.	Virtual	Energy Solutions Center & AGA	1	1	1	N	0
5.								0	N	0
Totals:	**Events:**					**4**		**12**		**1**

External Training

Event No.	Start Date	Class	Class Description	Training Location	Sponsor	*No. of Attendees (A)	Length of Session (B)	Training Session Man-Hours (A x B)	Any Certificates Awarded? (Y or N)	# of Certificates Awarded
1.	2/2/21	Weatherization Contractor Kick-Off	Discuss CLEAResult Protocols	Virtual	CLEAResult	6	1	6	N	0
2.	4/9/21	Greater Fort Smith Assc. Of Homebuilders Home Show 2021	Set up booth at Home Show to provide customers information regarding all AOG programs (Customer Development, EE, Billing)	Fort Smith	Greater Fort Smith Assc. Of Homebuilders	3	24	72	N	0
Totals:	**Events:**	**2**				**9**		**78**		**0**

*There were numerous attendees present at each conference, trade show, and outreach event. The values in the *No. of Attendees* column reflects

3.3 Information Provided to Consumers to Promote EE

AOG believes a successful marketing strategy is critical to the overall success of the CEE Plan, so AOG takes pride in delivering effective marketing to AOG customers and EE program participants. AOG's marketing efforts are driven through multiple channels, including both customer-direct outreach and marketing through contractors and other trade allies. AOG utilizes a mixture of print, web (including social media), radio, and word-of-mouth advertising.

AOG values the practice of continuous improvement, particularly with regard to the marketing of EE programs. AOG seeks a prudent balance of advertising efforts to maintain EE program participation and net energy savings results without stimulating program oversubscription. Maintaining this balance contributes to the success of the CEE Plan and ensures judicious use of ratepayers' money.

4.0 Appendix A: EM&V Contractor Reports

EVALUATION, MEASUREMENT AND VERIFICATION REPORT FOR THE 2021 ARKANSAS ENERGY EFFICIENCY PORTFOLIO

SUBMITTED TO: ARKANSAS OKLAHOMA GAS, A DIVISION OF SUMMIT UTILITIES

SUBMITTED ON: APRIL 13, 2022

SUBMITTED BY: ADM ASSOCIATES, INC.

SUBMITTED TO: ARKANSAS OKLAHOMA GAS, A DIVISION OF SUMMIT UTILITIES

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Arkansas Oklahoma Gas

aog
ENERGY FOR LIFE

Acknowledgements

We would like to thank the staff at Arkansas Oklahoma Gas (AOG) for their time and effort in contributing to the evaluation, measurement and verification (EM&V) of the program year 2020 (PY2021) portfolio. This evaluation was conducted with regular coordination with staff at AOG, 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 AOG customers, implementation contractor staff, and trade allies. As with the staff at AOG, 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 (IEM) for their involvement in providing thorough answers and clarification to the evaluation team when higher-level questions arose over the course of the PY2021 EM&V effort.

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1. Executive Summary

In June 2019, the Arkansas Public Service Commission (APSC) approved the Arkansas Oklahoma Gas (AOG, a Division of Summit Utilities) three-year energy efficiency Plan (the Plan), covering program years 2020-2022, filed in compliance with Order No. 43 of Docket No. 13-002-UF, which required investor-owned utilities in Arkansas to capture energy savings equivalent to 0.50% of their 2018 energy sales. As in previous APSC rulings, the Arkansas utilities retain flexibility to make up to 10% adjustments to program budgets and may adjust energy savings and demand reduction goals as appropriate within the modified budgets. Thus, AOG's 2020 budgets and energy savings goals, reflecting allowable adjustments as described above, serve as the basis against which its portfolio of programs was evaluated in 2021.

AOG's Plan includes a portfolio of energy efficiency programs designed to facilitate energy savings in every customer class. AOG services approximately 45,000 customers in Arkansas. AOG's service area encompasses the City of Fort Smith and several nearby municipalities.

In accordance with APSC Rules for Conservation and Energy Efficiency Programs (C&EE Rules), AOG engaged ADM Associates, Inc. (ADM) to conduct an evaluation, measurement, and verification (EM&V) of its portfolio. The ADM staff, collectively referred to as the Evaluators, evaluated the AOG portfolio.

1.1 Summary of AOG Energy Efficiency Programs

In PY2021, the AOG EE portfolio contained the following programs:

- Equipment Rebates Program;
- Commercial & Industrial (C&I) Solutions Program;
- AOG Weatherization Program; and
- Low Income Pilot Program.

AOG designed its programs to achieve the following objectives:

- Net savings of 457,858 Therms in PY2021;
- Significant energy-saving opportunities for all customers and market segments;
- Broad ratepayer benefits; and
- Comprehensiveness in seven areas (comprehensiveness factors) defined by the APSC.[1]

The Evaluators evaluated the results for PY2021 for two residential programs, one C&I program, and one jointly residential and C&I program. The Equipment Rebates Program (ERP), the

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

Commercial & Industrial Solutions Program (C&I Solutions) and the AOG Weatherization (AOGWP) Program[2] were all existing programs at the onset of PY2021.

Table 1-1: AOG PY2021 Energy Efficiency Portfolio Overview

Program	Channel	Sector
Equipment Rebates	Space Heating Equipment	All
	Water Heating Equipment	All
	Smart Thermostat	Residential
C&I Solutions	Custom	Commercial and Industrial
	Prescriptive	Commercial and Industrial
	Direct Install	Commercial and Industrial
AOG Weatherization	N/A	Residential
Low Income Pilot Program	N/A	Residential

Through its energy efficiency portfolio, AOG also 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. Refer to Table 1-2 for a list of the AOG programs and targeted customer segments.

Table 1-2: AOG PY2021 Energy Efficiency Portfolio Sectors Serviced

Channel	Single Family	Multifamily	Small Business	Large C&I	Municipal	Agricultural
Equipment Rebates	✓	✓	✓	✓	✓	✓
C&I Solutions			✓	✓	✓	✓
AOG Weatherization	✓	✓				
Low Income Pilot	✓	✓				

1.2 Evaluation Goals

The goals of the PY2021 EM&V effort are as follows:

- **For prescriptive measures,** verify that savings are being calculated according to appropriate TRM guidelines. For most measures, this constitutes applying TRM V8.2 methodologies.

[2] The AOGWP is AOG's implementation of the Consistent Weatherization Approach (CWA)

- **For custom measures,** this effort comprises the calculation of savings according to accepted protocols (such as IPMVP). This is to ensure that custom measures are cost-effective and providing reliable savings.
- **Conduct full process evaluations of AOG programs.** Full process evaluations were completed in PY2021 for the Equipment Rebates program, AOGWP, and LIPP.
- **Conduct net-to-gross assessments.** The Evaluators conducted NTG evaluation for Commercial and Industrial Solutions projects in PY2021.

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	
Equipment Rebates	53,779	53,779	789,899	789,899	100.0%
C&I Solutions	179,354	179,491	2,288,034	2,289,673	100.1%
AOG Weatherization	259,161	243,669	4,320,716	4,104,136	94.0%
Low Income Pilot	12,948	13,102	214,955	214,879	101.2%
Total	**505,242**	**490,041**	**7,613,604**	**7,398,587**	**97.0%**

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		
Equipment Rebates	43,556	43,551	651,342	651,267	81.0%	100.0%
C&I Solutions	174,135	174,241	2,230,284	2,231,549	97.1%	100.1%
AOG Weatherization	243,220	227,257	4,320,716	3,828,896	93.3%	93.4%
Low Income Pilot	12,948	13,102	214,955	214,879	100.0%	101.2%
Total	**473,859**	**458,151**	**7,417,297**	**6,926,591**	**93.5%**	**96.7%**

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

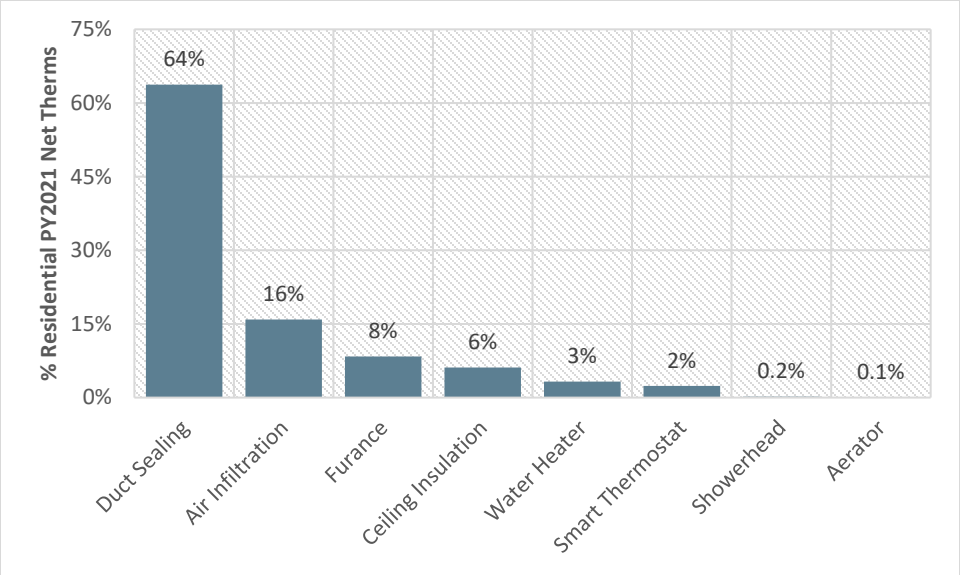


Figure 1-1: Savings Share by Measure – Residential

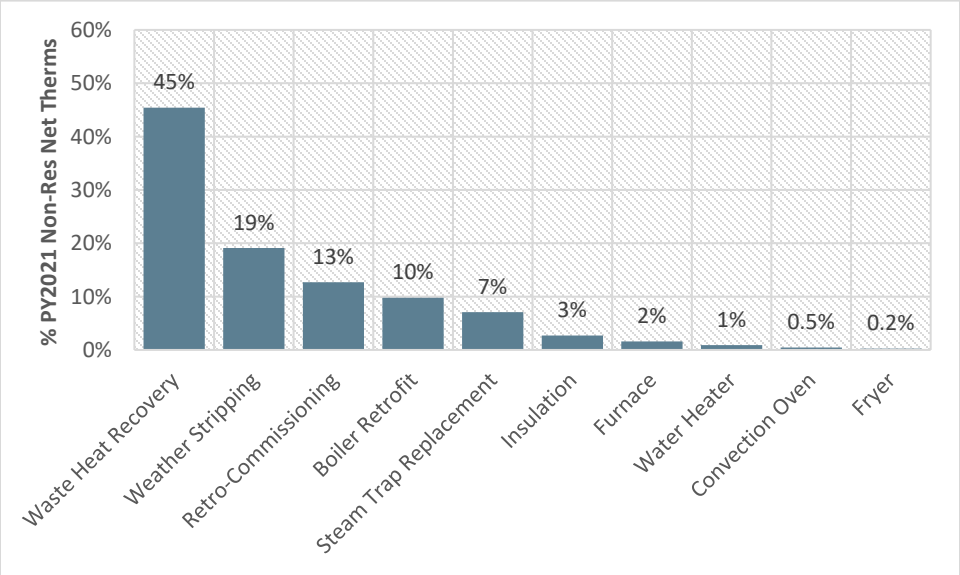


Figure 1-2: Savings Share by Measure – C&I

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

Residential:

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

Non-residential:

- Waste heat recovery;
- Weather stripping;
- Retro-commissioning;
- Boiler replacement; and
- Steam trap replacement.

Further, the Evaluators put the net savings into the context of AOG's PY2021 goal. Table 1-5 summarizes the performance against goals of programs evaluated in this report.

Table 1-5: AOG PY2021 EE Portfolio Performance Against Goals

Program	2021 Ex Post Net Therms	2021 Net Therms Goal	% of Goal Attained
Equipment Rebates	43,551	70,304	65.5%
C&I Solutions	174,241	160,923	108.1%
AOG Weatherization	227,257	216,543	104.9%
Low Income Pilot	13,102	10,088	129.9%
Total	**458,151**	**457,858**	**100.1%**

A summary of percent of budget spent and percent of goal reached is provided in Figure 1-3. The Overall value also includes expenditures for regulatory and PWC proceedings.

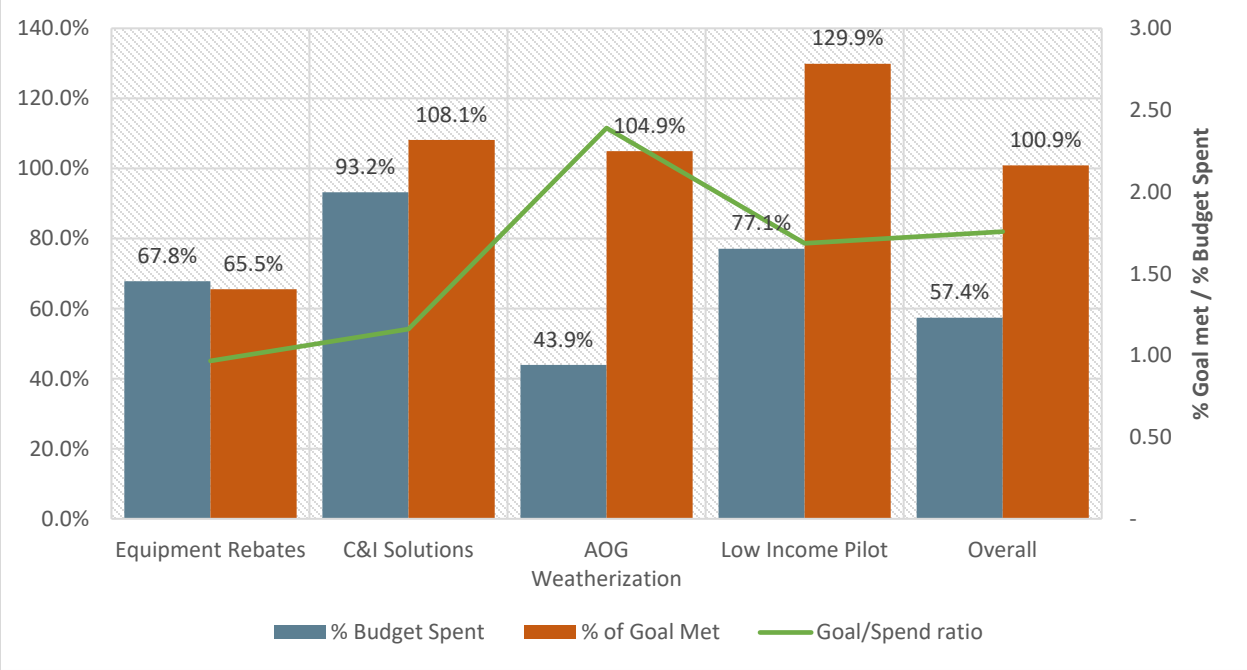


Figure 1-3: Summary of Budget Spend & Goals Attainment

The portfolio overall exceeded goals by .9%. The AOGWP and LIPP were particularly successful. The Equipment Rebates Program fell short of its goal, meeting 65.5% while spending 67.8% of the program budget.

Non-energy benefits (NEBs) attained by the AOG portfolio in PY2021 are detailed in the tables to follow.

Table 1-6: AOG PY2021 Ex Post Electric Savings

Program	Measure	Net Annual kWh	Net Peak kW	Lifetime Net kWh
Equipment Rebates	Smart Thermostats	80,636	0	886,996
C&I Solutions	Door Sweeps	470	.34	5,169
AOG Weatherization	Air Infiltration	25,451	19.05	279,965
	Ceiling Insulation	27,843	16.90	556,850
	Duct Sealing	265,516	133.11	4,779,284
	LEDs	5,420	.68	102,981
Low Income Pilot	Air Infiltration	2,480	0.85	27,276
	Ceiling Insulation	894	.57	17,872
	Duct Sealing	14,046	10.14	252,834
	LEDs	89	.01	1,690
Total		**422,844**	**182.65**	**6,910,916**

Table 1-7: AOG PY2021 Ex Post Water Savings (Gallons)

Program	Measure	Net Annual Water	Net Lifetime Water
AOG Weatherization	Aerator / Showerhead	165,548	1,655,483
Low Income Pilot	Aerator / Showerhead	11,787	117,870
Total		**177,335**	**1,773,353**

Table 1-8: AOG PY2021 Deferred and Avoided Replacement Cost

Program	Measure	Net ARC/DRC per Unit	Total ARC/DRC
Equipment Rebates	Res Furnace Early Retirement	$821.74	$101,073.94
	Res Tankless WH	$307.05	$56,421.78
	C&I Tankless WH	$109.09	$2,962.25
AOG Weatherization	LEDs	$3.40	$775.20
Low Income Pilot	LEDs	$4.53	$13.60
Total			**$161,246.77**

1.7 Process Findings

Following a review of present program offerings and interviews with utility and third-party implementation staff, the Evaluators found that:

- The programs are adequately staffed. AOG has allocated sufficient resources to successfully promote and implement their program offerings.
- There is increased coordination between AOG and overlapping electric utilities on large C&I custom projects, with jointly-rebated projects between AOG and OG&E.
- Program staff at AOG and CLEAResult actively responded to PY2020 program recommendations, adopting most of the recommendations made by the Evaluators.

1.7.1.1 Equipment Rebates

Price variation is increasing for smart thermostats as more brands enter the market	In prior program years, participation was limited to Nest and ecobee models, and the inter-quartile range of rebates (25% and 75% percentile markers) was {$166.71, $249}. In PY2021, there were rebates paid for systems from Honeywell, Emerson Sensi, Amazon Smart, Zen, and Trane thermostats, and the interquartile range is now {$130, $249}, reflecting increased lower cost options.
Acquisition cost of savings varies by thermostat brand	The Evaluators found that two of the new brands seen in the program (Zen, Trane) had savings acquisition costs per square foot that were 95% higher than average and over 10 times the average (respectively).
Decreased participation and savings	Net savings decreased by 26.9% compared to PY2020

1.7.1.2 C&I Solutions

The program met savings goals and was highly cost-effective	The program met 108% of its net savings goal while spending 93% of its program budget
	The program TRC has decreased from 1.79 to 1.57.
Custom project EUL increased significantly	Custom project EUL was 7.53 in PY2020 and increased to 13.26 in PY2021. If EUL had been the same as observed in PY2020, TRC would have dropped from 1.57 to .99.
Continued successful coordination with OG&E	16% of custom channel savings were from dual-fuel projects jointly incented with OG&E.
PY2021 savings were heavily focused on projects with long M&V periods	70% of PY2021 program-level net savings are from partial savings claims for projects that have been installed but are still under M&V. This is atypical and an unexpected result but was necessary to service customers that wished to engage with the program while maintaining cost-effectiveness on an annual basis.
NEBs have declined significantly	There were no water NEBs in PY2021. The direct install channel focused entirely on weather stripping, and the custom and prescriptive channels did not have water-saving projects (such as steam leak repair, condensate return, or combi ovens). As with the matter of projects with partial savings claims, this is largely happenstance – with the small size of AOG's service territory, the occurrence of water-saving projects is not a guarantee.
Custom project incremental costs required significant adjustments	The Evaluators reduced custom project incremental costs by 92%, after accounting for: 1) Cost duplication across line items 2) Cost-splitting between AOG and OG&E 3) Cost-splitting to account for partial savings claims

1.7.1.3 AOG Weatherization

Changes in program administration resulting from the hand-off from AOG internal implementation to third-party implementation by CLEAResult	The program met 105% of its net savings goal while spending 44% of its program budget.
	The program TRC has increased from 1.79 to 3.01.
	The three trade allies that had been in the program since inception were replaced with four new trade allies.
	The program migrated from per-measure payments to per-therm payments.
	The program migrated from year-round implementation to seasonal implementation with focused geographic pushes by trade allies.
	The program installed 2.45 measures at $685 per home, compared to 4.38 measures at $1,528 per home in PY2020.
Changes in tracking data from Frontier EnerTrek system to CLEAResult System	Program tracking data now presents an individual measure in each line item, with multiple rows of data per home. This simplifies the process for energy savings calculations in the evaluation
	Program tracking is missing low- and medium-importance data fields, including cooling system type, total home stories, and Act 1102 eligibility criteria.
	Program tracking is missing high-importance data fields, including overlapping electric utility, and participant email addresses.
Changes in measures & services after hand-off to CLEAResult	Savings per home increased from 266 to 329 therms per home.
	Program NTGR remains high, differing by <1% from PY2020 to PY2021.
	The percent of homes receiving each of the three core weatherization measures has declined – this includes duct sealing (18% decline), air sealing (37%), and ceiling insulation (80%).
	The percent of respondents “Very Satisfied” with the program overall declined from 91% to 70%.

1.7.1.4 Low Income Pilot

Changes in program administration resulting from the hand-off from AOG internal implementation to third-party implementation by CLEAResult	The program met 132% of its net savings goal while spending 77% of its program budget.
	The program TRC has increased from 1.97 to 2.09.
	The three trade allies that had served the program in PY2020 were replaced with four new trade allies
	The program migrated from per-measure payments to per-therm payments.
	The program migrated from year-round implementation to seasonal implementation with focused geographic pushes by trade allies.
	The program installed 1.67 measures at $623 per home, compared to 4.33 measures at $1,455 per home in PY2020
Changes in tracking data from Frontier EnerTrek system to CLEAResult System	Program tracking data now presents an individual measure in each line item, with multiple rows of data per home. This simplifies the process for energy savings calculations in the evaluation
	Program tracking is missing low- and medium-importance data fields, including cooling system type, total home stories, and basis for Act 1102 eligibility criteria
	The Evaluators found air sealing projects with blank savings entries, as well as errors in savings calculations for ceiling insulation with baseline R value > 4.
	Program tracking is missing high-importance data fields, including overlapping electric utility, electric rebate data, and participant email addresses
Changes in measures & services after hand-off to CLEAResult	Savings per home increased from 303 to 317 therms per home.
	Savings per-instance of each measure has increased: Duct Sealing: 154% Air Sealing: 35% Ceiling Insulation: 152%
	The percent of homes receiving each of the three core weatherization measures has declined – this includes duct sealing (29% decline), air sealing (29%), and ceiling insulation (89%)
Health & Safety Measure Delivery	The percent of respondents “Very Satisfied” with the program overall declined from 91% to 70%.

1.7.2 Response to PY2020 Recommendations

In the PY2020 evaluation, 11 program or portfolio level recommendations were provided to AOG. The Evaluators reviewed AOG's response to recommendations from the PY2020 EM&V report and categorized them as follows:

- **Adopted.** This applied to recommendations that pertained to the correction of an issue (such as using an incorrect baseline methodology) or modifications in program outreach that do not require a filing.
- **Under consideration.** This applies most typically to larger recommendations that would require APSC approval.
- **Rejected.** This applies to recommendations which are reviewed by AOG and rejected.
- **Not applicable.** This would apply to recommendations which are no longer applicable to the AOG portfolio (such as recommendations for a program that is subsequently cancelled).
- **Incomplete.** This applies to recommendations which were included in the PY2020 EM&V report but have either not yet been adopted or have been explicitly rejected by AOG.

The disposition of PY2020 recommendations is summarized in Figure 1-4.

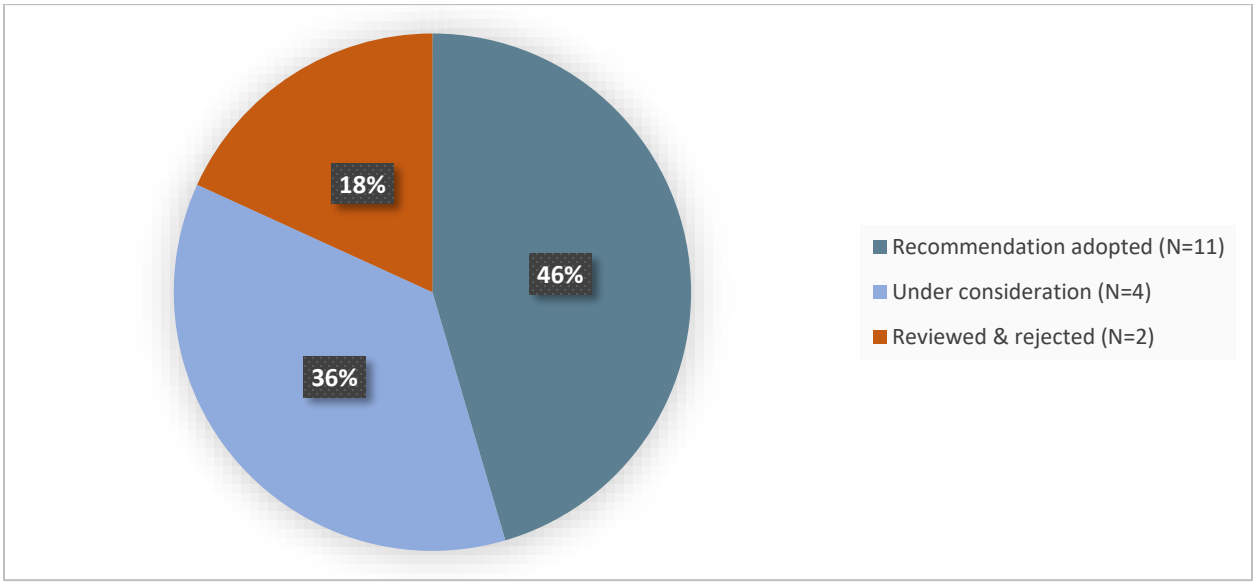


Figure 1-4: Status of PY2020 recommendations

1.8 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 presents general methodologies;
- Chapter 3 presents portfolio cross-cutting issues;
- Chapter 4 provides results for the Equipment Rebates Program;
- Chapter 5 provides results for the C&I Solutions Program;
- Chapter 6 provides results for the Weatherization Program;
- Chapter 7 provides results for the Low Income Pilot;
- Appendix A provides C&I Solutions custom site reports;
- Appendix B provides Deferred Replacement Cost (DRC) calculations; and
- Appendix C provides sample TRM calculations.

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 follow:[3]

- *Ex Ante* – Forecasted savings used for program and portfolio planning purposes (from the Latin for "beforehand")
- *Ex Post* – Savings estimates reported by an evaluator after the energy impact evaluation has been completed (from the Latin for "From something done afterward")
- *Deemed Savings* – An estimate of 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/purpose and (b) are 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 the Evaluators verify 15 therms per showerhead, Gross Realization Rate = 15/17.36 = 86%)
- *Free-rider* – A participant who *would have* implemented the program measure or practice in the absence of the program. Free-riders can be total, partial, or deferred.
- *Spillover* – Reductions in 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

[3] Arkansas TRM V8.2, Volume 1, Pg. 80-86

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 riders, spillover, 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
- *Deferred Replacement Cost (DRC)* = The present value of the benefit of shifting the replacement cycle in perpetuity subsequent to an early replacement.
- *Avoided Replacement Cost (ARC)* = The present value of the benefit of avoided purchases due to efficient equipment having a longer rated life than baseline equipment (such as residential tankless water heaters having an EUL of 20 years compared to a baseline storage tank EUL of 11 years).
- *Non-Energy Benefits (NEBS)* = Claimable TRC benefits other than natural gas savings. This includes kWh, kW, deferred replacement cost, avoided replacement cost, and water savings.

2.2 Overview of Methodology

The proposed methodology for the evaluation of the PY2021 AOG EE Portfolio is intended to provide:

- Net impact results at the 90% confidence and +/-10% precision 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.

2.4.1 Sampling

Sampling is necessary to evaluate savings for the AOG 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; and
- Stratified Random Sample.

2.4.1.1 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 the custom component of C&I Solutions.

2.4.1.2 Simple Random Sampling

For programs with relatively homogenous measures (largely in the residential portfolio), the Evaluators 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 of savings for program participants. Coefficient of Variation (CV) is defined as:

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

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 .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, the Evaluators 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.

2.4.1.3 Stratified Random Sampling

For the AOG C&I programs, 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 (i.e., a census of sites that are above a specified savings threshold) and take a random sample of the remaining sites. To further improve the precision, non-certainty (i.e., randomly selected sample rather than a census) 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.

2.4.2 Free-ridership

In determining ex post net savings for the AOG 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 V8.2 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.

2.4.2.1 Prescriptive 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 absent the rebate;

(2) Importance of the rebate in the decision-making process;

(3) Prior planning to purchase high-efficiency equipment; and

(4) Importance of the contractor in influencing the decision-making process.

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

[4] Arkansas TRM V8.2, Pg. 450.

program. This value is then applied to the program-level savings to discount savings attributable to free-ridership.

2.4.2.2 Custom Free-ridership

For custom projects from the C&I Solutions Program, 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 C&I Solutions chapter, the free-rider "case studies" are provided for every custom project.

2.4.3 Impact Evaluation Activities by Program

The Evaluators used established, industry-standard approaches to estimate energy savings and demand reductions at the measure, program, and portfolio levels. We followed all applicable measure- and program-level guidelines and protocols from the AR TRM V8.2.

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 calculations, 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 V8.2. Where sampling was used (for surveys and site visits), we designed a sampling plan to achieve a minimum precision of ±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: PY2021 Impact Evaluation Activities by Program

Program	Equipment Rebates	C&I Solutions	AOG Weatherization	Low Income Pilot
Database & Document Review	✓	✓	✓	✓
Engineering Desk Review		✓		
TRM Deemed Savings Review	✓	✓	✓	✓
On-site Verification / Metering		✓	✓	✓
Simulation Modeling		✓		
Billing Analysis		✓		

2.4.4 Net-to-Gross Approach by Program

For the PY2020 evaluation, the Evaluators conducted NTG research for most program offerings. 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 V8.2, Protocol F.

Table 2-2: PY2021 NTG Approaches by Program

Program	Assigned PY2020 Value	Literature Review	AOG-specific Survey
Equipment Rebates			
▪ Residential furnace retrofit	✓		
▪ Residential DHW retrofit	✓		
▪ Residential smart thermostats	✓		
▪ Housing authority furnace & DHW	✓		
▪ New construction – builders	✓		
▪ New construction – homeowner / custom	✓		
▪ Commercial furnace & DHW	✓		
C&I Solutions			
▪ Direct install	✓		
▪ Custom			✓
▪ Prescriptive boilers	✓		
▪ Prescriptive food service	✓		
AOG Weatherization			✓
Low Income Pilot		✓	

2.4.5 Process Evaluation

The Evaluator's 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 V8.2. In this review, the Evaluators determine what aspects of the program warrant a process evaluation (due to issues identified in the PY2020 evaluations). Most AOG programs over-performed, and as such most of the PY2021 process evaluation activity was focused around identifying AOG and implementer response to PY2020 recommendations. The Evaluators did address the program change for AOGWP and LIPP, which transitioned from AOG internal implementation to implementation by CLEAResult.

The PY2021 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 introduce portfolio-level issues. From this, 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 AOG program staff and third-party implementation staff. 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 PY2021 EM&V effort. Specifically, this chapter includes:

- A summary of program and portfolio performance in PY2021;
- A summary of EM&V activities and expenditures in PY2021; and
- High-level findings that cut across programs.

3.1 Summary of EM&V Effort

All programs have received at least one process evaluation and have continuously met or exceeded savings goals. Table 3-1 summarizes the data collection efforts for the PY2021 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
Equipment Rebates	0	72	3
C&I Solutions	0	4	3
AOG Weatherization	35	47	3
Low Income Pilot	8	10	3
Total	43	133	12

1 Tests of Portfolio Comprehensiveness

The Arkansas Public Service Commission 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 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 AOG programs and portfolio in order to assess whether it was in compliance 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.

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

3.4.1.1 Assessment of Education

The Evaluators assessed the educational components of the AOG 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:

- AOG'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.
- AOG 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

Program	*Provides Educational Materials*	*Outreach Through Multiple Channels*	*Education Targeted to Specific Market Barriers*	*Coordination of Education by Multiple Entities*
Equipment Rebates	●	●	●	●
C&I Solutions	●	●	●	●
AOG Weatherization	●	●	●	●
Low Income Pilot Program	●	●	●	●

3.4.1.2 Assessment of Training

The Evaluators reviewed each AOG program to assess:

1) Whether the program is trade ally-driven;
2) If not, is it a program that could or should be trade ally-driven;
3) The program provides training classes to support their program offerings; or
4) Whether the programs need trade ally certification.

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

Program	*Trade Ally Training Offered*	*Training Requirements Adhere to Best Practices*	*Trade Allies Participate in Training*
Equipment Rebates	●	●	●
C&I Solutions	●	●	●
AOG Weatherization	●	●	●
Low Income Pilot Program	●	●	●

AOG does not require trade ally registration to participate, except for in the AOG Weatherization Program and Low Income Pilot Program. Their approach has been to allow all licensed dealers or contractors to apply for the appropriate equipment rebates. The Evaluators have concluded that this has not to-date affected the quality assurance of the programs.

The Evaluators note that there was reduced installation of H&S measures as well as energy efficiency measures in PY2021 compared to PY2020. For energy-saving measures, this was in-part due to revisiting of prior homes that did not receive all measures (for example, prior to the roll out of the CWA, the AOGWP did not offer duct sealing). Nonetheless this should be monitored going forward to ensure that comprehensive measures are provided total eligible homes treated by the program. Regarding H&S measures for the LIPP, if the present package of measures are not needed due to the majority of participants having them in place (such as smoke alarms and carbon monoxide detectors), AOG and CLEAResult should consider

identifying other H&S measures for inclusion to address Act 1102 H&S goals (such as ventilation fans, gutter downspout repair, and other measures included in Act 1102 Pilots elsewhere in Arkansas).

3.4.1.3 Marketing & Outreach

The Evaluators reviewed the marketing and outreach strategies associated with each of the AOG 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 AOG's marketing and outreach is presented in Table 3-4.

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

Program	*Marketing Addresses Specific Barriers*	*Trade Allies Promote Program*	*Marketing Support Provided to Trade Allies*	*Marketing Performed Through Diverse Channels*
Equipment Rebates	●	●	●	●
C&I Solutions	●	●	●	●
AOG Weatherization	●	●	●	●
Low Income Pilot	N/A	N/A	N/A	N/A

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

- AOG programs have marketing materials that address specific barriers associated with the targeted segments or technologies.
- Trade ally involvement in the C&I Solutions Program has increased significantly. The program now allows for prescriptive rebates to be fully signed over to trade allies and their promotion of the program has increased.
- The AOG 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 Evaluators have at this time assigned a "Not Applicable" score for the LIPP. It is in pilot phase and as a result is not expected to have marketing and outreach at program-scale. The Evaluators note here that the program was oversubscribed and exceeded its savings goal.

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

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

- Self-reports from program management staff;
- Cost per therm saved; and
- Review of trade ally resources dedicated to program promotion.

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

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*
Equipment Rebates	●	◒	●	●
C&I Solutions	●	●	●	●
AOG Weatherization	●	●	●	●
Low Income Pilot	●	●	●	●

From this review, the Evaluators concluded that the AOG portfolio overall has adequate budget and staff allocations. Aggregated across all programs, actual cost per therm is significantly lower than planned. As demonstrated in Figure 3-1, in PY2021 the AOG portfolio had an acquisition cost of $3.38, a significant decrease from $5.16 per net therm in PY2020. PY2021 acquisition costs were 43.3% lower than the program plan value of $5.96. At the individual program level, AOG Weatherization and the Low Income Pilot Program significantly outperformed relative to their planned acquisition cost. The Equipment Rebates Program is 9.5% above its program plan acquisition cost. Though this is higher than the acquisition cost in PY2020 (where acquisition costs were 1.3% lower than program plan), this a marked improvement over PY2019, during which the program had acquisition costs 54% higher than planned.

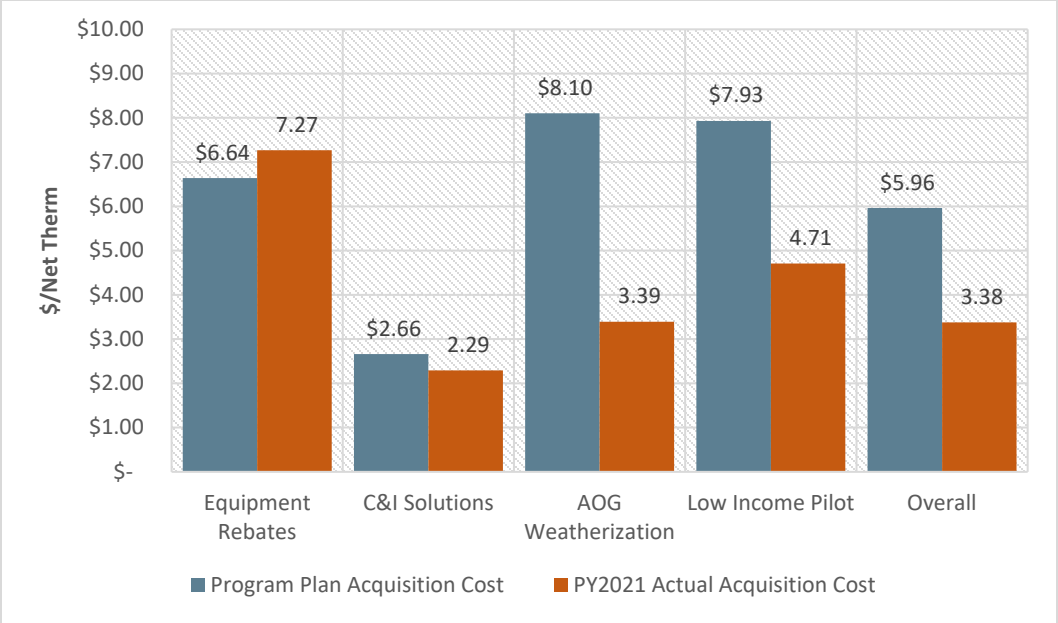


Figure 3-1: Comparison of Program Plan vs. Actual Acquisition Costs

3.4.3 Factor 3: Addressing Major End-Uses

The Evaluators identified the end-uses served by each of the AOG programs. Most AOG 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*
Equipment Rebates	●	●	NA	NA	NA	NA	NA
C&I Solutions	●	●	NA	●	●	●	NA
AOG Weatherization	●	●	NA	NA	NA	NA	NA
Low Income Pilot	●	●	NA	NA	NA	NA	NA

● Measure targeted ◒ Measure offered ○ Measure not offered

The portfolio has expanded its C&I offerings, introducing commercial and industrial retro-commissioning in the C&I Solutions Program.

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

- **Behavioral.** The AOG portfolio does not include any behavioral-based programs. However, this is likely not viable given the size of AOG's service territory. When examining the experiences of Black Hills Energy and CenterPoint Energy Arkansas, the Evaluators found that gas behavioral programs in Arkansas would require a recipient group of at least 25,000 households to reach cost-effectiveness. With the need of a

control group, a behavioral program would likely encompass the entirety of AOG's service territory. Behavioral marketing is likely best-driven through Energy Efficiency Arkansas (EEA) which receives funding from all Arkansas investor-owned utilities (IOUs).

- **Residential appliances.** The TRM V8.2 includes deemed savings for residential appliances, including dishwashers and clothes washers. These are not presently offered in any AOG 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 in order to be cost-effective.

Figure 3-2 summarizes the percent of projects that are single- versus multiple-measure installations by program. The Evaluators define "multiple measures" as follows:

- **Equipment Rebates:** Completing more than one of the following four categories:
  - Furnace
  - Water Heater
  - Smart Thermostat
- **C&I Solutions:** 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.
- **AOG Weatherization & LIPP:** Completing more than one of the energy-saving improvements as part of weatherization, excluding the Assessment incentive:
  - Duct Sealing
  - Air Sealing
  - Ceiling Insulation
  - Faucet Aerators
  - Showerheads

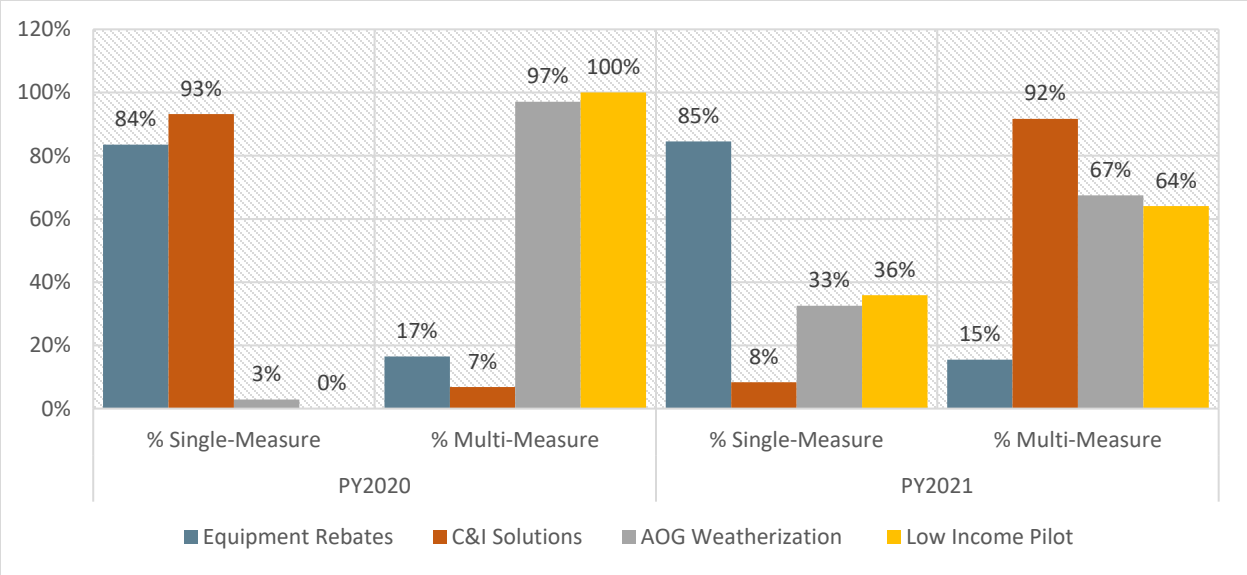


Figure 3-2: Installation of Multiple Measures

Equipment Rebates and C&I Solutions are largely similar in extent of multi-measure participation. AOGWP and LIPP both had a significant increase in single-measure participation:

- AOGWP: single-measure participation increased from 2.9% to 32.5%
- LIPP: single-measure participation increased from 0.0% to 35.9%.

In many instances, this increase in single-measure homes was due to revisiting past participants to provide duct sealing.

3.4.4 Factor 4: Comprehensively Addressing Customer Needs

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

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

The AOG 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. However, there is no specific encouragement in place to incentivize comprehensive projects, as seen elsewhere in Arkansas[5].

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

3-7: 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*
Equipment Rebates	N/A	◒	○	●	●
C&I Solutions	●	●	●	●	●
AOG Weatherization	●	●	NA	NA	NA
Low Income Pilot	●	●	NA	NA	NA

Findings from the assessment of this factor included:

- Most AOG prescriptive programs offer incentives to trade allies for installation of top-tier efficiency measures. This has included incentives for condensing furnaces, tankless water heaters, and cooking equipment.
- The AOG portfolio formerly offered tiered incentives for premium efficiency across all their rebate programs. In some cases, this tiering has been removed in lieu of only including premium efficiency. Examples include:
  - High-efficiency boiler incentives are $1,400/MMBtuh for units < 94% efficient and $2,000/MMBtuh for units with 94% efficiency or greater.
  - The C&I Solutions program pays an incentive per verified therm, and as a result projects with higher savings are by design paid a higher incentive.
  - The AOG Weatherization Program provides a fixed budget for home retrofits at no cost to the participant.
- The AOG portfolio has programs that bundle on-site technical assistance with direct installation.
- The Equipment Rebates Program does not fund customer audits; there is technical assistance via the licensed HVAC and plumbing contractors that participate in the

[5] For example, the CenterPoint Gas Equipment Rebates Program increases the incentive when a customer installs both a tankless water heater and 95 AFUE furnace.

program, but in a prescriptive HVAC/DHW equipment rebate program, program-funded audits and technical assistance are not warranted.

- The AOGWP and LIPP programs had a decline in project comprehensiveness in PY2021 compared to prior program years.
- The range of technical assistance varies by program. The Equipment Rebates program offers technical assistance through trade allies. C&I Solutions provides on-site technical assistance that is directly funded by the program.
- The programs have procedures for following up with customers after their participation, which includes thank-you calls or emails, and a verification inspection.
- Marketing materials typically make attempts at cross-promotion of programs.

3.4.5 Factor 5: Targeting Market Sectors & Leveraging Opportunities

The Evaluators reviewed whether the AOG 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 3-8: Assessment of Targeted Customer Sectors by Program

Program	**Residential**	**Multifamily**	**Manufactured Housing**	**Small Commercial**	**Large Commercial**	**Industrial**	**Agricultural**	**Public Sector**
Equipment Rebates	●	◒	◒	●	◒	◒	◒	●
C&I Solutions	NA	NA	NA	●	●	●	●	●
AOG Weatherization	●	◒	◒	NA	NA	NA	NA	NA
LIPP	●	◒	◒	NA	NA	NA	NA	NA

● Program targets this sector
◒ Sector is eligible for this program
NA 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:

- Agriculture and Industrial sectors are not specifically targeted by the Equipment Rebates program as the equipment used by these facilities generally requires custom calculations.

- Public Sector facilities are targeted with a wide range of programs. This has included residential programs that reach out to public housing authorities.
- Multifamily and manufactured housing are eligible for AOG programs, but the opportunity to engage these segments is limited as most of this housing stock within AOG's service territory has all-electric utility service.

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

Examples of cross-utility coordination included:

- The AOG AOGWP is jointly implemented with Oklahoma Gas & Electric (OG&E) with both utilities using CLEAResult to provide third-party implementation support and is a very successful example of cross-fuel coordination. The costs are split when a home is an AOG and OG&E customer and paid in full by AOG if they are served by another electric utility (such as a municipal or a rural co-op).
- AOG has brought on a third-party implementer (CLEAResult) for their C&I Solutions Program. This implementer uses similar program design and incentive levels for CenterPoint (CNP) and Black Hills Energy of Arkansas (BHEA). This has allowed for reduced program costs for C&I Solutions, which is the largest program in each of the three gas utility portfolios.
- AOG coordinates with OG&E and SWEPCO on joint custom projects that save both fuels.
- The Evaluators provide EM&V to AOG, CNP, and BHEA. This allows for sharing of fixed EM&V costs (such as development of data collection instruments) and more seamless comparison of program offerings and lessons learned across the natural gas energy efficiency portfolio. This has reduced the overall cost of EM&V across all three natural gas utilities.

Examples of coordination with non-utility partners included:

- AOG's programs are marketed through industry partners including professional organizations, trade groups, universities, and homeowners' associations.
- AOG's programs are prominently featured on the EEA website.

3.4.6 Factor 6: Cost-Effectiveness of Energy Efficiency

To assess this factor, the Evaluators reviewed whether:

- Programs met net savings goals;
- Whether the NTG ratios were in line with industry norms; and

- Whether programs passed cost-effectiveness (TRC) testing.

Table 3-9: Assessment of Cost-Effectiveness

Program	*NTGR*	*NTGR Within Industry Norms*	*Met Net Savings Goal*	*Program TRC*
Equipment Rebates	81.0%	Yes	No	1.17
C&I Solutions	97.1%	Yes	Yes	1.63
AOG Weatherization	93.4%	Yes	Yes	3.01
Low Income Pilot	100.0%	Yes	Yes	2.09

3.4.7 Factor 7: Adequacy of EM&V Procedures

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

- QA/QC and EM&V procedures by AOG program staff;
- QA/QC and EM&V procedures by third-party implementation staff (where applicable); and
- QA/QC and EM&V procedures by the Evaluators.

The EM&V of the AOG programs incorporated industry best practices and was conducted in an iterative process that incorporated feedback from AOG and implementation contractors as well as the IEM. The Evaluators developed EM&V plans that corresponded to protocols set out in the AR TRM V8.2.

AOG provided the Evaluators with full documentation of their QA/QC post inspection results.

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 V8.2 algorithms versus the use of simplifying assumptions[6]. The results of the review are summarized in Table 3-11.

[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.

Table 3-10: 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*
Equipment Rebates	●	●	●	●
AOG Weatherization	●	●	●	●
C&I Solutions	●	●	●	●
Low Income Pilot	●	●	●	●

3.5 Cost-Effectiveness Findings

3.5.1 Cost-Effectiveness Results

Table 3-12 summarizes the cost-effectiveness results by program.

Table 3-11: Cost-Effectiveness Summary

Program	TRC	UCT	RIM	PCT	TRC Net Benefits
Equipment Rebates	1.17	.83	.35	1.57	$72.151
C&I Solutions	1.63	2.20	.58	2.85	$410,492
AOG Weatherization	3.01	2.01	.46	N/A	$1,485,538
Low Income Pilot	2.09	1.42	.42	N/A	$66,987
EEA	.00	.00	.00	.00	($3,505)
Regulatory	.00	.00	.00	.00	($75,575)
Total	**2.00**	**1.1**	**.47**	**3.48**	**$1,955,599**

3.5.2 NEBs Summary

NEBs claimed by program are as follows:

- **Equipment Rebates:** avoided and deferred replacement costs, kWh, kW, and water[7];
- **C&I Solutions:** kWh[8], kW, and water;
- **AOGWP:** avoided replacement costs, kWh, kW, and water; and
- **LIPP:** avoided replacement costs, kWh, kW, and water.

[7] Actual water savings claim was 0 for this program in PY2020 due to there being no implementation of water conservation kits.

[8] kWh savings claim was 0 in PY2019 (PY2020?) due to all weather stripping projects having been installed in OG&E service area.

Table 3-12: Residential NEBs

Measure	Water	kWh / kW	ARC / DRC	AR TRM V8.2 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[9]	✓			2.3.5
LEDs		✓	✓	2.5.1

Table 3-13: Non-residential NEBs

Measure	Water	kWh / kW	ARC / DRC	AR TRM V8.2 Section
Weather stripping[10]		✓		3.2.11
Tankless water heater			✓	3.3.1
Faucet aerators	✓			3.3.2
Low-flow showerheads	✓			3.3.5
Pre-rinse spray valves	✓			3.8.11
Steam leak repair	✓			N/A - Custom

NEBs were a significant contributor to program benefits in PY2021, accounting for 19.9% of total TRC benefits across the portfolio (decreased from 24.8% found in PY2020). Figure 3-3 summarizes TRC benefits by benefit source by program.

[9] When AOG administers mailer kits, there are claimable kWh / kW due to customers with electric water heating receiving kits. In PY2020, all aerators and showerheads were installed through the AOG Weatherization Program so no cross-fuel savings occurred.

[10] kWh savings claim was 0 in PY2020 due to all weather stripping projects having been installed in OG&E service area.

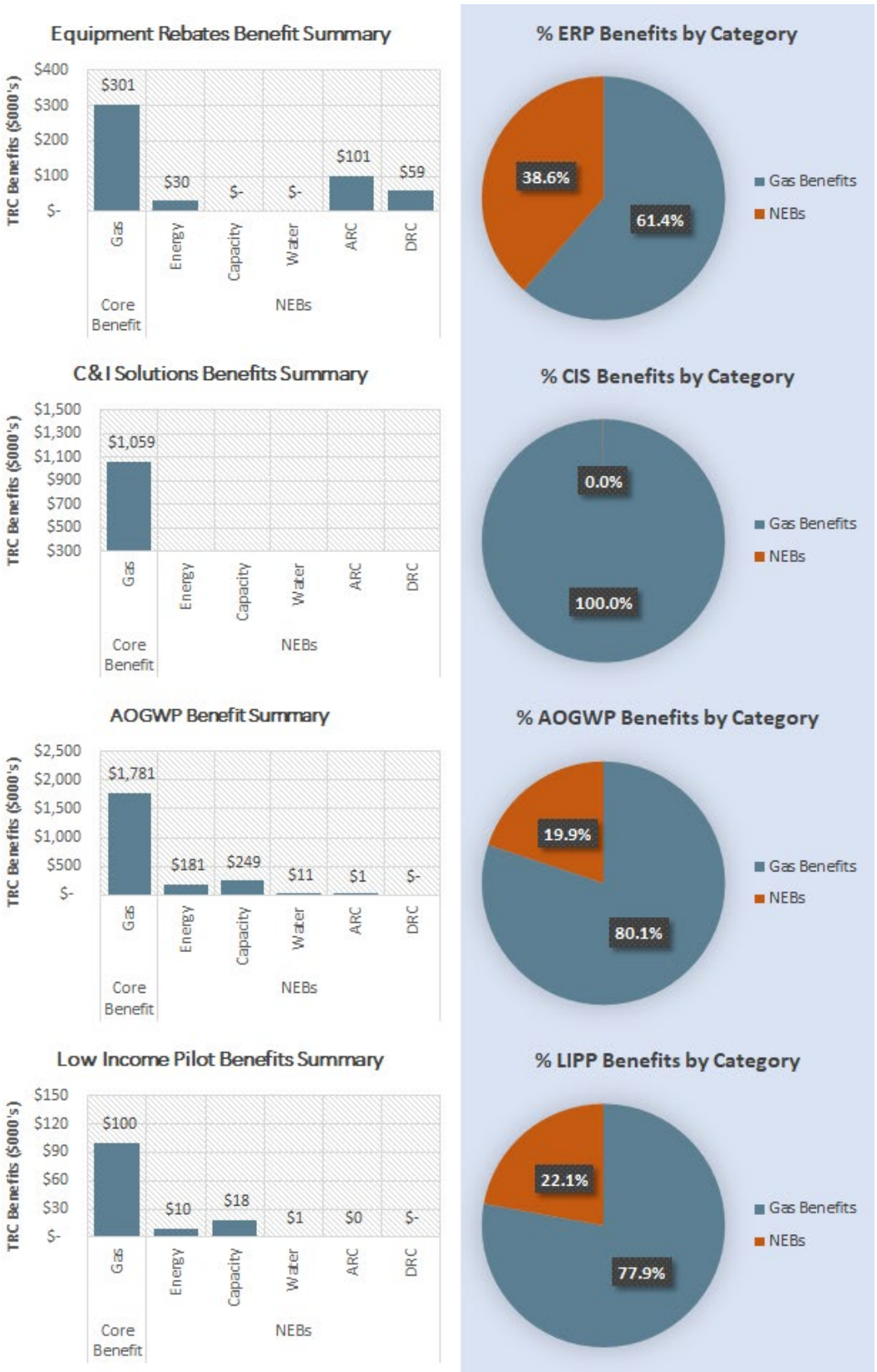


Figure 3-3: Benefit Summary by Program

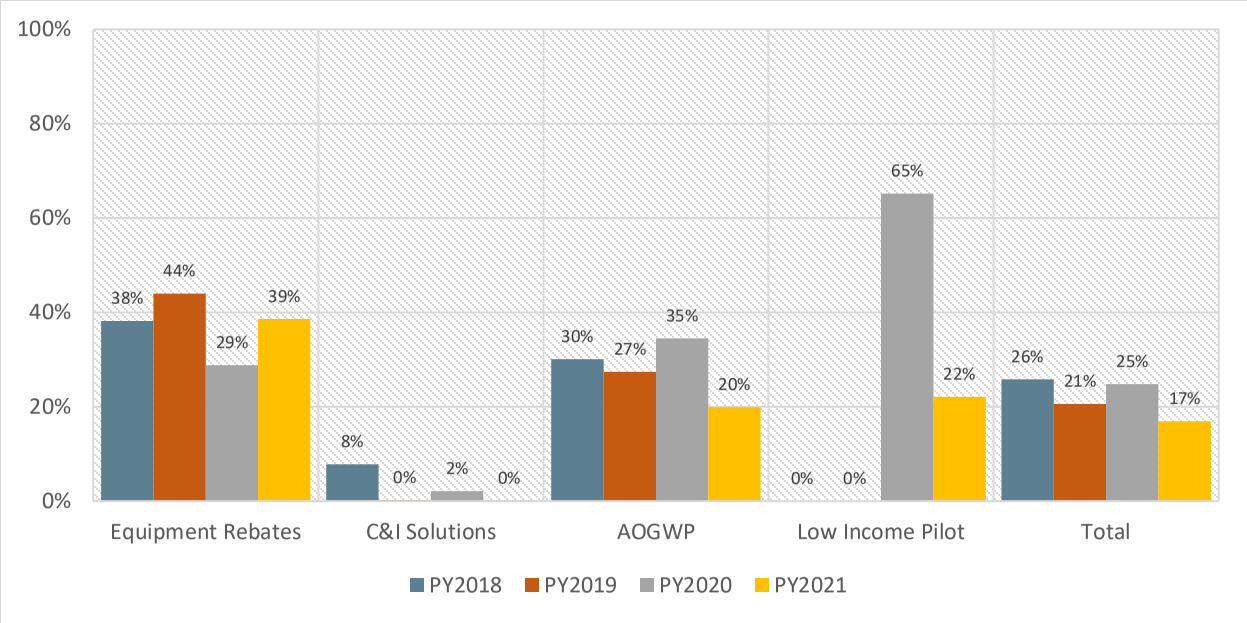


Figure 3-4: Percent of Total TRC Benefits Derived from NEBs

The change in benefit share from NEBs from PY2020 to PY2021 is attributable to the following factors:

- **Equipment Rebates:** Increased savings from furnace replacement and water heater replacement corresponded to increased NEBs.
- **C&I Solutions:** The extent to which this program generates NEBs is a function of the types of custom projects that occur in a given year; when there are a significant number of steam leak repair or condensate return projects, the program can show NEBs from water savings. PY2020 had steam leak repair projects that contributed significant water NEBs. In contrast, PY2021 projects were mostly HVAC and as a result PY2021 saw lower NEBs.
- **Weatherization:** NEBs from this program depend on AOG incentivizing homes served by Arkansas Valley Electric Co-op. When the participation mix has a larger share of OG&E homes, the program claims a lower level of kWh savings.
- **Low Income Pilot:** The Low Income Pilot offers a similar measure package as the AOG Weatherization Program. As with that program, the percent of benefits from NEBs will be related to the extent of project co-funding with OG&E.

3.5.3 Portfolio-Level Recommendations

Consider issuing a Request for Information (RFI) for Program Innovations	The portfolio spent 57% of its available budget. AOG will need to position itself to potentially make up savings shortfalls should key measure offerings (such as weatherization) reach saturation. An RFI may provide avenues to develop new program ideas and would come without the obligation to hire a specific vendor. RFI program groupings could be categorized in terms of AMI-reliant and non-AMI-reliant program offerings. Another avenue for this type of program development could be via an innovations pilot fund.

4. Equipment Rebates

The Equipment Rebates program provides incentives to residential and non-residential customers for high-efficiency space heating and water heating equipment. This program is an aggregated program combining the former Heating Equipment Rebates and Water Heating & Conservation Programs. Eligible measures for this program include:

- $300 for gas furnaces with 90%-94.9% AFUE;
- $500 for gas furnaces with 95% or higher AFUE;
- $100 for eligible smart thermostats;
- $500 for tankless water heaters with an EF of .90 or greater;
- $50 Trade Ally Incentive for all program-qualified furnaces and water heaters.

4.1 Program Overview

The Heating Equipment Rebates and Water Heating & Conservation programs began in 2010. The combined Equipment Rebate Program is designed to incentivize the purchase of high-efficiency space heating and water heating equipment. Presently, the program incentivizes high-efficiency furnaces, hydronic heating systems, and high-efficiency water heaters. In PY2021, the program had $466,605 in budget allocated.

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

Table 4-1: Equipment Rebates Historical Performance against Goals

Program Year	# Participants			Budget			Net Therms		
	Actual	Goal	% Met	Spent	Allocated	% Spent	Ex Post	Goal	% Met
2010	1,250	1,445	87%	$96,259	$164,870	58%	26,411	44,020	60%
2011	1,663	1,680	99%	$143,325	$229,835	62%	45,098	44,904	100%
2012	2,380	1,632	146%	$284,486	$285,555	100%	69,843	41,838	167%
2013	1,740	1,536	113%	$336,073	$279,523	120%	74,493	25,446	293%
2014	1,563	1,536	102%	$384,142	$232,679	165%	45,182	25,446	178%
2015	390	216	181%	$348,455	$255,763	136%	42,181	12,096	349%
2016	492	216	228%	$421,884	$255,763	165%	102,817	12,096	850%
2017	594	829	72%	$385,881	$480,524	80%	52,038	92,438	56%
2018	842	829	102%	$462,805	$462,805	100%	55,983	92,438	61%
2019	796	829	96%	$391,456	$481,948	81%	49,446	92,438	53%
2020	824	969	85%	$407,599	$460,479	89%	59,606	66,482	90%
2021	679	1,004	68%	$316,439	$466,605	68%	43,551	70,304	62%

4.1.1 Participation Summary

Figure 4-1 summarizes total rebates and net savings installed by month. The ERP did not show any notable slowdown during the time period in which AOG had shut down other program operations (such as weatherization). August shows high savings despite low participation due to the timing of a high-savings commercial water heater rebate.

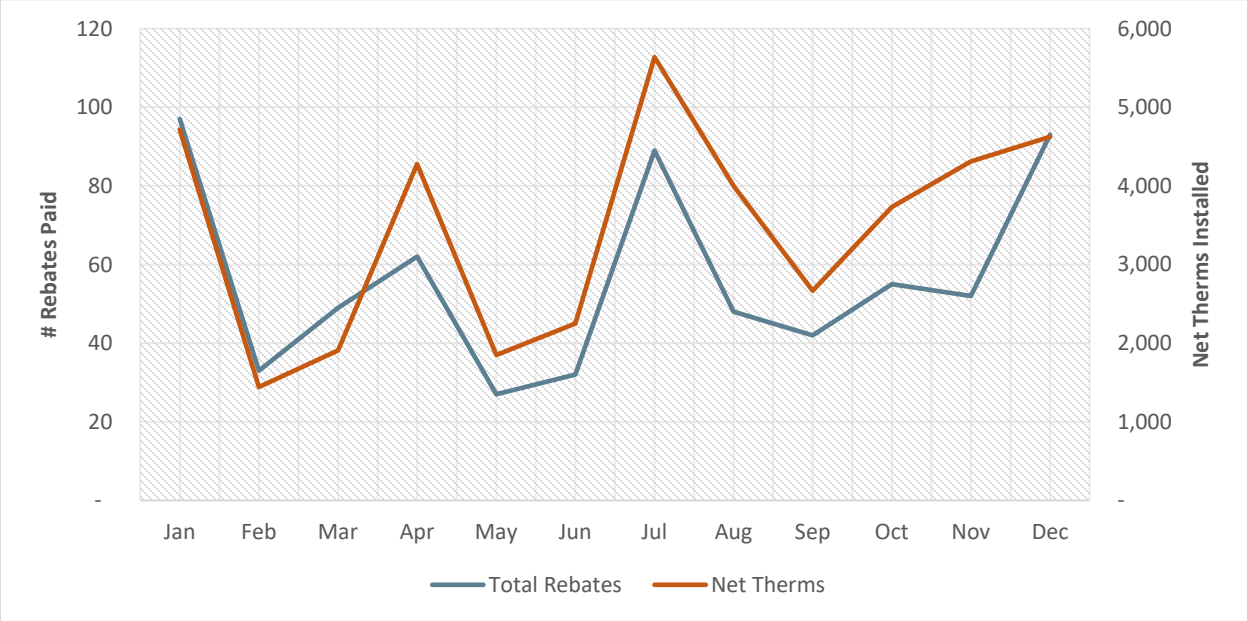


Figure 4-1: Participation & Savings by Month

4.1.1.1 Residential Participation - Furnaces

The residential component had a total of 196 residential rebates at 179 premises. This is a decrease from 247 residential rebates at 209 premises observed in PY2019. All units were 95 AFUE or higher. Sixty-three percent of PY2021 participants were in retrofit applications, with 37% being new construction applications.

Of the new construction applications:

- 54.8% were production homes by home builders; and
- 45.2% were custom homes with incentives to homeowners.

4.1.1.2 Commercial Participation - Furnaces

The commercial component had a total of 28 rebates at five premises. There were no units installed with 90.-94.9 AFUE; all 28 were 95 AFUE or higher. One educational facility accounted for 59.3% of savings in this measure group.

4.1.1.3 Residential Participation – Water Heaters

The residential component had a total of 183 residential rebates at 161 premises. This is a decrease from 201 residential rebates at 174 premises observed in PY2020. All rebated units in PY2021 were tankless units. Nine percent of residential retrofit projects were submitted by one housing authority that installed the water heaters in municipally-owned homes where the gas bill is paid by the occupants. Fifty-nine percent of PY2021 participants were in retrofit applications, with 40.9% being new construction applications.

Of the new construction applications:

- 68.0% were production homes by home builders.
- 32.0% were custom homes with incentives to homeowners.

4.1.1.4 Commercial Participation – Water Heaters

The commercial component had a total of 25 rebates at eight premises. This is comparable to the 24 rebates at 10 premises in PY2020. All 24 units were tankless. Four percent of PY2021 applications were for retrofit projects and 96% were new construction. Figure 4-2 summarizes non-residential participation (in percent of total rebates) by facility type.

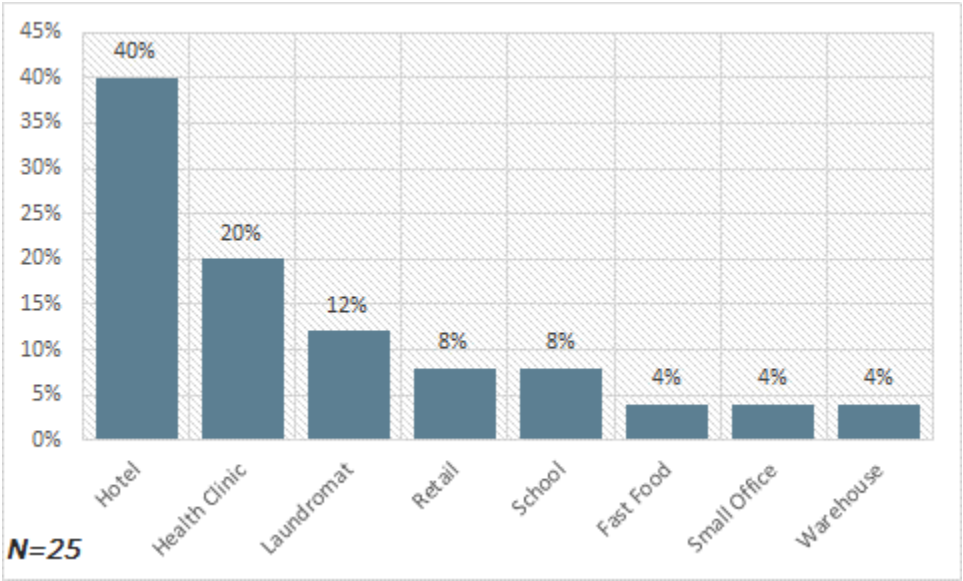


Figure 4-2: Water Heating Equipment Rebates C&I Participation by Facility Type

4.1.1.5 Residential Smart Thermostats

The Equipment Rebates Program began rebating smart thermostats in PY2017. In PY2021, 246 rebates were issued for 222 premises. This is an increase compared to PY2020, where there were 283 rebates issued for 197 premises. The program provides a $100 rebate for pre-approved models. Last year, the Evaluators had found that the program application erroneously

stated that only Nest and ecobee models are eligible. This has since been corrected to reflect that all Energy Star-rated thermostats are eligible.

In PY2020, all rebated units were either ecobee or Nest (30% ecobee, 70% Nest). As seen in Figure 4-3, in PY2021 there was much greater diversity in participation, with seven brands found in tracking data and the program share from Nest and ecobee declining from 100% to 80%.

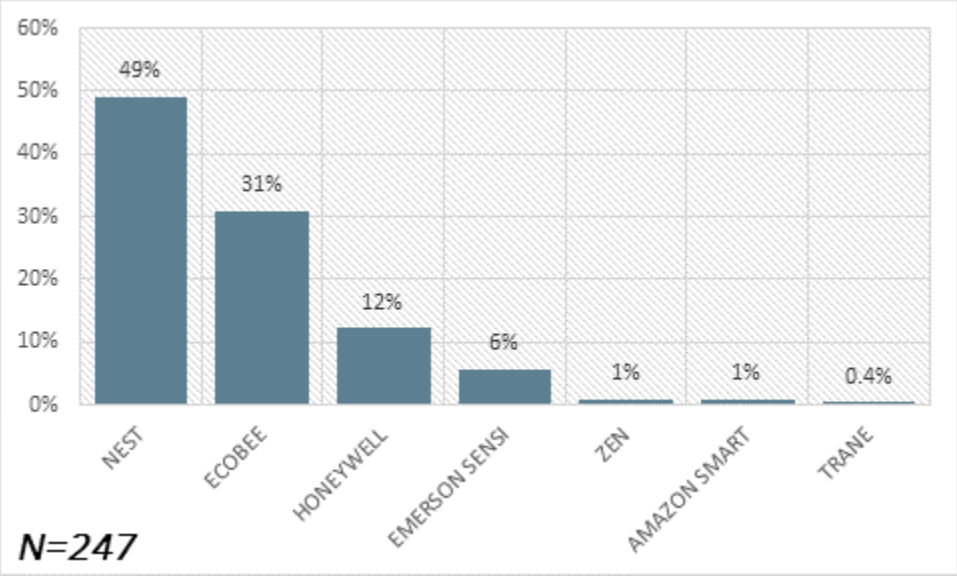


Figure 4-3: Smart Thermostat Participation by Brand

Nine percent of thermostats were installed by participants that also installed a high efficiency furnace (this is a decrease over the 18% observed in PY2020 but is the same rate that had been observed in PY2019).

4.2 Equipment Rebates Process Evaluation

The Evaluators conducted a formal process evaluation of the Heating Equipment Rebates and Water Heating & Conservation Program in PY2017 and found that the program was successful in meeting participation, savings, and satisfaction goals. Table 4-2 and Table 4-3 summarize the Evaluators' review of the Equipment Rebates Program in comparison to TRM V8.2 Protocol C for timing and conditions of conducting a process evaluation.

Table 4-2: Determining Appropriate Timing to Conduct a Process Evaluation

Component	Determination
New and Innovative Components	No. The program is designed in a manner consistent with similar programs elsewhere and applies deemed savings values from the TRM.
No Previous Process Evaluation	No. The program received a comprehensive process evaluation in PY2017.
New Vendor or Contractor	No. The program has been run internally by AOG since program inception in 2010.

Table 4-3: Determining Appropriate Conditions to Conduct a Process Evaluation

Component	Determination
Are program impacts lower or slower than expected?	Partial. Program met 90% of savings goal in PY2020
Are the educational or informational goals not meeting program goals?	No. The programs have had successful consumer and contractor outreach & education.
Are the participation rates lower or slower than expected?	Partial. Program met 90% of savings goal in PY2020
Are the program's operational or management structure slow to get up and running or not meeting program administrative needs?	No. The prior 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?	At the program-level, no. However commercial water heating has lower cost-effectiveness due to high participation rates from low-volume facility types.
Do participants report problems with the programs or low rates of satisfaction?	No. Participant surveys found exceedingly high satisfaction levels.
Is the program producing the intended market effects?	Yes. Interviews with participating contractors found significant market transformation occurring.

The program met goal in PY2020. The Evaluators conducted a limited process evaluation in PY2021.

4.2.1 Data Collection Activities

The process evaluation of the Equipment Rebates included the following data collection activities:

- *AOG Program Staff Interviews*. The Evaluators interviewed staff at AOG involved in the administration of the Equipment Rebates Program. These interviews were to collect information from program staff as to any changes or developments, as well as responses to program recommendations.

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

Table 4-4: AOG Equipment Rebates Data Collection Summary

Target	Component	Activity	n	Sample Precision	Role
AOG Program Staff	Director – Energy Efficiency Programs	Interview	1	NA	Overall administration of AOG EE programs. This manager is involved in the larger strategic decisions associated with the EE portfolio, and is involved with the Equipment Rebates Program in the overall coordination of utility resources.
	Energy Efficiency Program Manager	Interview	1	NA	Day-to-day management of programs, customer application assistance, energy savings calculations, and data QA/QC
Residential Participants	Furnace	Survey	20	±15.5%	AOG-specific survey with residential participants that received rebates for furnaces and/or water heaters.
	Water Heater	Survey	13	±18.2%	
Non-residential Participants	Furnace	Survey	26	±11.8%	Multi-utility survey, aggregating AOG, BHE, and CenterPoint customers
	Water Heater	Survey	13		
Trade Allies	Furnace & Water Heater	Interview	1	N/A	A trade ally survey was attempted. The participant pool was limited and Evaluators could only obtain one response. Results not included in this evaluation.

4.2.2 Process Results & Findings

This section will present 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.

4.2.2.1 Response to Program Recommendations

Table 4-5 summarizes the status of issues and recommendations identified in the PY2019 process evaluation.

Table 4-5: Equipment Rebates Response to PY2020 Recommendations

Recommendation	AOG Response	Status of Issue
Consider marketing emphasis for mobile app functionality from modern HVAC and DHW equipment. Messaging could be in tandem with traditional marketing efforts focused on energy and cost savings.	Not adopted yet but looking into it with new rebate processing in conjunction with CNP. Looking into that 2022.	Under consideration
Investigate cost bases for smart thermostats sold/installed by HVAC contractors. With the higher sale price shown from this sales channel, program administrators should consider discussing costs and sourcing for smart thermostats with participating HVAC contractors (with most of whom they have a preexisting relationship from the Heating System Rebates channel) and identifying whether there are opportunities to reduce equipment costs.	They continue to track, but the confluence of supply chain issues and a lack of itemized receipts makes it difficult to assess cost bases.	Recommendation adopted
Collaborate in a process to develop early retirement savings for water heaters. This would be completed with the PWC and facilitated via the IEM	Defer to PWC. Collecting information on the rebates but need updates from PWC	Recommendation adopted

4.2.1 Participant Detailed Review

The Evaluators completed a detailed participant review, incorporating equipment cost and housing characteristics.

4.2.1.1 Residential Furnaces

Cost for furnace replacement was characterized in three categories:

- Replace on Burnout;
- Early Retirement; and
- New Construction.

Table 4-6: Residential Furnace Participant Cost Metrics

Participant Type	Median Sq. Ft.	Median Home Age	Median Input BTU	Median $/unit	Median $/Input BTU	Median $/Sq. Ft.
Replace on Burnout (N=21)	1,780	25	80,000	$7,085	$0.089	$3.98
Early Retirement (N=102)	1,925	31	80,000	$7,740	$0.097	$4.02
New Construction (N=73)	1,745	0	80,000	$4,375	$0.055	$2.50

Median project costs were 9% lower for replacement on burnout compared to early retirement applications. New construction projects had 43% lower total cost than retrofits.

4.2.1.2 Residential Water Heaters

Cost for water heater replacement was characterized in four categories:

- Replace on Burnout;
- Early Retirement;
- New Construction; and
- Housing Authority.

Housing Authority was an aggregate category and was separated in the analysis due to significantly smaller average residence size as well as cost differences due to the potential for bulk purchasing.

Table 4-7: Residential Water Heater Participant Cost Metrics

Participant Type	Median Sq. Ft.	Median Input BTU	Median $/unit	Median $/Input BTU	Median $/Sq. Ft.
Replace on Burnout (N=30)	2,318	199,000	$3,200	$0.016	$1.38
Early Retirement (N=63)	2,084	199,000	$2,521	$0.013	$1.21
New Construction (N=74)	1,890	199,000	$1,294	$0.007	$0.68
Housing Authority (N=16)	703	150,000	$2,575	$0.017	$3.66

Median project costs were 27% higher for replace-on-burnout applications compared to early retirement. New construction projects had 51% lower total cost than retrofits.

Residential water heaters must have an input BTU lower than 200,000 to be tested under the Uniform Energy Factor procedure. Median sizing was 199,000 BTU for all categories other than housing authorities. Among all program participants, a total of 56% of rebates were for 199,000 BTU systems. Excluding Housing Authority projects, 79% of all projects were 199,000 BTU systems. For the 16 projects from housing authorities, 15 were for 150,000 BTU units and one was for a 199,000 BTU unit.

4.2.1.3 Smart Thermostats

The Evaluators reviewed the equipment purchases by program participants to identify trends or commonalities in purchase patterns. There were 38 unique sellers identified among the 246 rebated units. Of these, the top five sellers accounted for 68% of units sold (with this group including one corporate chain household products retailer, two corporate chain hardware retailers, and two online marketplaces).

The Evaluators characterized the 42 sellers into the following groups:

- HVAC contractors;
- Online retailers;
- Household products / electronics retailers;
- Hardware stores;
- Telecoms (including cable, internet, and cellular service providers) and
- Manufacturer-direct.

Two hardware store chains accounted for 38% of thermostat sales. HVAC contractors averaged 3.26 rebates per vendor, and accounted for 25% of all rebates. A new avenue to purchase smart thermostats was found in telecoms participating – ADM found that there were rebates that listed cable TV, home internet, and cellular service providers, as these entities have begun selling "Internet of Things" (IoT) products.

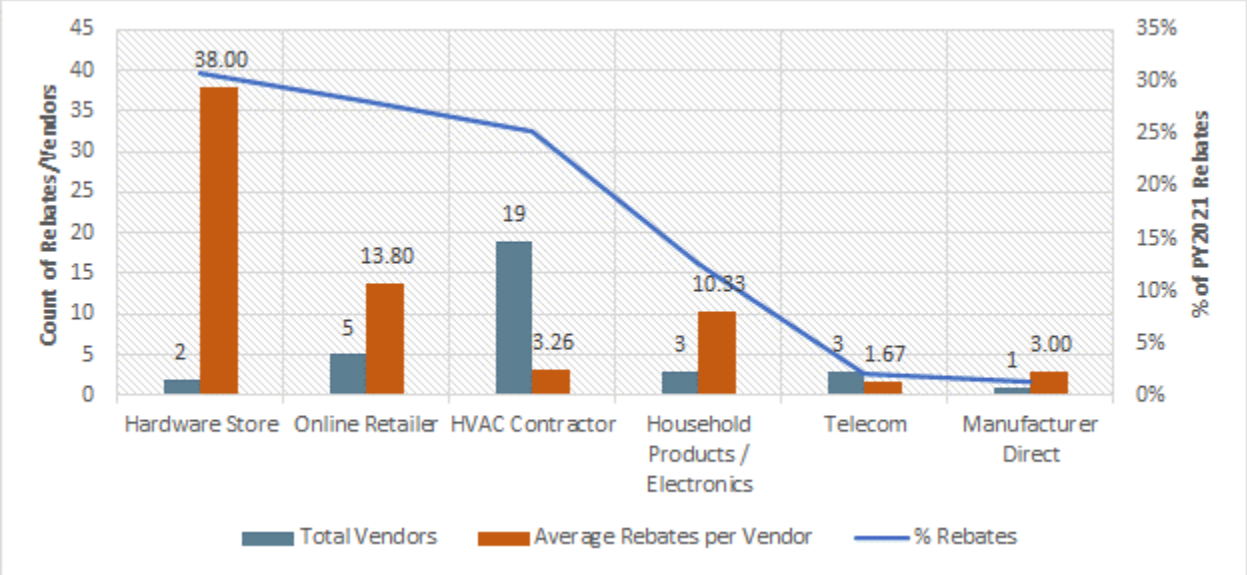


Figure 4-4: Seller Types and Quantities

Figure 4-5 summarizes the relative share of thermostat rebates by vendor type from PY2020 to PY2021. The largest shift is observed in the doubling of the share held by online retailers. This

has come as relative contribution has declined for household products and manufacturer-direct vendors.

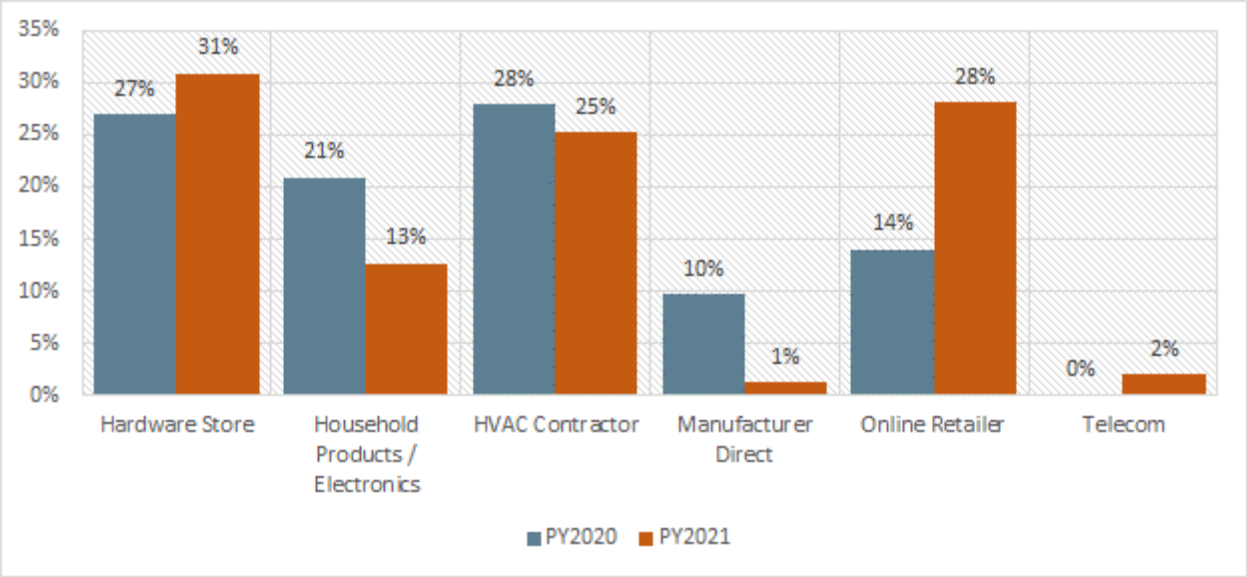


Figure 4-5: Comparison of Thermostat Vendors – PY2020 to PY2021

When comparing cost, the Evaluators found that ecobee thermostats were on average 31% more expensive than Nest thermostats ($265 versus $192, respectively). Costs are summarized in Figure 4-6

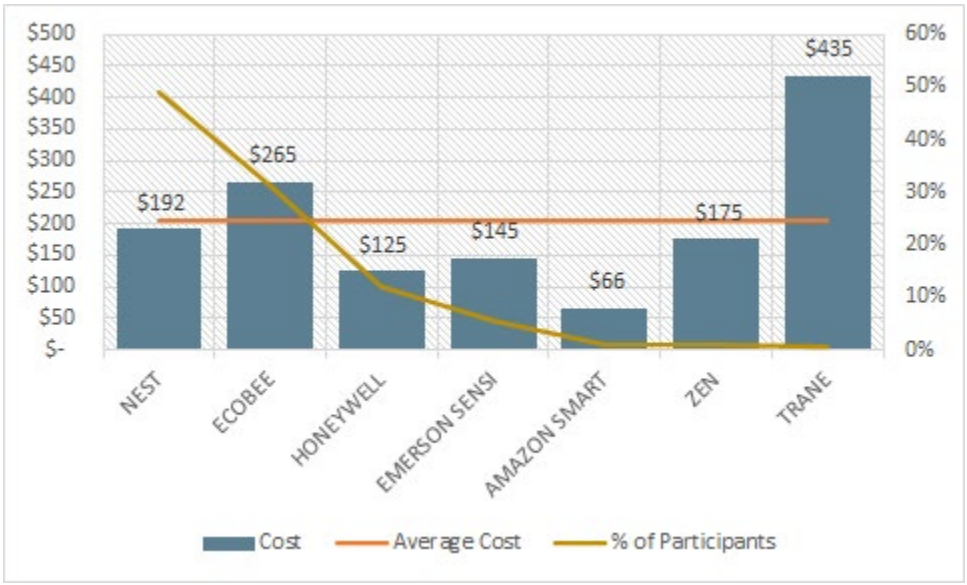


Figure 4-6: Equipment Cost by Thermostat Bran

The Evaluators then examined whether this difference in purchase price manifests in terms of higher acquisition costs for therms savings. This analysis normalized for home square footage, to account for brand bias in higher-income customers that may have larger homes.

As shown in Figure 4-7, ecobee, Zen, and Trane thermostats displayed acquisition costs of savings per square foot that were higher than the program average. Of note:

- The most prevalent thermostat in the program, Nest, had normalized acquisition costs that were 14% lower than program average.
- Ecobee models had costs that were 19% higher than program average.
- Zen thermostats are a prevalent new model in the program (5.7% of all units) and had savings acquisition costs that are 95% higher than program average.
- Trane thermostats had acquisition costs more than 10 times program average. There were only one rebates for a Trane thermostat, however.

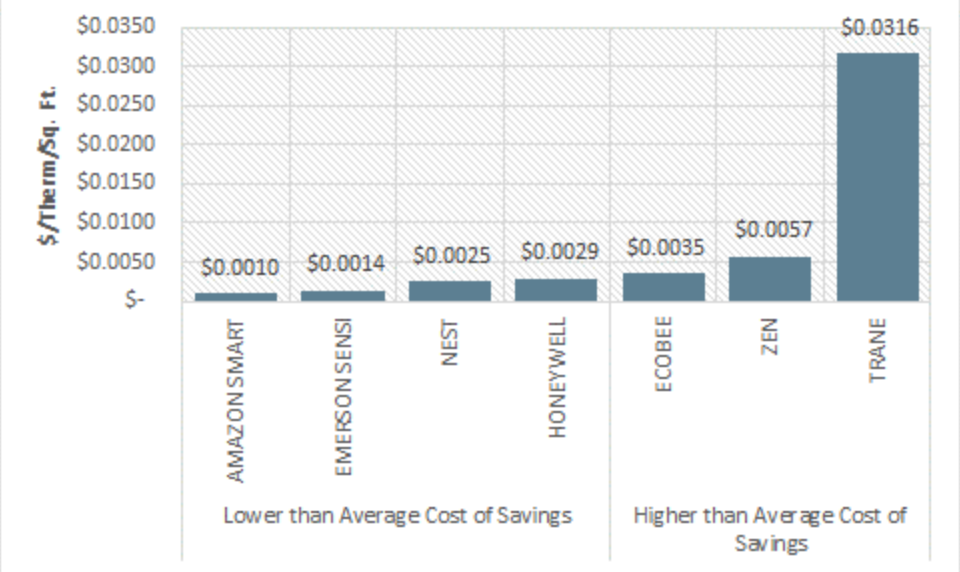


Figure 4-7: Normalized Savings Acquisition Cost by Thermostat Brand

Figure 4-8 summarizes the purchase price by seller type.

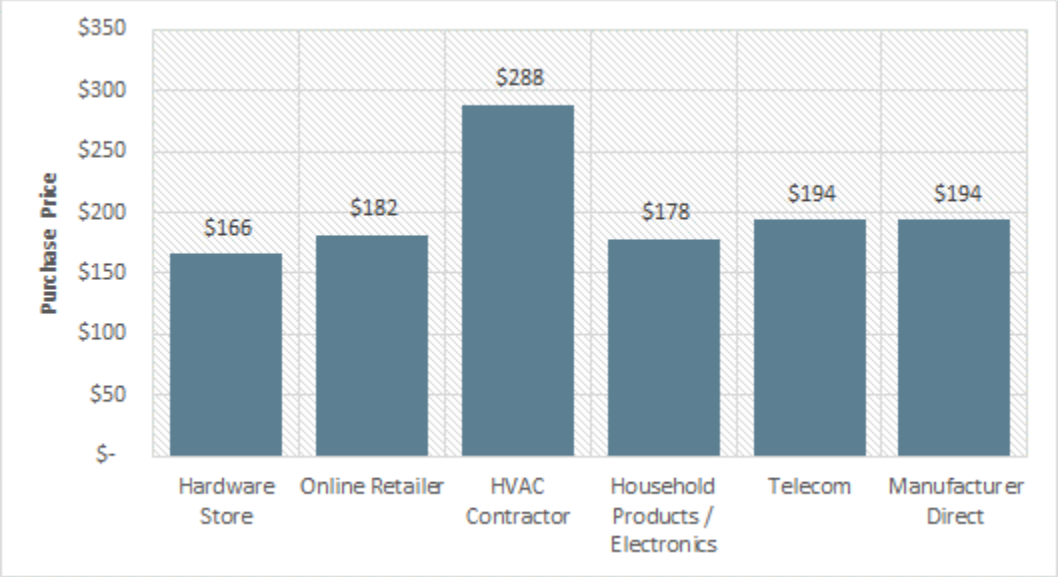


Figure 4-8: Average Purchase Price by Seller Type

Though most thermostats perform near the program average or benchmark established by the three core brands (Nest, ecobee, Honeywell), there is the potential for growing costs to mar cost-effectiveness. The Evaluators recommend that AOG periodically monitor brand-specific savings and cost-effectiveness to stay apprised of any risk to TRC from new entrants.

4.2.2 Residential Survey Response

Residential participants were contacted via phone to complete an online survey regarding their experience with the downstream equipment rebates program. At the time of survey administration, contact information was available for 201 customers that had completed the program. The response rate was 17.9% with 36 participants completing the survey lasting approximately 9.5 minutes.

Respondent Profile

All respondents own their home (n = 35), and the average number of people living in the home is 2.8 (n = 34). Respondents were age 35 or older, and in terms of annual household income level 18% made less than $50,000, 43% made $50,000 to less than $100,000, and 39% made more than $100,000 per year. Lastly, 33 out of 34 respondents self-identified as white or Caucasian.

Equipment Status

Table 4-8: Status of Replaced Equipment

Measure	Furnace (n = 23)	Water Heater (n = 13)*
Replacement	**82.6%**	**69.2%**
Fully working and not in need of repair	*39.1%*	*38.5%*
Working, but needed minor repairs	*17.4%*	*7.7%*
Working, but needed major repairs	*4.3%*	*7.7%*
Not working	*17.4%*	*15.4%*
I don't know / Prefer not to answer	*4.3%*	-
New Installation	**17.0%**	**23.0%**

Across the 19 replaced furnaces, the average age of the original unit was approximately 17.7 years old, and respondents estimated that it would have lasted another zero to ten years (average: 4.2 years) if they did not replace it. To control the furnace, 48% use a programmable thermostat, 22% use a smart thermostat connected to the internet, and 30% use a standard thermostat. For those that use a programmable or smart thermostat (n=16), 69% have it programmed for winter heating season, and 80% of smart thermostat users "Always" have it connected to the internet.

Participation Experience

Figure 4-9 summarizes sources of program awareness. As observed in prior years, the most common sources of awareness are from the installing contractor or from a friend, relative, or colleague.

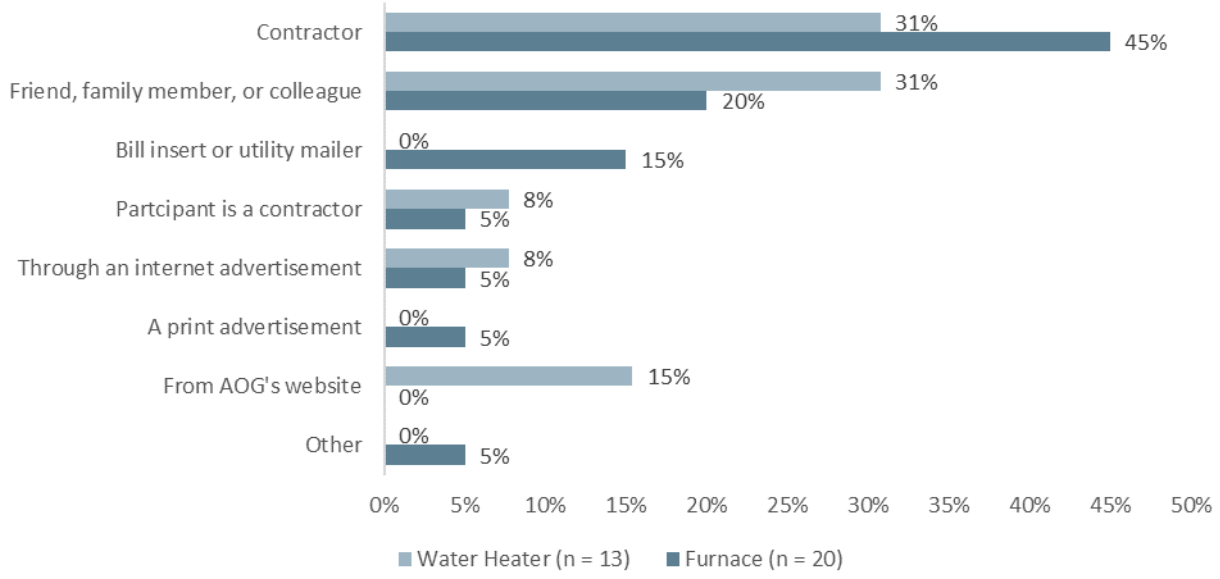


Figure 4-9: Source of Program Awareness

Figure 4-10 summarizes reasons for participation, with respondents ranking three categories based on importance.

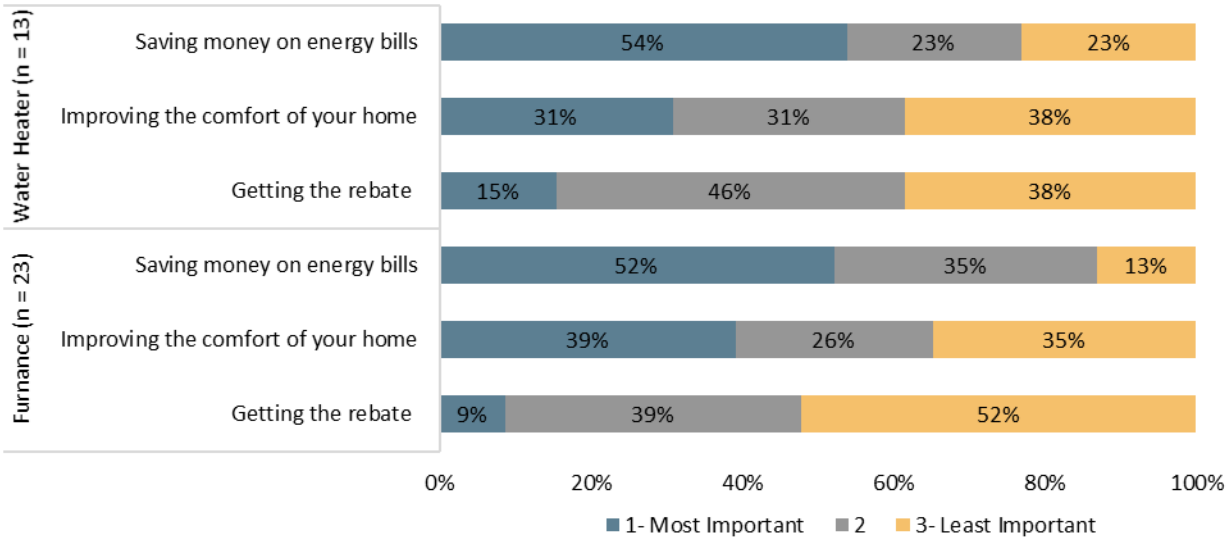


Figure 4-10: Reason for Participation

Contractor Experience

When selecting equipment, 87% of furnace respondents and 31% of water heater respondents indicated the contractor was "very influential" or "extremely influential. When discussing their contractor:

- 97% *"strongly agreed"* that the contractor was courteous and professional
- 94% *"strongly agreed"* that the work was scheduled in a reasonable amount of time
- 88% *"strongly agreed"* that the work was completed in a reasonable amount of time

Table 4-9 summarizes how respondents found their contractors. When aggregating the categories of "someone you worked with before" and "referral from a friend / relative / colleague", 68.4% of furnace respondents and 63.7% of water heater respondents selected their contractor out of their personal network.

Table 4-9: How Respondents Found their Contractor

	Furnace (n = 19)	Water Heater (n = 11)
The contractor was someone you worked with before	57.9%	27.3%
Internet search	15.8%	9.1%
Referral from friend/relative/colleague	10.5%	36.4%
The AOG program website	5.3%	0.0%
A program representative referred me to a contractor	5.3%	0.0%
Referral from home builder	0.0%	18.2%
Other	5.3%	9.1%

Participant Satisfaction

Figure 4-11 and Figure 4-12 present satisfaction ratings for furnace and water heater respondents, respectively. Respondents indicated high satisfaction across all categories, and the sole instance of dissatisfaction was indicated by a respondent that was "somewhat dissatisfied" with the wait time to receive their rebate.

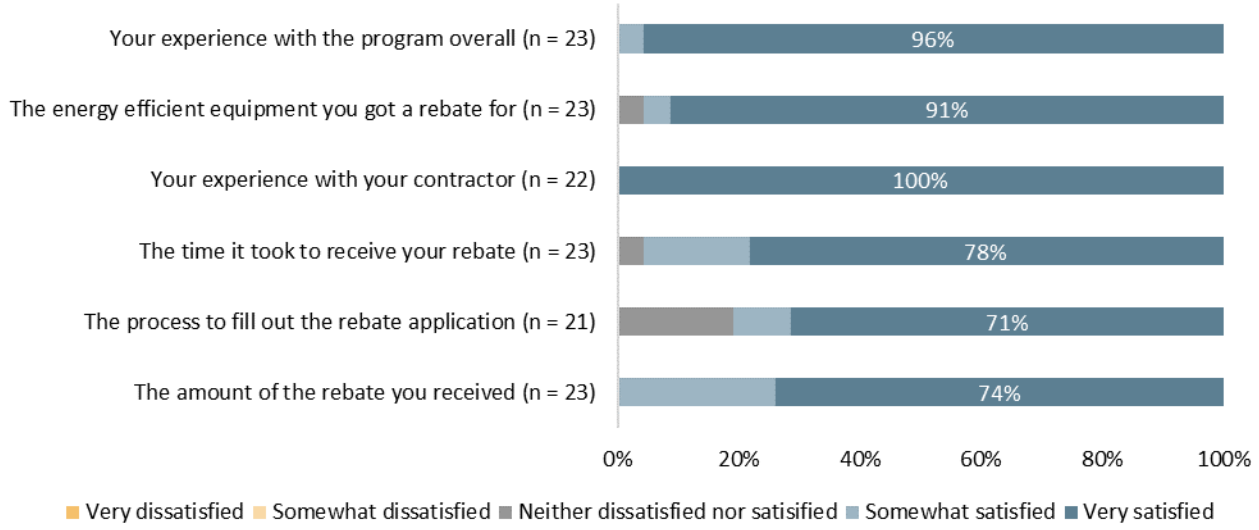


Figure 4-11: Participant Satisfaction - Furnaces

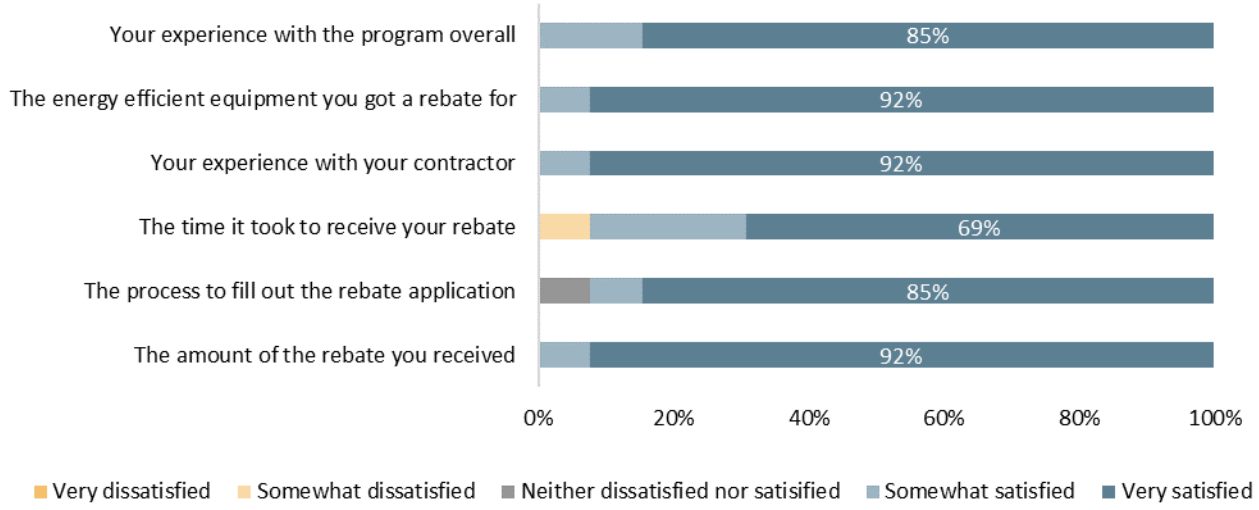


Figure 4-12: Participant Satisfaction – Water Heaters

4.2.3 Commercial Participant Survey Response

Commercial participants were contacted via phone to complete an online survey regarding their experience with the equipment rebates program. Due to the limited number of survey completes, utility respondents were aggregated to provide valuable insights. At the time of survey administration, contact information was available for 203 customers that had completed the program. The response rate was 19.2% with 39 participants completing the survey. Of those 39 respondents, 23 installed high efficiency furnaces and 13 installed high efficiency water heaters.

Table 4-10: Total Respondents by Utility

Sample Breakdown	Sample Size (N = 179)	Survey Completes (n = 39)
Arkansas Oklahoma Gas	12	2
Black Hills Energy	19	4
CenterPoint Arkansas	148	33

Decision Making Process

Table 4-11 summarizes the level of influence various parties had in the decision-making surrounding the project. Vendors and contractors were most typically characterized as having a "moderate to large effect" on the project.

Table 4-11: Influence Level of Project Stakeholders

	No effect	Small effect	Moderate to large effect	Critical effect
Installed a furnace (n = 22)				
Vendor (n = 9)	33%	-	67%	-
Contractor (n = 9)	-	-	100%	-
Program Representative (n = 1)	-	-	100%	-
Other (n = 4)	-	-	75%	25%
	No effect	**Small effect**	**Moderate to large effect**	**Critical effect**
Installed a water heater (n = 11)				
Vendor (n = 3)	-	-	100%	-
Contractor (n = 7)	-	29%	43%	29%
Program Representative (n = 2)	-	50%	50%	-
Other (n = 1)	-	-	-	100%

Participant Satisfaction

Overall, respondents are satisfied with all aspects of the program as well as the utility as their service provider.

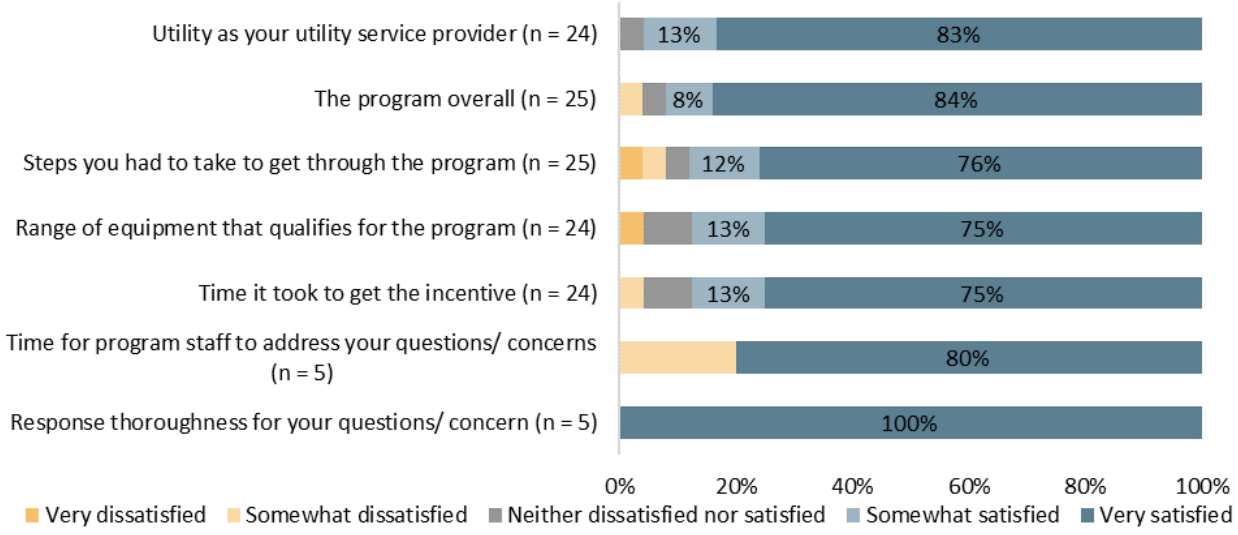


Figure 4-13: Furnace Respondent Satisfaction

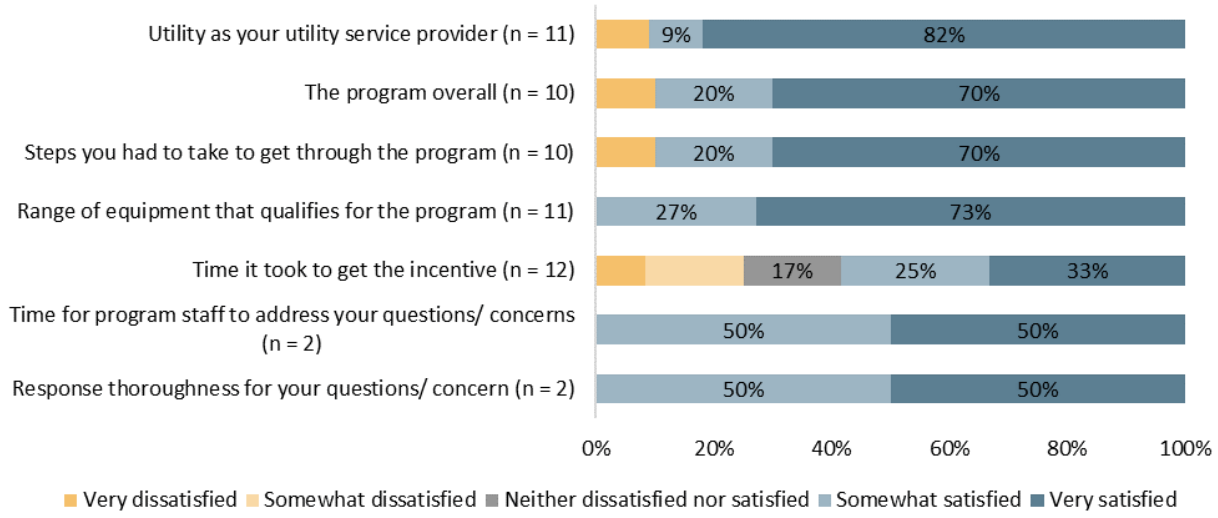


Figure 4-14: Water Heater Respondent Satisfaction

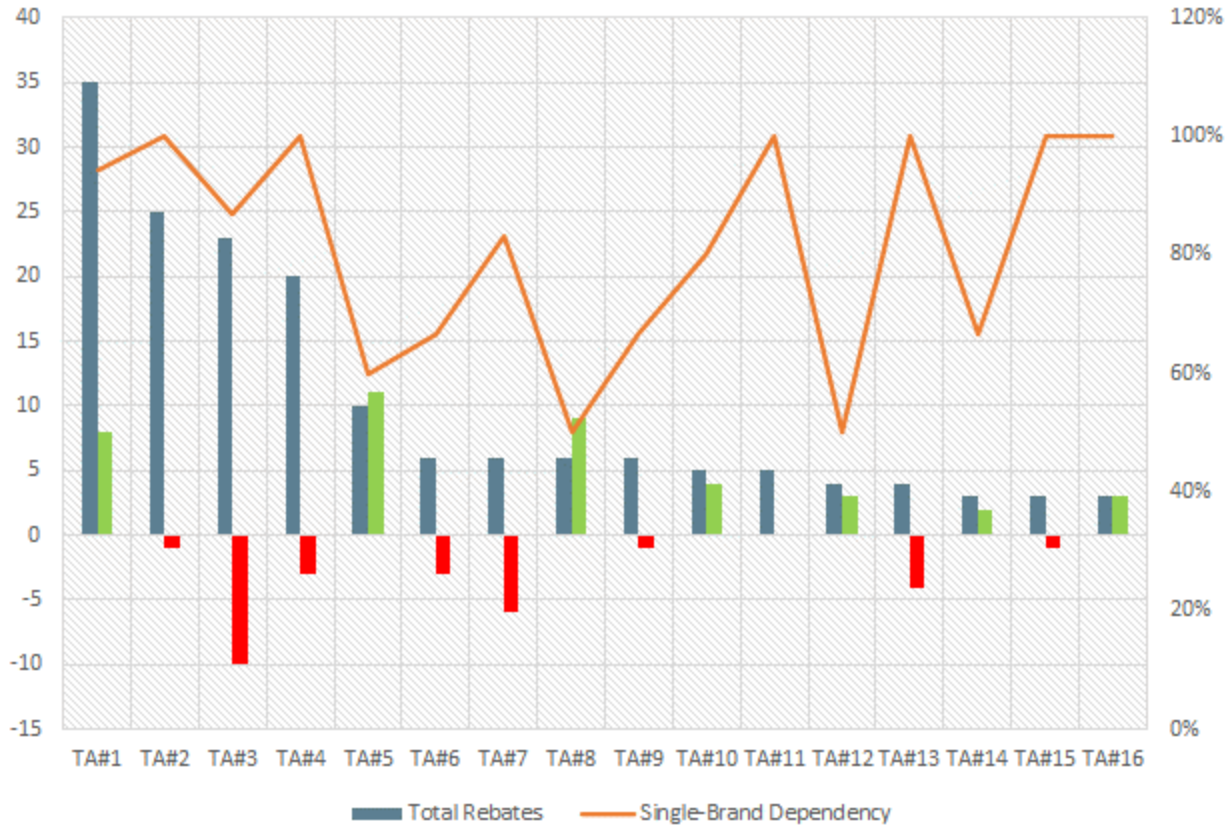
4.2.4 Trade Ally Interview

Brand Dependence

The responding trade ally did not indicate major disruptions due to COVID-19. Although there have been some delays and price increases due to supply chain issues, participation and interest in the program has not waned. In general, the trade ally stated that they avoided major supply chain related disruptions by buying other brands that have stock available.

The Evaluators then examined the extent to which program contractors are "brand-dependent". The Evaluators examined data for trade allies with three or more rebates in PY2021 and examined what percent of their projects are from their single most-prevalent brand. Single-brand dependency averages 88% among the program's top-five trade allies by volume in PY2021.

This is summarized for furnaces in Figure 4-15. In this figure, their year-over-year change in rebates from PY2020 to PY2021 is noted with the green and red columns.



**Green and red columns denote 2021 project totals compared to 2020 project totals*

Figure 4-15: Brand Dependency by Participation Volume – Furnaces

The Evaluators then examined whether year-over-year project totals had any correlation with brand flexibility/dependency. This data is presented in Figure 4-16. There is a negative relationship between increased brand dependency and change in projects from 2020 to 2021, indicating that brand flexibility may be associated with higher participation. The regression R-square is only .18, though brand dependency displays statistical significance at 90% confidence.

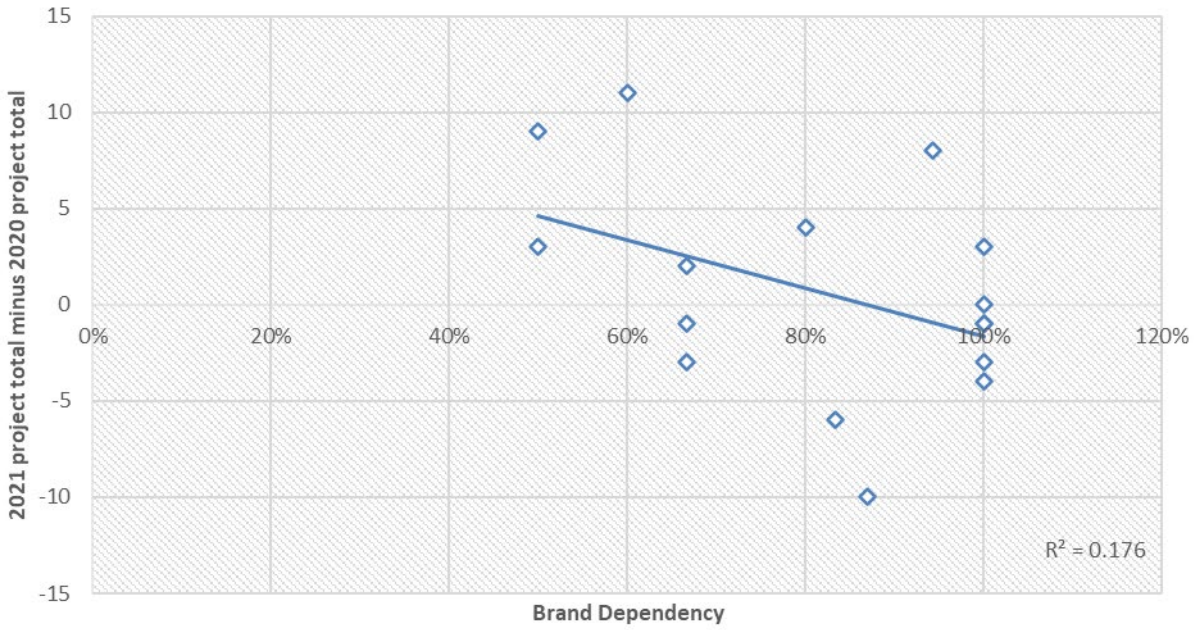


Figure 4-16: Year-over-Year Project Totals Regressed against Brand Dependency

Comments about Application Process

The responding trade ally was generally satisfied with AOG's application and rebate process, but had two suggestions for improvement:

1. **Add a job ID number to rebates paid to trade allies.** The trade ally interviewed noted that they do many projects through the program and that it would be helpful for them to be able to track which jobs they have received rebates. They further noted that it would assist them when following up with AOG about pending payments.
2. **Develop a bulk-order form for multiple rebates.** The trade ally interviewed noted that they filled out individual applications for multiple furnaces they had installed in one facility, and that they would have found it beneficial to be able to bulk-apply.

4.3 Equipment Rebates Impact Evaluation

The evaluation effort of the Equipment Rebates Program included the following:

- *Desk Review of Residential Calculations.* The Evaluators utilized TRM V8.2 values in assessing savings from residential furnaces.
- *Commercial Verification*. The Evaluators applied TRM V8.2 deemed savings parameters in assessing savings of the commercial component.
- *Calculation of Deferred Replacement Costs.* The Evaluators used the calculation tool developed by the IEM to assess deferred replacement cost for residential and commercial water heaters.
- *Free-ridership Rates.* Free-ridership rates were developed from current-year survey efforts.

4.5.1 Summary of Non-Energy Benefits

Table 4-17 summarizes the non-energy benefits by measure that will be credited to the Equipment Rebates Program.

Table 4-12: Equipment Rebates Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	Deferred Replacement Cost	Avoided Replacement Cost
Residential Furnace Early Replacement				✓	
Residential Tankless WH					✓
Commercial Tankless WH					✓
Smart Thermostat	✓				

4.5.2 Residential Impact Evaluation

4.5.2.1 Residential Free-ridership

Figure 4-17 summarizes the scoring mechanism for free-ridership for residential furnaces, water heaters, and smart thermostats. This scoring mechanism was used in the PY2020 evaluations in determining the NTGRs that have been applied to PY2021.

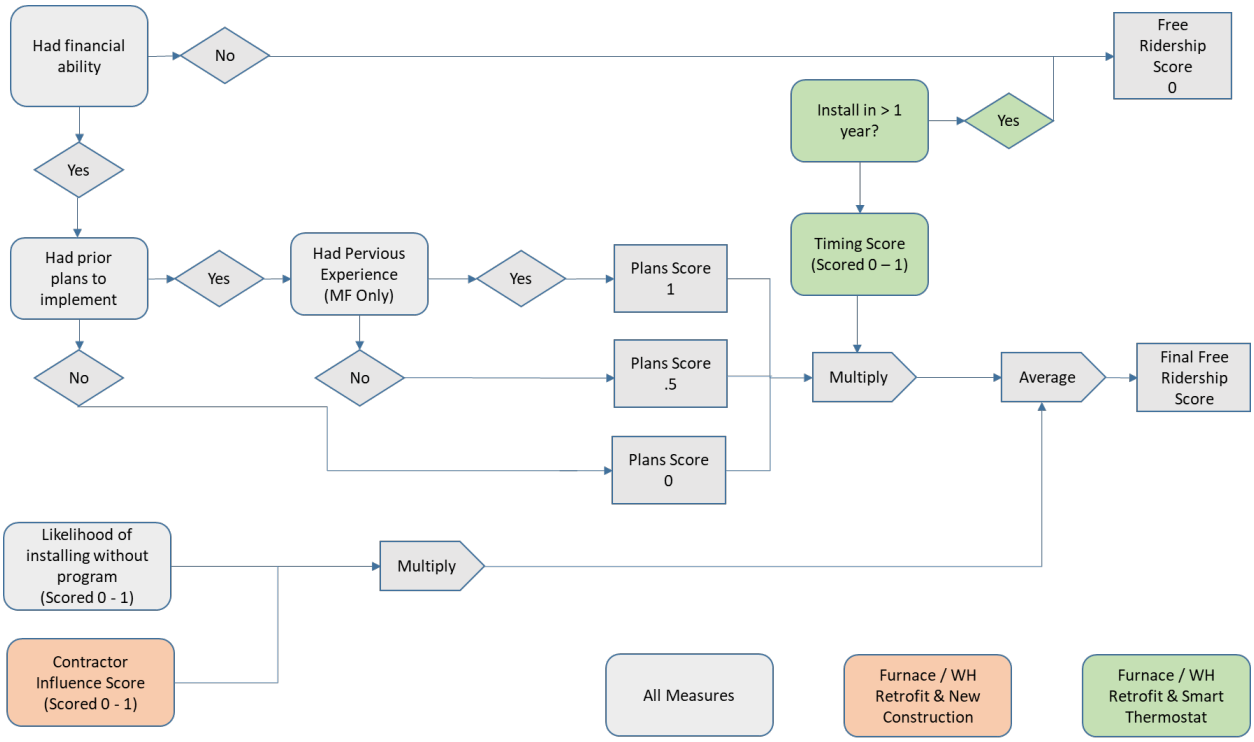


Figure 4-17: Residential Equipment Rebates FR Diagram

The methodology incorporates prior planning, program influence, contractor influence, and a rebate counterfactual.

The plans score was factored by the program's impact on timing. Specifically,

- If the respondent stated that they would have installed the measure more than one year after the measure was installed, the prior plan score reduced to zero.
- If the respondent stated that they would have installed the measure in 6 months to one year, then the prior plans score was reduced by one-half.
- If the respondent stated that they would have installed the measure at the same time or within 6 months of when it was installed, the prior plans score was not adjusted.

A likelihood of installing the measure in the absence of the program was developed based on respondents stated likelihood of installing a measure. Specifically, responses to this question were scored as follows:

- Very likely: 1
- Somewhat likely: .75
- Neither particularly likely nor unlikely: .5

- Somewhat unlikely: .25
- Very unlikely: 0

Contractor Influence: This score is first determined via respondent answers to Question 18. The scores are as follows:

- Very influential: .5
- Somewhat influential: .25
- All other answers: .00

This value is then scaled by .667 due to contractor estimates that the rebate assisted them in upselling to a high-efficiency model two-thirds of the time. The resulting NTGRs are as follows:

- Residential Furnace Retrofit: 81.0%
- Residential Water Heating Retrofit: 100.0%
- Smart Thermostat: 63.6%

For new construction applications, we apply a similar scoring mechanism as-completed in the multi-utility survey effort for owner-built custom homes. For homes from production builders, we apply the PY2017 values developed as part of the new construction builder survey effort completed for CenterPoint Energy Arkansas. The values are:

- New Construction: Owner-built custom: 64.4%
- New Construction: Builder production homes: 91.0%

4.5.2.2 Energy Savings Calculations - Heating

Savings for residential furnaces are calculated using protocols from AR TRM V8.2 Section 2.1.3. For sample calculations, see Appendix C.

4.5.2.3 Impact of Early Replacement

As per the TRM V8.2, 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:[11]

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

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

[11] Arkansas TRM V8.2 Volume 1, Pg. 44

M[12] = 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 TRM V8.2 updated the RUL table, which has been reflected in Table 4-13.[13]

Table 4-13: 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		

ADM assessed whether a unit qualified for early retirement, and the Evaluators examined the following survey questions:

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

1. Fully functional and not in need of repair?
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

[12] 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.
[13] AR TRM V8.2, Volume 1, Pg. 45

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

1. ___ # Years
98. DON'T KNOW

Figure 4-18 summarizes the scoring for early retirement based on these three questions.

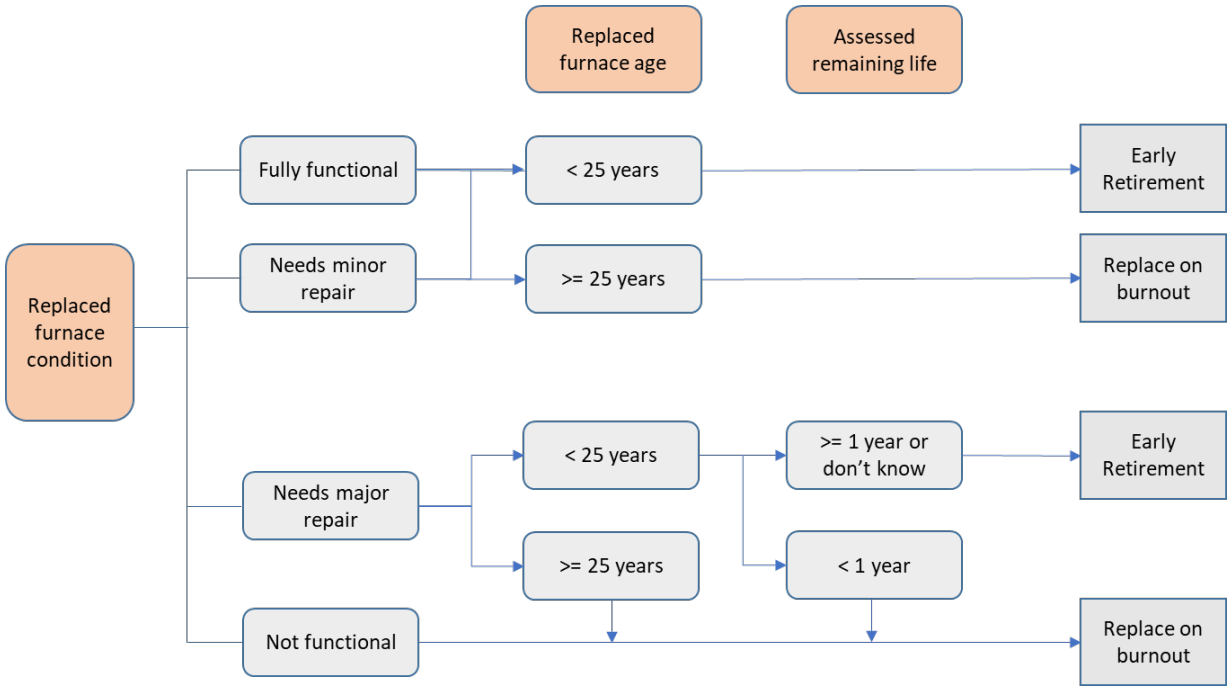


Figure 4-18: Residential Furnace Early Retirement Flowchart

In total, the Evaluators found that 71.7% of AOG furnace retrofits were early retirement. Based on survey results from the PY2020 evaluation, the Evaluators applied an average age of 15.13 years for early retirement furnaces.

Based on the degradation equation from TRM V8.2, this leads to an Early Retirement AFUE of:

$$AFUE_{base_{early}} = (.80) \times (1 - .01)^{15.13} = .6871$$

Further, based on the values in Table 4-13, the RUL of the early replacement units is four years. For years 5-20 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 71.74% early replacement and 28.26% normal replacement. The resulting weighted average baseline is:

$$AFUE_{base_{early\_weighted}} = 71.74\% \times .6871 + 28.26\% \times .80 = .7190$$

4.5.2.4 Energy Savings Calculations – Water Heating

Savings from tankless water heaters were calculated using protocols from Arkansas TRM V8.2 Vol. 1 Section 2.3.1. For sample calculations see Appendix C.

4.5.2.5 Energy Savings Calculations – Smart Thermostats

Gross savings were calculated for smart thermostats using protocols AR TRM V8.2 Vol. 1 2.1.12. For example calculations, see Appendix C.

AOG tracked the baseline thermostat on their program application. The Evaluators applied the appropriate baseline for each line item. For new Construction applications, the Evaluators applied the "Default" weighted average baseline from the TRM V8.2.

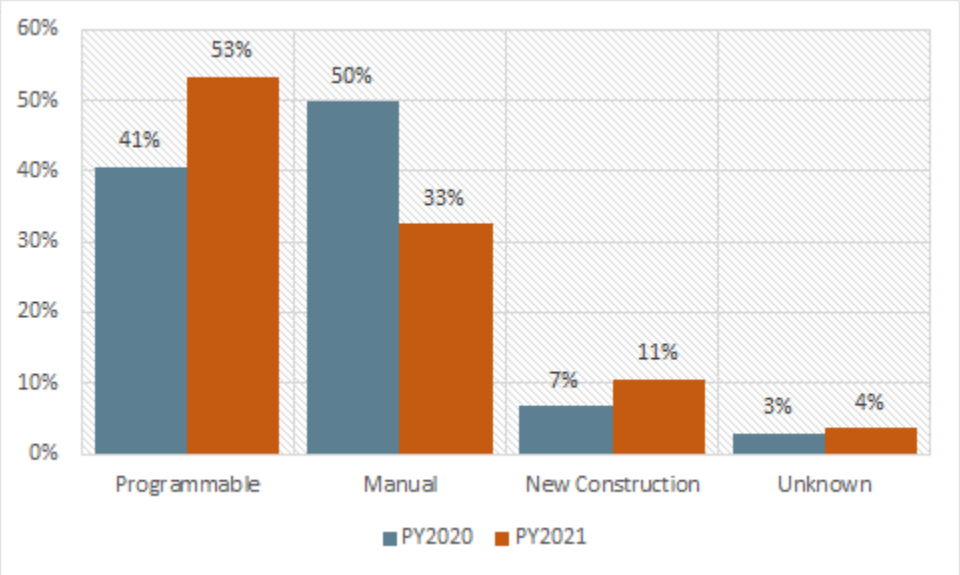


Figure 4-19: Baseline Thermostat for Smart Thermostat Rebates

To evaluate attributable kWh savings for smart thermostats, the tracking data from the AOG program was compared to OG&E tracking data in order to identify premises that received rebates from both utilities. The Evaluators did not find any instances of joint-rebating and assigned all kWh from smart thermostats to AOG.

Of the 246 projects for which AOG had claimable electric savings, 36.1% were from municipal or rural cooperative utilities. The remaining 63.9% were from OG&E and SWEPCO AR, and were potentially eligible for an incentive.

4.5.3 Commercial Impact Evaluation

4.5.3.1 Commercial Free-ridership

In PY2020, the Evaluators completed a survey across AOG, BHEA, and CNP to evaluate commercial furnace and water heater free-ridership. Figure 4-20 summarizes the scoring mechanism for free-ridership for prescriptive commercial furnaces and water heaters.

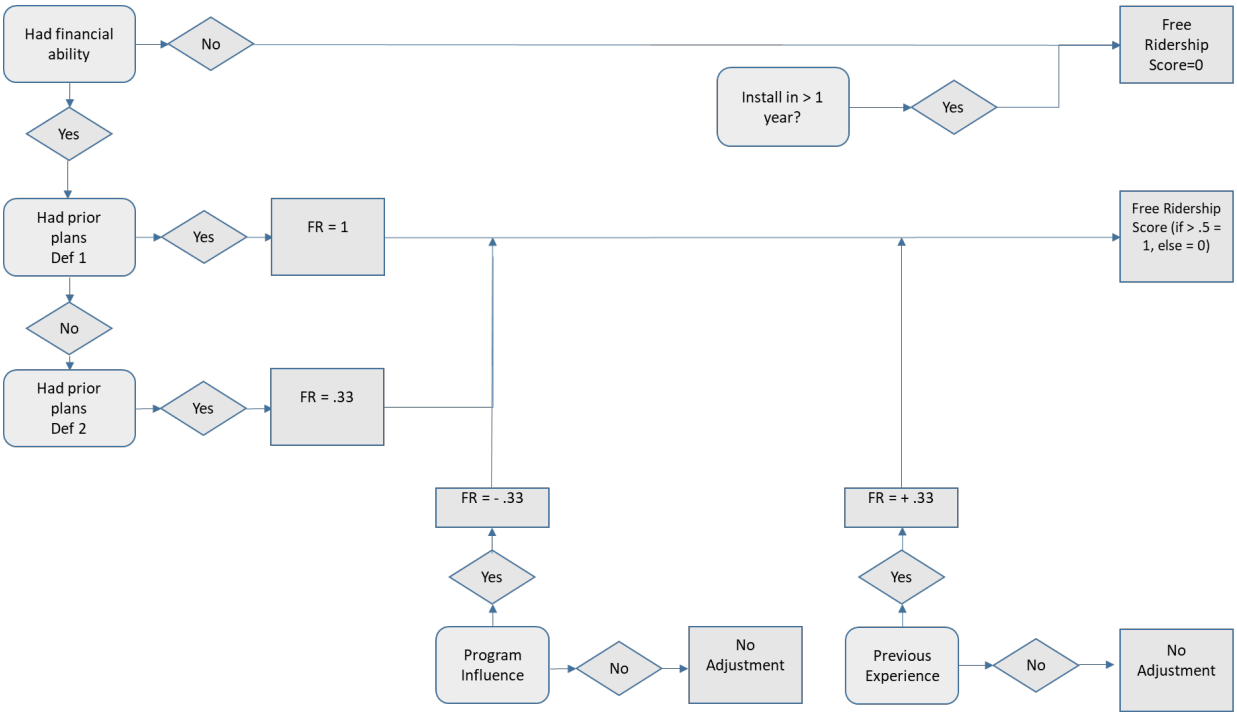


Figure 4-20: Nonresidential Free-ridership Scoring Flow Chart

Several criteria determine which portion of a participant's savings should be attributed to free-ridership. The first criterion comes from the response to:

> "Would you have been financially able to install the equipment or measures without the financial incentive from the Program?"

If a customer answered "No" a free-ridership score of 0 was assigned to the project. That is, if a customer required financial assistance from the program to undertake a project, that customer was not deemed a free-rider.

The second question pertains to project timing. Respondents are asked "Did you purchase and install the [MEASURE] earlier than you otherwise would have without the program?". If they indicate that they installed the measure more than one year earlier than they otherwise would have, they are not a free-rider.

For decision makers who indicated they could undertake energy efficiency projects without financial assistance from the program, three additional factors determined what percentage of savings is attributable to free-ridership. The three factors are:

- Plans and intentions of the firm to install a measure even without support from the program;
- Influence that the program had on the decision to install a measure; and
- A firm's previous experience with a measure installed under the program.

For each of these factors, rules were applied to develop binary variables indicating whether a participant showed free-ridership behavior. Responses to the decision-maker questionnaire helped to develop the rules for the free-ridership indicator variables

The first required step was to determine if a participant stated that his or her intention was to install an energy efficiency measure without the help of the program incentive. The survey respondents' answers to a combination of questions, then a set of rules determined whether a participant's behavior indicated likely free-ridership. Two binary variables were constructed to account for customer plans and intentions: one, based on a more restrictive set of criteria that may describe a high likelihood of free-ridership, and a second, based on a less restrictive set of criteria that may describe a relatively lower likelihood of free-ridership.

The first, more restrictive criteria indicating customer plans and intentions that likely signify free-ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the Program?"
- The respondent answered, "definitely would have installed" to the following question: "If the financial incentive from the Program had not been available, how likely is it that you would have installed [Equipment/Measure] anyway?"

The second, less restrictive criteria (Definition 2) indicating customer plans and intentions that likely signify free-ridership are as follows:

- The respondent answered "yes" to the following two questions: "Did you have plans to install the measure before participating in the program?" and "Would you have gone ahead with this planned installation of the measure even if you had not participated in the Program?"
- Either the respondent answered, "definitely would have installed" or "probably would have installed" to the following question: "How likely would you have been to have

completed the [Equipment/Measure] project even if you had not participated in the program?"

The second required factor was determining if a customer reported that a recommendation from a program representative or experience with the program was influential in the decision to install a piece of equipment or measure. This criterion indicates that the program's influence may lower the likelihood of free-ridership when any of the following conditions are true:

- The respondent answered "very important" to the following question: "How important was previous experience with the Program in making your decision to install [Equipment/Measure]?
- The respondent answered, "definitely not would have" or "probably not would have" to the following question: "If the Program representative had not recommended implementing the [Equipment/Measure], how likely is it that you would have implemented it anyway?"

The third required factor is determining if a participant in the program indicated that he or she had previously installed an energy efficiency measure similar to one that they installed under the program without an energy efficiency program incentive during the last three years. A participant indicating that he or she had installed a similar measure was considered to have a higher likelihood of free-ridership. The criteria indicating that previous experience may signify a higher likelihood of free-ridership is as follows:

- The respondent answered "yes" to the following question: "Thinking about all of the projects you completed in the last three years, did you implement any energy efficient equipment or projects similar to the [Equipment/Measure] that you implemented at your facility located at [LOCATION] as part of any of those projects?

4.5.3.2 Energy Savings Calculations – Commercial Furnaces

Savings for commercial furnaces are calculated using protocols from AR TRM V8.2 Section 3.1.9. For sample calculations, see Appendix C.

4.5.3.3 Energy Savings Calculations – Water Heating

Savings for commercial water heaters are calculated using protocols from AR TRM V8.2 Section 3.3.1. For example calculations, see Appendix C.

4.5.3.4 Commercial Desk Review Findings

The Evaluators conducted desk reviews for all 25 commercial water heating projects. There were no causes for savings adjustment. The Evaluators note that the acquisition cost from commercial water heating higher than compared to PY2020 but lower compared to PY2019.

- PY2019: $11.89/net therm
- PY2020: $2.89
- PY2021: $7.86

in this program year, the average first-year acquisition cost was $7.86 per therm. As seen in Figure 4-21, this acquisition cost varies widely based on TRM V8.2 facility types.

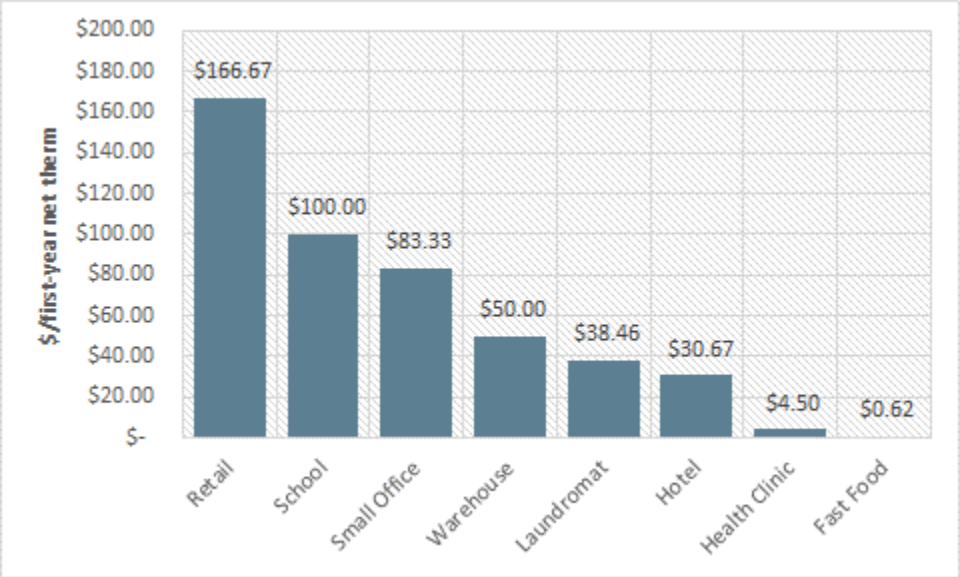


Figure 4-21: Acquisition Cost of First Year Savings by DHW Facility Type[14]

At the low participation volume AOG observes in the program, this is to some degree a performance risk. In PY2021, one health clinic accounted for 50% of savings in this channel but only 4% of program incentives for this measure category. Another health clinic accounted for 35% of the savings but 20% of the incentives.

4.5.4 Ex Post Savings

Table 4-14 presents the gross savings results of the evaluation of the PY2021 Equipment Rebates Program. Total gross savings summarizes the savings calculations performed by TRM V8.2 Protocols.

[14] Facilities had been entered as "fieldhouse" in AOG tracking. These were elementary school facilities and the cost per therm reflects that TRM designation.

Table 4-14: Equipment Rebates Ex Post Gross Therms Savings

Measure Category	Ex Ante Therms Savings	Ex Post Therms Savings	Gross Realization Rate	EUL	Lifetime Therms Savings
Residential Furnaces	28,965	28,965	100%	13.16	381,315
Residential Tankless WH	9,829	9,829	100%	20	196,580
Smart Thermostat	9,744	9,744	100%	11	107,184
C&I Furnaces	3,449	3,449	100%	20	68,980
C&I Water Heaters	1,792	1,792	100%	20	35,840
Total Gross Savings	**53,779**	**53,779**	**100%**	**14.69**	**789,899**

The resulting net savings are presented in Table 4-15.

Table 4-15: Equipment Rebates 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		
Residential Furnaces	19%	19%	23,373	23,368	100%	307,025
Residential Tankless WH	7%	7%	9,118	9,118	100%	182,360
Smart Thermostat	32%	32%	6,602	6,602	100%	72,622
C&I Furnaces	17%	17%	2,873	2,873	100%	57,460
C&I Water Heaters	11%	11%	1,590	1,590	100%	31,800
Total	**19%**	**19%**	**43,556**	**43,551**	**100%**	**651,267**

4.5.5 Non-Energy Benefits Summary

4.5.5.1 Residential Furnace Early Replacement

Early replacement of residential furnaces makes them eligible for the Deferred Replacement Cost Non-Energy Benefit, which assesses the economic value of the deferred replacement in perpetuity. This NEB was calculated using the IEM calculation tool[15]. 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: 5.00%
- Inflation Rate: 1.92%
- Real Discount Rate: 4.18%

[15] Protocol L Avoided & Deferred Replacement Cost_08_31_16.xlsx

The resulting gross deferred replacement cost is $1,014.49 per unit. The calculator for this is provided in Appendix B of this report. For individual line items in the AOG program, this value was scaled by the appropriate NTGR.

There were 123 residential furnaces eligible for DRC in PY2021, and the resulting DRC value is $101,073.94

4.5.5.2 Residential Tankless Water Heaters.

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 Avoided Replacement Cost Non-Energy Benefit. This NEB was calculated using the IEM calculation tool[16]. 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: 5.00%
- Inflation Rate: 1.92%
- Real Discount Rate: 4.18%

The resulting gross avoided replacement cost is $307.05 per unit. The calculator for this is provided in Appendix B of this report. For individual line items in the AOG program, this value was scaled by the appropriate NTGR.

There were 183 residential tankless systems rebated in PY2021, and the resulting ARC value is $56,190.15.

4.5.5.3 Commercial Tankless Water Heaters.

Commercial tankless water heaters have an EUL of 20 years. The baseline system has an EUL of 15 years. This makes the systems eligible for the Avoided Replacement Cost Non-Energy Benefit. This NEB was calculated using the IEM calculation tool[17]. 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: 6.18%

[16] Protocol L Avoided & Deferred Replacement Cost_08_31_16.xlsx

[17] Ibid.

- Inflation Rate: 1.92%
- Real Discount Rate: 4.18%

The resulting gross avoided replacement cost is $123.13 per unit. The calculator for this is provided in Appendix B of this report. The Evaluators used the incremental costs associated with residential tankless systems as commercial costs are aligned with systems that are 200,000 BTU or greater in capacity (and therefore use the Combustion Efficiency baseline rather than the Energy Factor). All tankless systems rebated in commercial facilities in AOG's program were below 200,000 BTU and were units that are certified for residential applications. The values were then scaled by the commercial water heater NTGR factor (88.6%).

There were 25 commercial tankless systems rebated in PY2021, and the resulting ARC value is $2,962.25.

4.5.5.4 Smart Thermostats

AOG did not have a savings sharing agreement with any electric utilities for this component of their portfolio. To ensure that savings are claimable by AOG, the Evaluators cross-referenced AOG smart thermostat tracking data with OG&E and SWEPCO tracking data. The Evaluators found that no thermostats were rebated by SWEPCO or OG&E, and thus all electric savings from them were credited as NEBs to AOG. The resulting kWh savings are in the table below. Avoided kWh and kW costs cite OG&E's filed avoided costs.

Table 4-16: Smart Thermostat kWh Savings Summary

Savings Type	Annual	Lifetime	Monetized Benefit
Gross	119,109	1,310,199	-
Net	80,636	886,996	$20,146

4.8 Conclusions

Price variation is increasing for smart thermostats as more brands enter the market	In prior program years, participation was limited to Nest and ecobee models, and the inter-quartile range of rebates (25% and 75% percentile markers) was {$166.71, $249}. In PY2021, there were rebates paid for systems from Honeywell, Emerson Sensi, Amazon Smart, Zen, and Trane thermostats, and the interquartile range is now {$130, $249}, reflecting increased lower cost options.
Acquisition cost of savings varies by thermostat brand	The Evaluators found that two of the new brands seen in the program (Zen, Trane) had savings acquisition costs per square foot that were 95% higher than average and over 10 times the average (respectively).
The program saw significant decreases in participation and savings	Net savings decreased by 26.9% compared to PY2020

4.9 Recommendations

Monitor costs for new smart thermostat brands that enter the program	Two of the new brands found in the program had savings acquisition costs significantly higher than program average. These brands are not themselves cost-effective and could mar the program TRC if they ever constitute a large enough share of participation (currently they account for 5% of participation).
Add a job ID number to rebates paid to trade allies	The trade ally interviewed noted that they do many projects through the program and that it would be helpful for them to be able to track which jobs they have received rebates. They further noted that it would assist them when following up with AOG about pending payments.
Develop a bulk-order form for multiple rebates	The trade ally interviewed noted that they filled out individual applications for multiple furnaces they had installed in one facility, and that they would have found it beneficial to be able to bulk-apply
Encourage brand flexibility among trade allies to mitigate supply chain issues	The Evaluators found that brand-dependency was weakly associated with decreased participation in 2021 compared to 2020. This will be analyzed in greater detail in subsequent evaluations, but it may be helpful to encourage HVAC contractors to broaden their brand choices if their primary brand is facing shortages

5. Commercial & Industrial (C&I) Solutions Program

The C&I Solutions program is directed at developing and incenting custom energy efficiency projects for which deemed values are not applicable or feasible. It is implemented by CLEAResult Consulting (CLEAResult) on behalf of AOG. CLEAResult handles program administration, marketing and outreach, direct install of water conservation and air infiltration measures, and technical review of custom efficiency projects. Program participants are provided:

(1) No-cost direct installation of low flow faucet aerators, showerheads, door air infiltration and pre-rinse spray valves (PRSVs), if they have gas comfort heating or water heating;

(2) Prescriptive incentives for boilers and food service equipment;

(3) $0.80 per therm for custom projects; and

(4) $0.90 per therm for small business custom projects.

5.1 C&I Solutions Program Overview

The C&I Solutions Program had $428,492 in budget allocated in PY2021. The C&I Solutions Program's historical performance is summarized in Table 5-1. The C&I Solutions Program achieved 108% of the savings goal and expended 93% of the program budget.

Table 5-1: C&I Solutions Program Historical Performance Against Goals

Program Year	# Participants			Budget			Net Therms		
	Actual	Goal	% Achieved	Spent	Allocated	% Spent	Ex Post	Goal	% Achieved
2011	78	127	61%	$82,115	$129,478	63%	31,528	29,766	106%
2012	68	162	42%	$132,970	$155,499	86%	80,347	39,890	201%
2013	123	2,009	6%	$271,858	$387,244	70%	267,250	175,049	153%
2014	157	2,009	8%	$369,939	$387,224	96%	341,703	218,811	156%
2015	165	149	111%	$335,369	$387,244	87%	256,546	175,049	147%
2016	186	149	125%	$372,156	$387,244	96%	232,038	175,049	133%
2017	53	146	36%	$424,060	$378,721	112%	193,139	194,361	99%
2018	36	146	25%	$398,136	$398,136	100%	194,054	194,361	100%
2019	26	146	18%	$419,003	$424,435	99%	220,683	194,361	114%
2020	34	82	41%	$395,147	$415,881	95%	162,774	161,132	101%
2021	13	83	16%	$399,356	$428,492	93%	174,241	160,923	108%

The C&I Solutions Program participants fall into one of three categories:

- Direct install;
- Prescriptive;

- Closed custom projects.

5.1.1 Direct Install Participation Summary

In PY2021, there were direct install projects completed at 6 unique premises, a significant decrease from 28 unique premises in PY2020. The summary of participation by facility type and the relative share of program therm savings are summarized in Figure 5-1.

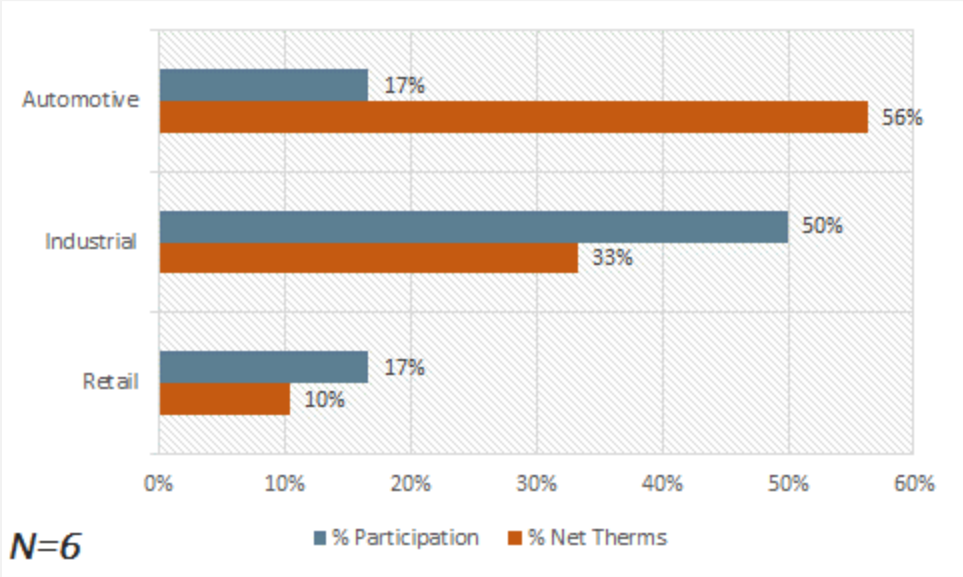


Figure 5-1: Direct Install Participation Summary

There were no pre rinse spray valves (PRSVs), aerators, showerheads, and steam traps installed in PY2021. Weather stripping accounted for 100% of direct install savings in PY2021.

5.1.2 Closed Custom Project Participation Summary

Table 5-2 summarizes the closed projects from the PY2021 C&I Solutions custom component. Closed projects are projects that have been verified by the Evaluators and incentive issued by the implementer.

Table 5-2: Custom Project Participation Summary

Facility Type	Project ID	Measure
K-12 School	EA-0000352588	Steam Trap Replacement
Medical	EA-0000447432	Retrocommissioning
Food Processing	EA-0000429856	Insulation
Agriculture	EA-0000363835	Boiler Retrofit
		Waste Heat Recovery
Medical	EA-0000447256	Retrocommissioning

5.1.3 Prescriptive Rebate Participant Summary

In PY2021, the program had two prescriptive food service projects, comprising one fryer and four convection ovens.

5.2 C&I Solutions Process Evaluation

The Evaluators conducted a formal process evaluation of the C&I Solutions Program in PY2017 and a limited process evaluation in PY2020 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 C&I Solutions Program in comparison to TRM V8.2 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 was unchanged from PY2020.
No Previous Process Evaluation	No. The program received a comprehensive process evaluation in PY2017.
New Vendor or Contractor	No. The program has been implemented by CLEAResult since 2011.

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.
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 program years PY2012-PY2021.
Are the program's operational or management structure slow to get up and running or not meeting program administrative needs?	No. The prior process evaluations 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 vastly exceeded expectations.
Do participants report problems with the programs or low rates of satisfaction?	No. Participant surveys found exceedingly 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, limited process evaluation was conducted for PY2021.

5.4.1 Data Collection Activities

The process evaluation 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:
  - *AOG Program Staff*. The Evaluators interviewed staff at AOG involved in the administration of the C&I Solutions Program.
  - *Third Party Implementation Staff Interviews.* The Evaluators conducted interviews with CLEAResult involved with the C&I Solutions Program.
- *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 of AOG's commercial and industrial customers.

Table 5-6 summarizes the data collection for this process evaluation effort. This includes the titles, role, sample sizes, and timeframe of data collection.

Table 5-5: AOG C&I Solutions Data Collection Summary

Target	Component	Activity	n	Precision	Role
AOG Program Staff	Director – Energy Efficiency Programs	Interview	1	NA	Overall administration of AOG EE programs. This manager is involved in the larger strategic decisions associated with the EE portfolio, and is involved with the Equipment Rebates Program in the overall coordination of utility resources.
	Energy Efficiency Program Manager	Interview	1	NA	Day-to-day management of programs, customer application assistance, energy savings calculations, and data QA/QC
CLEAResult Program Staff	Senior Manager	Interview	1	N/A	The Senior Manager at CLEAResult manages the day-to-day implementation, marketing, rebate processing, and QA/QC for the program.
Program Participants	Custom Participants	Interview	4	±0%	Custom participants received a semi-structured interview at the beginning of a project and a structured survey at the close. The Evaluators interviewed a census of participants.

5.4.2 Process Results & Findings

This section will present 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.

5.4.2.1 Response to Program Recommendations

Table 5-7 summarizes PY2020 recommendations and AOG responses.

Table 5-6: C&I Solutions Response to PY2020 Recommendations

Recommendation	AOG Response	Status of Issue
Expand upon the success in building optimization projects with further coordination with OG&E.	CLEAResult staff noted there are two retro commission projects in AOG territory being conducted with OG&E	Recommendation adopted

5.4.2.2 Program Theory & Design

The C&I Solutions Program was designed to provide outreach in hard-to-reach sectors of the C&I markets. The main bullets below list program activities and their expected outcomes. The secondary bullets indicate new program enhancements.

- **Direct installation of high-return saving measures.** The C&I Solutions program provides no-cost direct installation of door air infiltration, low flow faucet aerators, pre-rinse spray valves, steam traps, 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 provided 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. It is also the intention that these activities will serve as an introductory teaser 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.
- **Incentives for custom measures.** The C&I Solutions program provides $.80 per therm for verified savings from custom projects. These projects may be driven by a program-funded audit or be customer-directed. In some instances, customers attempting to participate in prescriptive programs are referred to the C&I Solutions program if their application is ineligible for deemed savings.

- **Incentives for prescriptive measures in C&I Solutions.** This includes boiler and food service equipment at fixed incentive rates.
- **Enhanced outreach to small business customers with sizable gas loads.** Customers with usage below 200,000 Therms annually qualify for $.90 per therm incentives.
- **Referral to AOG prescriptive programs.** Conversely, there are instances where the CLEAResult audit identifies energy savings opportunities that qualify for a prescriptive incentive for a furnace or water heater. In these instances, the project is referred to staff at AOG for processing, and the savings are not credited to the C&I Solutions program.

5.4.2.3 Program Administration

The C&I Solutions program is overseen by the manager of energy efficiency, regulatory and finance, and the energy efficiency manager. The utility staff report to the Director of Customer Development and the Chief Customer Officer. They also manage an energy efficiency specialist who oversees the rebate processor and rebate payments. Given the size of AOG's territory and associated program budgets, the Evaluators determined this to be an efficient allocation of staff.

At CLEAResult's end, the program overall is led by the Program Manager, who oversees the implementation of the C&I Solutions Program for AOG. 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. CLEAResult also oversees the C&I contractors. The Program Manager handles high level questions with the trade allies. Other in-house communications with trade allies involve meeting communications.

Direct install and audit activities are run by Field Staff. This staff performs direct installation and conduct the energy audits. After this, their responsibilities include development of the audit report and recommendations and following up with the customer to gauge interest in completing a project.

Marketing and Outreach activities are run by CLEAResult in collaboration with AOG. The marketing channels that are used include collateral such as brochures as well as in-person activities. Other marketing channels include online channels such as updates to the website and email blasts.

Utility staff did not report any issues with data management and quality control/assurance.

5.4.2.4 Program Implementation and Delivery

Throughout the program year, CLEAResult would provide the Evaluators with updates regarding their pipeline of custom projects. The Evaluators were provided with monthly updates, listing

the full scope of facility audits, ex ante 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 C&I Solutions Program. These participants are customers that have received a facility audit and indicated systems of interest to CLEAResult.
- *Pre-Inspected*. Projects listed as Pre-Inspected are in the phase where CLEAResult has just completed a facility audit. During these audits, CLEAResult conducts a comprehensive review of the facility's systems and operation 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 viability of recommended measures. Measures that are stated to be viable by the customer are then noted and focused upon in the next steps of the audit process.
- *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, viable 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 cost, 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 indicated as well in order to provide the customer with a full scope of the benefits of the project.
- *Project Application*. At this point, the customer has informed CLEAResult and AOG 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 Evaluator's engineering staff then reviews the M&V plan and makes recommendations for any changes needed. A project application is then signed, in which the reserved incentive amount is detailed and reflects the savings approved 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. At this point, 40% of the reserved incentive is paid if the project requires a lengthy M&V period. 100% of the reserved incentive is paid to the customer if the project only requires post-verification inspection or a short M&V period.

- *M&V*. M&V marks the phase when post-installation data are collected for an installed project in order to allow for calculation of a final savings estimate, from which the remaining incentive or 100% of the incentive amount owed to the customer is determined. There are some measures that do not need post-retrofit data; for such measures, the M&V phase is short and requires completion of calculations based upon inputs verified in the Post-Inspection. For facilities that require post-installation data, the data collection period can range from 30 days to 12 months.
- *Complete*. Facilities marked as Complete have received their full incentive. As stated previously, 60% of the reserved funds for the incentive are available to pay the remaining incentive amount or 100% of the reserved funds are available to pay the incentive amount owed to the customer. If the verified savings are below the Project Application savings, the customer's incentive is reduced accordingly, to keep incentive levels at $.80 or $.90/therm. If the verified savings are higher than the Project Application amount, CLEAResult and AOG then see if there are available incentive funds left for the program year. If the program has available funds, the customer receives a total incentive higher than the initial agreement. If the funds are not available, the customer's incentive is capped at the Project Application amount.

The process flow for the C&I Solutions Program is presented in Figure 5-2.

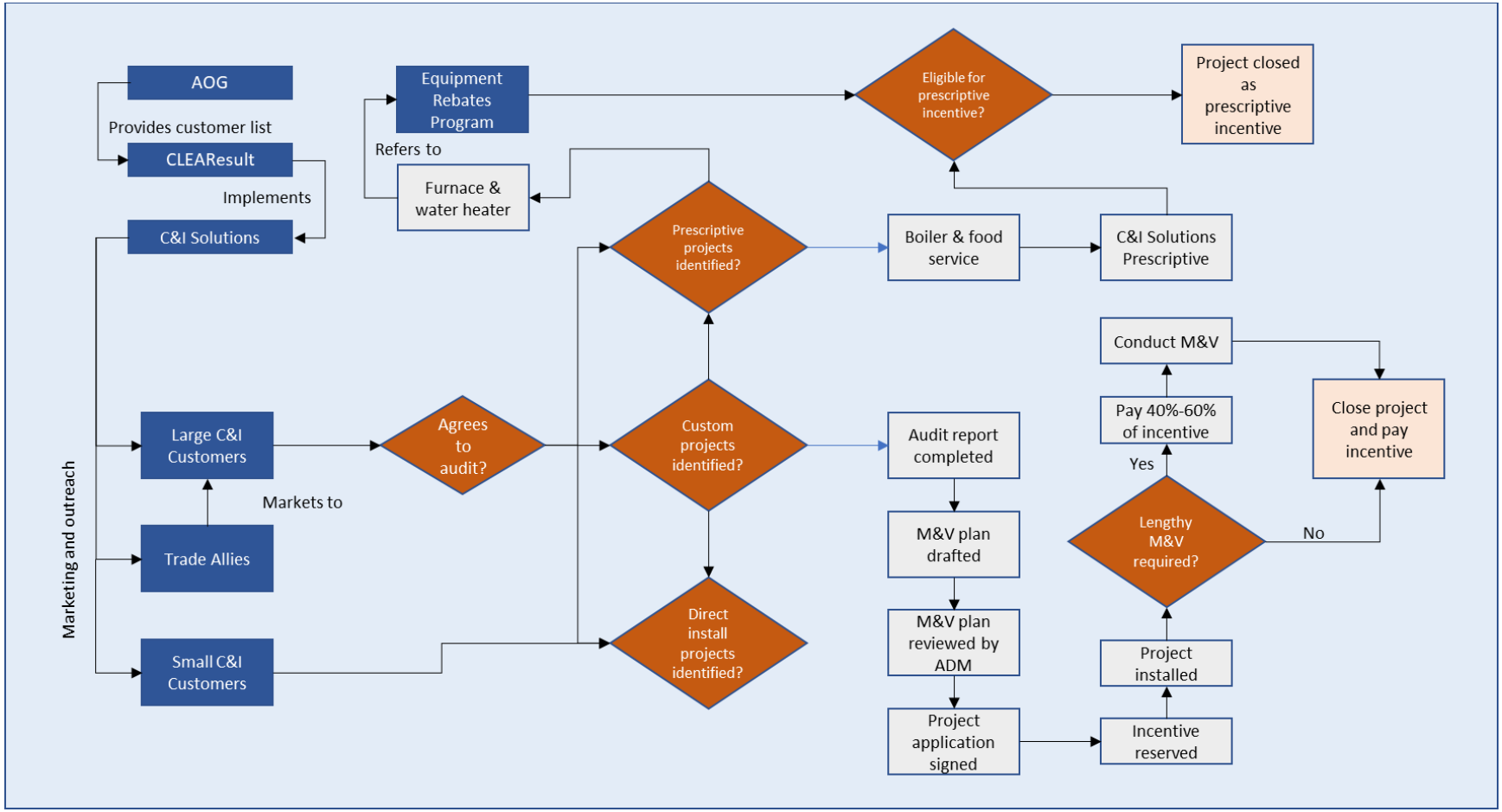


Figure 5-2: C&I Solutions Process Flow Chart

5.4.3 Adherence to Protocol A

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

During PY2021, the Evaluators received monthly tracking data updates as well as final tracking exports. The tracking system was updated to include necessary inputs as per AR TRM V8.2. Other than these updates, there were no major updates to the structure or content of program tracking data. The Evaluators reviewed program tracking data in PY2021 to assess its compliance with Protocol A 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 conducted a review of each of the above factors within PY2021 tracking data except for marketing and outreach activities as these are outside the scope of the tracking system's reporting.

Customer, Premise, Cost, and Vendor Information

Each of these factors was assessed individually based on the guidelines stated in AR TRM V8.2. Overall, the Evaluators conclude the following regarding tracking data completeness:

- Participating customer information was complete for nearly all participants.
- Custom and prescriptive projects contained complete information on the contractor that completed the installation. This was not needed for direct install as this is done in-house with CLEAResult staff.
- Tracking data included the measure and project costs for each project.
- Weather zones were provided in the tracking data.
- All inputs needed to re-calculate savings according to TRM V8.2 Protocols were present in the direct install database.

Measure Specific Information

The content of tracking data was found to include sufficient information for all measures in PY2021.

5.4.4 Custom Participant Survey Response

The Evaluators interviewed four custom participants as part of the EM&V of the C&I Solutions Program. Given the low volume of participants, these surveys were treated as one-off case studies rather than as an aggregated survey.

Three participants that accounted for four measures were participants that have completed multiple projects in the program in prior program years. The participants included a school district with one project, and a hospital system with projects at two locations.

The two hospitals received retrocommissioning that is jointly funded with OG&E, and M&V is still in progress. As a result, these projects have 40% partial savings claim for PY2021 based on their initial savings reservation that had been reviewed by the Evaluators as part of the custom M&V plan review process. Their estimated savings is 56,676 (combined for both facilities) and 22,670 of this has bene claimed in PY2021.

Seventy-one percent of custom savings are from four measures completed at one facility. This an agricultural facility that has installed two boilers and two waste heat recovery systems. This has a lengthy M&V period, and thus a 40% partial savings claim was made for PY2021. The estimated savings is 246,624 therms and 98,650 if this has been claimed for PY2021.

5.5 C&I Solutions Impact Evaluation

The impact evaluation of the C&I Solutions Program included the following:

- *Custom Project M&V.* The Evaluators conducted project-specific M&V on a census of custom projects completed through the C&I Solutions program. Each project included an M&V plan and project-specific report.
- *Free-ridership Estimation.* A free-ridership rate for custom participants was estimated through participant surveying. Respondents were asked a series of questions related to their past experience with the appropriate measures, and whether they had ever installed similar equipment at the participating premise or at other premises within their organization. Direct Install and Prescriptive channels had NTGRs based on PY2020 survey efforts.

5.5.1 Summary of Non-Energy Benefits

Table 5-7 summarizes the non-energy benefits by measure that are be credited to the C&I Solutions Program.

Table 5-7: C&I Solutions Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	ARC/DRC
Weather Stripping	✓			

5.5.1.1 Electric Savings Calculation Procedure

Electric savings were claimed for commercial weather stripping. This direct install effort is not jointly administered with OG&E so all projects produce NEBs claimable by AOG. For these projects, AOG is credited with the cooling savings from weather stripping specified in AR TRM V8.2 Section 3.2.11.

5.5.2 C&I Solutions Direct Install Impact Evaluation

5.5.2.1 Deemed savings calculations

For sample TRM calculations, see Appendix C.

5.5.2.2 Direct Install Verification Rates

The Evaluators conducted documentation review for a sample of five direct install projects (out of the total population of 6) and found that program tracking entries matched supporting documentation in all instances. Direct install was entirely comprised of weather stripping in PY2021.

5.5.2.3 Direct Install Free-ridership

Direct Install participants were surveyed in PY2020 to estimate NTG, and this value was applied to PY2021. The methodology used in that evaluation is summarized here.

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 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 the 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. Based on PY2020 survey findings, the direct install channel had 87.5% NTGR.

5.5.2.4 Direct Install Spillover

No instances of spillover were identified among the C&I Solutions DI survey respondents.

5.5.3 C&I Solutions Prescriptive Projects Impact Evaluation

The C&I Solutions Program processed two prescriptive food service rebates in PY2021. The gross realization was 109%.

Table 5-8: C&I Solutions Prescriptive Project Summary

Measure	Ex Ante Therms	Ex Post Therms	Lifetime Savings
Fryer	585	558	6,696
Convection Oven	916	1,080	12,960
Total	**1,501**	**1,638**	**19,656**

5.5.4 Prescriptive Program Free-ridership

The C&I Solutions Program processed two prescriptive food service rebates in PY2021. A NTG of 77.2% was assigned based on prior NTG research conducted for CenterPoint Energy's Commercial Food Service Conservation Improvement Program.

5.5.5 C&I Solutions 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 PY2021. "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: AOG C&I Solutions Custom Project Summary

Facility Type	Project ID	Measure	Ex Ante	Ex Post	M&V Protocol
K-12 School	EA-0000352588	Steam Trap Replacement	1,915	1,915	Deemed
		Steam Trap Replacement	10,757	10,757	Deemed
Hospital	EA-0000447432	Retrocommissioning	4,558	4,558	Option C*
Food Processing	EA-0000429856	Insulation	4,848	4,848	Option A
Agriculture	EA-0000363835	Boiler Retrofit #1	8,746	8,746	Option C*
		Boiler Retrofit #2	8,746	8,746	Option D*
		Waste Heat Recovery #1	40,579	40,579	Option D*
		Waste Heat Recovery #2	40,579	40,579	Option D*
Hospital	EA-0000447256	Retrocommissioning	18,112	18,112	Option D*
Total			**138,840**	**138,840**	
***Project claiming 40% of ex ante in PY2021, M&V not completed**					

5.5.5.1 Custom Project Free-ridership

The Evaluators conducted interviews with four decision-makers responsible for the completed custom projects in the C&I Solutions program in PY2021. 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 Evaluators opted to present the results in terms of individual case studies, rather than aggregated survey responses. 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 [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 any 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-2 Did you have plans to install the [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

- *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
❑ No

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
❑ More than 5 years later

The scoring mechanism for custom projects is presented in Figure 5-3.

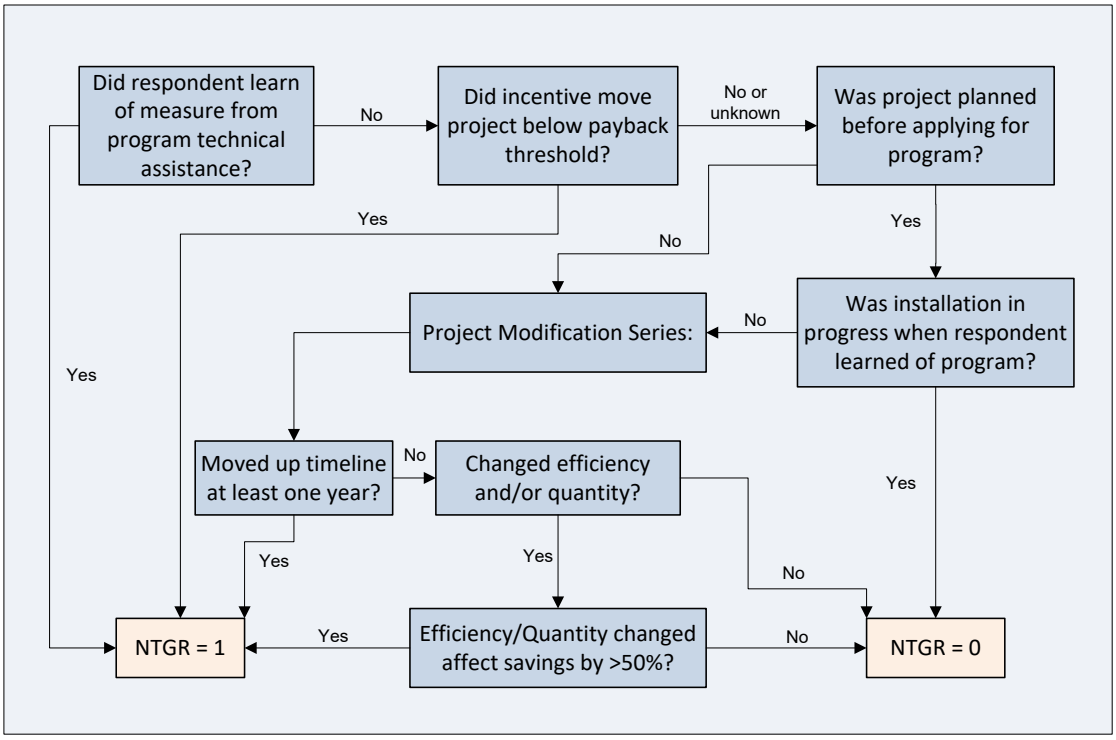


Figure 5-3: C&I Solutions Custom Project Free-ridership Diagram

The resulting NTGRs by project are presented in Table 5-10.

Table 5-10: AOG C&I Solutions Custom Project Free-ridership Results

Facility Type	Project ID	Measure	Ex Post Gross Savings	Ex Post Net Savings	NTGR
K-12 School	EA-0000352588	Steam Trap Replacement	1,915	1,915	100%
		Steam Trap Replacement	10,757	10,757	100%
Hospital	EA-0000447432	Retrocommissioning	4,558	4,558	100%
Food Processing	EA-0000429856	Insulation	4,848	4,848	100%
Agriculture	EA-0000363835	Boiler Retrofit #1	8,746	8,746	100%
		Boiler Retrofit #2	8,746	8,746	100%
		Waste Heat Recovery #1	40,579	40,579	100%
		Waste Heat Recovery #2	40,579	40,579	100%
Hospital	EA-0000447256	Retrocommissioning	18,112	18,112	100%
Total			**138,840**	**138,840**	**100%**

5.5.5.2 Overall Program NTGR

The overall program NTGR for the C&I Solutions Program is defined as:

$$Program\ NTGR = \frac{Net\ DI\ Savings + Net\ Custom\ Sasvings + Prescriptive\ Net\ Savings + \ Particpant\ Spillover}{Gross\ DI\ Savings + Gross\ Custom\ Savings + Gross\ Prescriptive\ Savings}$$

The resulting NTGR is:

$$Program\ NTGR = \frac{34{,}136 + 138{,}840 + 1{,}265 + \ 0}{39{,}013 + 138{,}840 + 1{,}638} = 97.0\%$$

5.5.6 C&I Solutions Project Cost Review

Incremental costs were developed as follows:

Direct Install	Incremental cost set to equal total incentive, as incentive covers equipment and labor costs, and there is no customer co-pay.
Prescriptive	Prescriptive projects in PY2021 were all food service measures. Incremental costs cited most-recent ENERGY STAR cost values.
Custom	ADM conducted a cost review on a census of custom projects.

Cost estimates for Direct Install and Prescriptive were straightforward and in-line with program expectations.

Cost estimates for Custom showed discrepancies that required resolution. Cost estimate revisions are summarized below.

EA-0000447432	Project cost of $64,063.72. The project is retro-commissioning and cost-shares with OG&E. Based on incentive amounts by fuel, 65% of the project cost was attributable to AOG. Further, the project is only a 40% savings claim for PY2021 while M&V is complete. Final project cost was calculated as: Project Cost: $64,063.72 * 65% cost share * 40% PY2021 partial savings claim = $16,567.70
EA-0000363835	Project cost of $839,970.00, shown across four separate measure line-items and totaling $3,359,880.00. This project includes multiple measures: indoor agriculture lighting, chillers, boilers, and waste heat recovery. The cost shown included costs associated with electric measures. These were separated out. Further, the project is only a 40% savings claim for PY2021 while M&V is complete. After adjusting for measure line item duplication, removal of electric measures, and 40% pro-rating, project cost for AOG was $128,298.14.
EA-0000447256	Project cost of $574,609.84. The project is retro-commissioning and cost-shares with OG&E. Based on incentive amounts by fuel, 52% of the project cost was attributable to AOG. Further, the project is only a 40% savings claim for PY2021 while M&V is complete. Final project cost was calculated as: Project Cost: $574,609.81 * 52% cost share * 40% PY2021 partial savings claim = $120,157.65

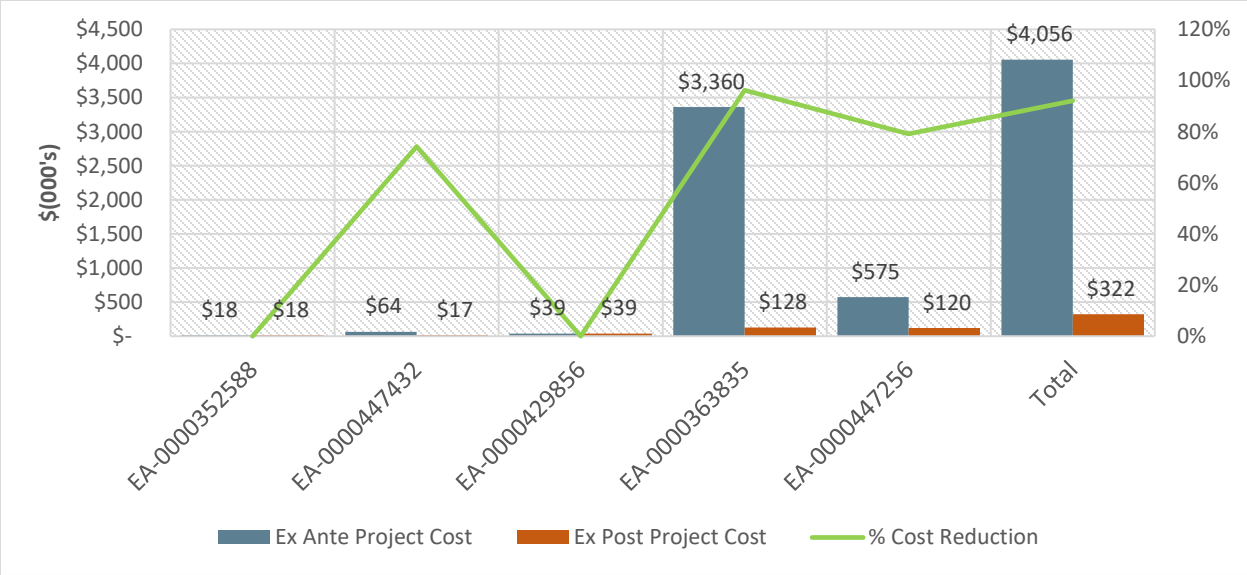


Figure 5-4: Custom Project Incremental Cost Revision

5.5.7 Ex Post Savings

Table 5-11 and Table 5-12 present the ex-post savings for the Commercial & Industrial Solutions program. EUL for the custom component is variable.

Table 5-11: Commercial & Industrial Solutions Ex Post Gross Savings

Measure Category	Ex Ante Therms	Ex Post Therms	Gross Realization Rate	EUL	Ex Ante Lifetime Savings	Ex Post Lifetime Savings
Direct Install	39,013	39,013	100.0%	11	429,139	429,139
Custom	138,840	138,840	100.0%	13.26	1,840,878	1,840,878
Prescriptive	1,501	1,638	109.1%	12	18,017	19,656
Total Gross Savings	**179,354**	**179,491**	**100.1%**	**12.75**	**2,288,034**	**2,289,673**

Table 5-12: Commercial & Industrial Solutions Ex Post Net Savings

Measure Category	Ex Ante NTGR	Ex Post NTGR	Ex Ante Net Savings	Ex Post Net Savings	Net Realization Rate	Ex Ante Lifetime Savings	Ex Post Lifetime Savings
Direct Install	87.50%	87.50%	34,136	34,136	87.50%	375,497	375,497
Custom	100.00%	100.00%	138,840	138,840	100.00%	1,840,878	1,840,878
Prescriptive	77.20%	77.20%	1,159	1,265	100.00%	13,909	15,174
Total	**100.00%**	**97.40%**	**174,135**	**174,241**	**97.40%**	**2,230,284**	**2,231,549**

Table 5-13: Commercial & Industrial Solutions Ex Post Net Electric Savings

Measure Category	Net Annual kWh	Net Peak kW	Lifetime Net kWh
Direct Install	470	.34	5,169
Custom	0	0	0
Prescriptive	0	0	0
Total	**470**	**.34**	**5,169**

5.6 Conclusions

The program met savings goals and was highly cost-effective	The program met 108% of its net savings goal while spending 93% of its program budget
	The program TRC has decreased from 1.79 to 1.63.
Custom project EUL increased significantly	Custom project EUL was 7.53 in PY2020 and increased to 13.26 in PY2021. If EUL had been the same as observed in PY2020, TRC would have dropped from 1.57 to .99.
The program has continued successful coordination with OG&E	16% of custom channel savings were from dual-fuel projects jointly incented with OG&E.
PY2021 savings were heavily focused on projects with long M&V periods	70% of PY2021 program-level net savings are from partial savings claims for projects that have been installed but are still under M&V. This is atypical and an unexpected result but was necessary to service customers that wished to engage with the program while maintaining cost-effectiveness on an annual basis.
NEBs have declined significantly	There were no water NEBs in PY2021. The direct install channel focused entirely on weather stripping, and the custom and prescriptive channels did not have water-saving projects (such as steam leak repair, condensate return, or combi ovens). As with the matter of projects with partial savings claims, this is largely happenstance – with the small size of AOG's service territory, the occurrence of water-saving projects is not a guarantee.
Custom project incremental costs required significant adjustments	The Evaluators reduced custom project incremental costs by 92%, after accounting for: 1) Cost duplication across line items 2) Cost-splitting between AOG and OG&E 3) Cost-splitting to account for partial savings claims

5.7 Recommendations

Refine incremental cost methods for custom projects	Refinements to incremental costs that should be completed include: 1) Examining custom projects for cost duplication across measure line items. 2) Pro-rating incremental costs by the same percentage as claimed in a partial savings claim for large projects undergoing long-term M&V. 3) Splitting costs for jointly incented dual-fuel projects between AOG and OG&E

6. AOG Weatherization Program

AOG launched the AOG Weatherization Program (AOGWP) in 2011. For its first five years of operation, the program was run as the AOG/OG&E Joint Weatherization Program. After the Arkansas utilities adopted the Consistent Weatherization Approach (CWA) under APSC guidance, the program had its offerings modified to comply with the CWA. The program is designed to train contractors to analyze energy use for single and multifamily homes and identify energy efficiency improvements which are then provided at no cost to the customer.

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;
- Low flow showerheads; and
- LEDs.

Weatherization measures include:

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

The program offers direct installation of LEDs in municipal/co-op-served homes that are otherwise eligible for weatherization measures. AOG opted to offer this to ensure a consistent offering for their customers. This benefit is possible due to the APSC guidance on NEBs allowing for the claiming of cross-fuel savings.

6.1 Program Overview

The AOGWP was operated formerly implemented directly by AOG with trade ally assistance. In PY2021, this transitioned to third-party implementation by CLEAResult. In PY2021, the program had $1,754,746 in budget allocated. Table 6-1 summarizes the historical performance of the AOGWP since its reorganization to the CWA.

Table 6-1: AOG AOGWP Performance against Goals

Program Year	Budget			Net Therms		
	Spent	Allocated	% Spent	Ex Post	Goal	% Achieved
2017	$1,514,740	$1,546,943	98%	291,031	158,145	184%
2018	$1,564,105	$1,564,105	100%	250,792	158,145	159%
2019	$1,424,484	$1,600,745	89%	221,942	158,145	140%
2020	$1,280,586	$1,747,200	73%	230,147	216,543	106%
2021	$770,478	$1,754,746	44%	227,257	216,543	105%

6.1.1 Participation Summary

The AOGWP had 691 participants in PY2021, a decrease from 838 in PY2020. The program focuses on single family housing, as multifamily housing in AOG's service territory is largely all-electric.

Figure 6-1 summarizes the share of program savings contributed by each measure, compared to PY2020. Most savings came from ceiling insulation, duct sealing, and air sealing. There was a 62-therm penalty due to the direct installation of LEDs in homes served by Arkansas Valley Electric Cooperative (a co-op utility based in Van Buren, AR) and SWEPCO, with whom AOG does not have a fuel coordination agreement. The projects that included these therm penalties were completely paid for by AOG for all measures installed.

Savings from ceiling insulation declined 82% and savings from air sealing declined by 27%. Savings from duct sealing increased 119%.

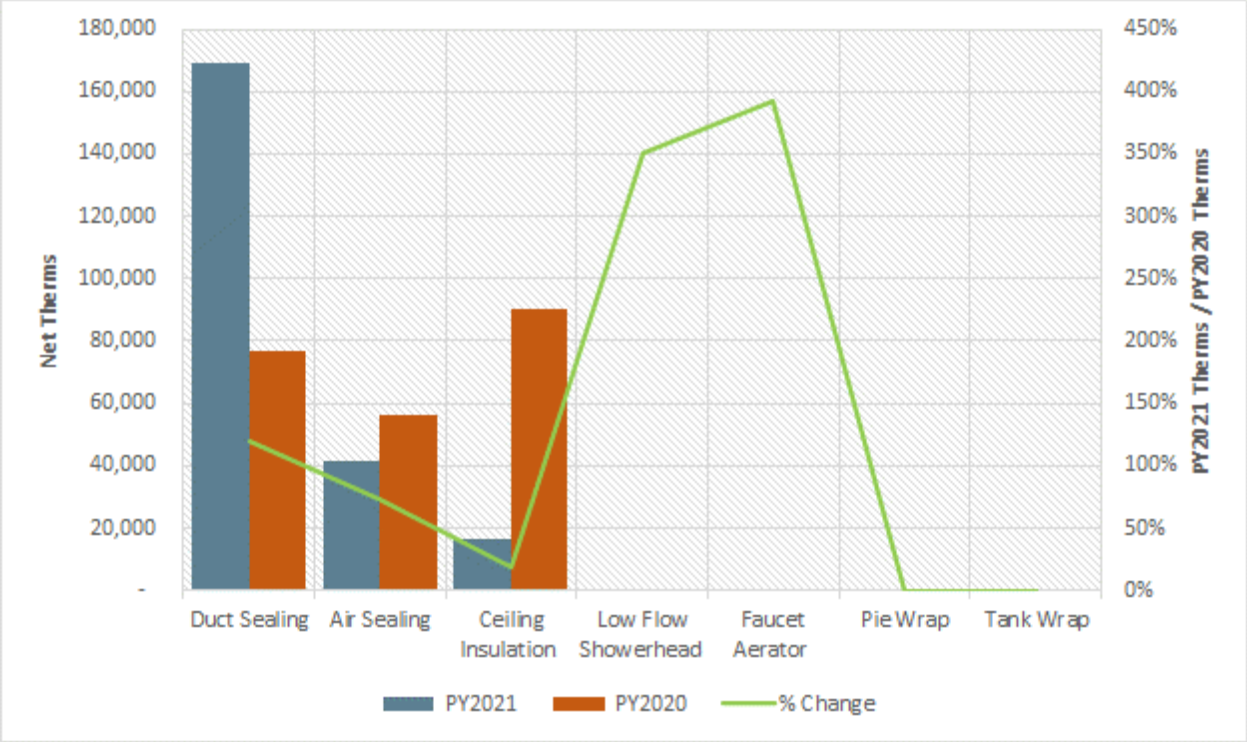


Figure 6-1: Program Net Savings by Measure

Figure 6-2 summarizes the per-project savings for weatherization measures from PY2020 to PY2021. The per-project savings increased for all measures, most notably with duct sealing increasing from 98 to 334 therms.

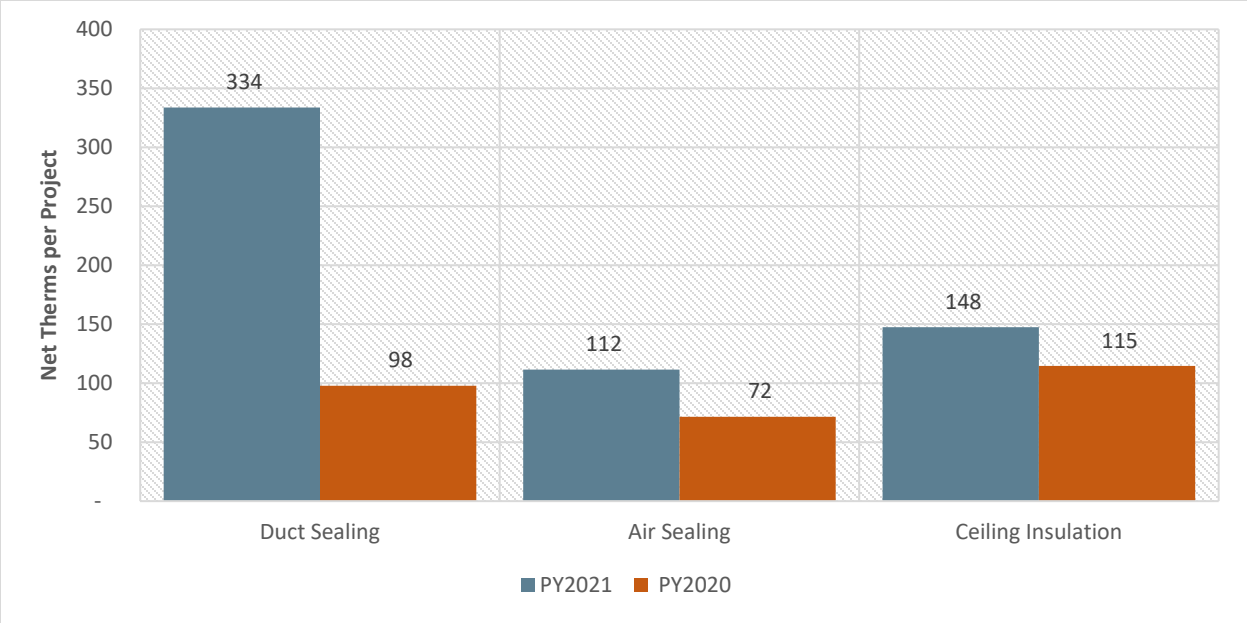


Figure 6-2: Savings Per-Project for Major Measures

In addition, incentives were provided for 679 assessments (98% of participants, increased from 96% of total participants in PY2021).

6.1.2 Contractor Participation

In PY2021, the AOGWP used four trade allies that were subcontracted under CLEAResult to administer the weatherization services. The three trade allies that had supported the program prior to PY2021 elected to discontinue services under the revised program rules.

6.1.3 Participation Timing

Figure 6-3 summarizes the premises by month as determined by the date services were provided. There was no participation in the first quarter due to the onboarding process for CLEAResult. Participation began in the second quarter and peaked in September through November.

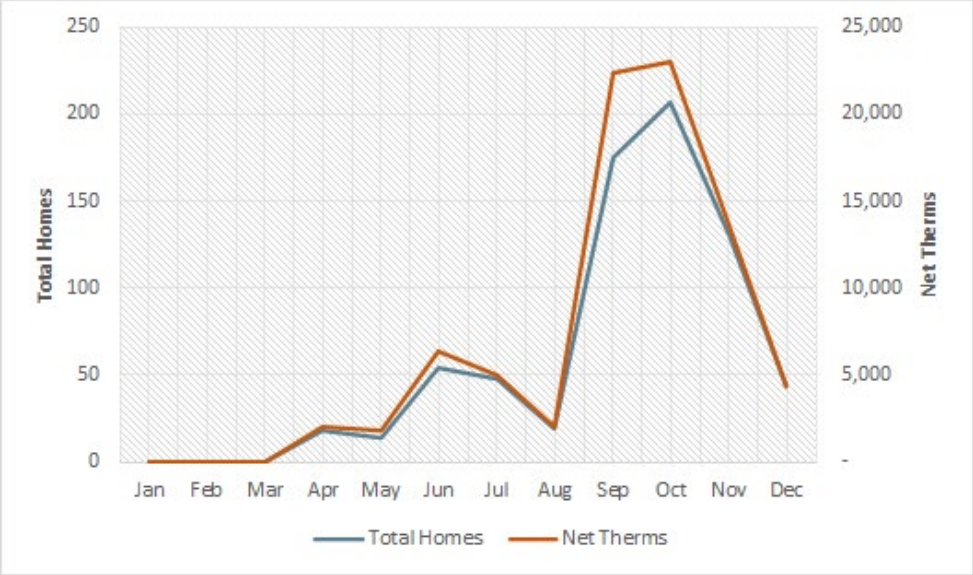


Figure 6-3: AOGWP Premises by Month

AOG staff noted a change in project flow following the management handoff to CLEAResult. In the past, AOG's weatherization program witnessed a steady flow of energy savings throughout the year. However, since the transition to CLEAResult, energy savings have occurred in ebbs and flows, with large bursts followed by plateaus. AOG staff noted that this change in cadence reflects CLEAResult's model of having contractors cover geographical area by geographical area, so plateaus occur when contractors are focused on a geographical area outside of AOG's territory.

6.2 AOGWP Process Evaluation

The Evaluators conducted a formal process evaluation of the AOGWP in PY2020 and determined that the program was operating effectively and had been successful in meeting its goals. AR TRM V8.2 Protocol C addresses the criteria used to determine the timing and conditions needed for a process evaluation, and the following tables summarize the program in the context of these requirements.

Table 6-2: Determining Process Evaluation Timing

Component	Determination
New and Innovative Components	No. The program has remained the same as previous years.
No Previous Process Evaluation	No. A formal process evaluation was conducted in 2020, and limited process evaluations have been conducted in each year since 2012.
New Vendor or Contractor	Yes. The program transitioned to being implemented under CLEAResult.

Table 6-3: Determining Process Evaluation Conditions

Component	Determination
Are program impacts lower or slower than expected?	No. The program has consistently met its savings goals.
Are the educational or informational goals not meeting program goals?	No. Program awareness within the customer market has increased, and educational efforts have been successful.
Are the participation rates lower or slower than expected?	No. The program has consistently met its participation goals.
Are the program's operational or management structure slow to get up and running or not meeting program administrative needs?	No. The prior process evaluation found these structures to be operating efficiently with adequate resources.
Is the program's cost-effectiveness less than expected?	No. The program's cost-effectiveness has been maintained at expected levels.
Do participants report problems with the programs or low rates of satisfaction?	No. Participants have consistently reported high levels of satisfaction with their program experience.
Is the program producing the intended market effects?	Yes. Non-program contractors are being informed of opportunities within the non-participant market. Surveyed participants also appear more aware of energy efficiency in general.

The Evaluators conducted a full process evaluation for AOGWP in PY2020. The Evaluators conducted a partial process evaluation in PY2021 to address the impact of transitioning away from in-house implementation to implementation by CLEAResult.

6.2.1 CWA Metrics Summary

The key CWA metrics are presented in Table 6-4. The table presents PY2020 in comparison to PY2021 to address changes as a result of transitioning to CLEAResult.

Table 6-4: CWA Program Metrics Summary

Metric	Value	
	PY2020	PY2021
Program Name	AOG Weatherization Program	AOG Weatherization Program
CWA Implementation	The CWA is implemented directly by AOG with the use of a closed network of pre-approved trade allies. The program coordinates heavily with OG&E. Of particular note, AOG has opted to fund installation of LEDs in customer premises that are served by municipal or co-op utilities.	The CWA is implemented by CLEAResult under contract with AOG. The program uses a closed network of pre-approved trade allies. The program coordinates heavily with OG&E. Of particular note, AOG has opted to fund installation of LEDs in customer premises that are served by municipal or co-op utilities
Total Audits Completed	805	679
Total Submitted Projects	838	691
Conversion Rate	96.1%	98.2%
Measures installed per-project	4.38	2.45
Cost per participant	$0 cost to participants. AOG paid $1,528 per home	$0 cost to participants. AOG paid $685 per home
Percent of contractors promoting program	100%	100%

The program significantly declined in measures per-home (4.38 to 2.45), and decreased spending per-home from $1,528 to $685.

6.2.2 Prior Recommendation Response

The prior recommendations and their status are as follows:

Table 6-5: Weatherization Prior-Year Recommendation Tracking

Recommendation	AOG Response	Status
Add an indicator for whether a home was assessed prior to the launch of the Consistent Weatherization Approach.	Currently not tracking that on induvial homes, but have past tracking data. No new indicator.	Reviewed & rejected
Consider increasing referral rates to the Low Income Pilot Program.	Have not increased goal, but have gone over it. Willing to increase in conjunction with PWC based on joint action	Under consideration

6.2.3 Data Collection Activities

The process evaluation of the AOG Weatherization Program 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:
  - *AOG Program Staff*. The Evaluators interviewed staff at AOG involved in the administration of the AOG Weatherization Program.
  - *CLEAResult Program Staff*. The Evaluators interviewed staff at CLEAResult that conduct implementation of the program
- *Participant Surveying*. The Evaluators surveyed 47 owner-occupant participants in the AOGWP, collecting feedback on their experiences with the program.

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: AOGWP Data Collection Summary

Target	Component	Activity	n	Sample Precision	Role
AOG Program Staff	Director of Energy Efficiency Programs	Interview	1	N/A	The Director of Energy Efficiency manages financial, contractual, and regulatory matters across the AOG portfolio.
	Senior Manager of Energy Efficiency Programs	Interview	1	N/A	The Senior Manager of Energy Efficiency conducts day-to-day management and oversight of implementation and marketing efforts by CLEAResult.
CLEAResult Program Staff	Senior Manager	Interview	1	N/A	The Senior Manager at CLEAResult manages the day-to-day implementation, marketing, rebate processing, and QA/QC for the program.
Program Participants	Single Family Participants	Survey	47	±11.6%	This survey was conducted on a sample of single-family owner-occupants who participated in the program.

6.2.4 Program Theory & Design

The program provides comprehensive weatherization services at no cost to all eligible AOG customers. It fulfills the requirements specified in the Consistent Weatherization Approach and remains AOG's most successful program offering.

6.2.5 Program Administration

The AOGWP is managed by the following staff:

- AOG Staff:
  - Director of Energy Efficiency Programs – overall contractual oversight, financial management.
  - Senior Manager of Energy Efficiency Programs – Day-to-day project management and oversight of CLEAResult.
- CLEAResult Staff:
  - Senior Manager of Energy Efficiency Programs – Day-to-day project management, over-sight of Trade Allies, program administration, marketing, delivery, and QA/QC.

The program transitioned to CLEAResult in PY2021. In past years, AOG staff indicated that the program faces the same issue of interest levels being higher than the program can accommodate, so they endeavored to limit marketing. This would result in the program being

shut down prior to the end of year. In PY2021, the program was moved under CLEAResult's geographical targeting approach, with the intent of completing projects in a compressed timeframe with a trade ally network that serves multiple utility service territories.

Prior to the transition to CLEAResult, the program paid incentives that were fixed based on the type of measure installed. This has changed to a per-Therm performance payment in PY2021.

6.2.6 Program Implementation & Delivery

There are three distinct program channels for the AOGWP:

- **Assessment.** The Assessment is a comprehensive audit which includes conducting duct blast and blower door testing. This testing is needed to pre-qualify a home for duct sealing and air sealing improvements. To qualify for an assessment, a home must have natural gas space heating and must have been built prior to 2009. These customers also receive all eligible direct install measures.
- **Installation without Assessment.** Further, in some instances trade allies would perform a limited weatherization effort without a complete Assessment. This would occur in instances where a home received one measure in a prior year but did not receive all eligible measures (for example, for many years the program did not offer duct sealing).
- **Direct Install Only.** If a home has electric space heating but natural gas water heating, or otherwise does not qualify for weatherization improvements, the AOGWP would still provide direct installation of faucet aerators, low flow showerheads, pipe wrap, tank wrap, or LEDs where appropriate.

AOG enrolls participants through its online portal, its customer call center, and through outreach by program trade allies. The online registration portal is straightforward and captures the information needed for program qualification (year built) and whether the customer is served by an electric investor-owned utility or by a muni/co-op. The fields use drop-down menus wherever possible in order to ensure ease of use. The portal has added income criteria to assist identifying Act 1102-eligible customers.

6.2.7 Marketing

The AOGWP is marketed to trade allies and to end-use customers. AOG works very closely with OG&E in jointly administering the program in their largely overlapping service territory. Figure 6-4 shows the website advertisement for the program.

Figure 6-4: AOG Website Marketing

AOG does not engage in any larger, mass-media marketing of the program. The reasons they cite for this include:

- High program awareness (which has been supported by past non-participant surveys completed by the Evaluators);
- Issues with oversubscription: AOG staff note that they work carefully to manage oversubscription under current operational practices, and as such they have concluded that funds should go to AOGWP projects rather than more costly marketing efforts.

6.2.8 Adherence to Protocol A

With implementation moving to CLEAResult, program tracking transitioned from the Frontier Associates EnerTrek database to the CLEAResult DSMT database. In accordance with Protocol A, 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 note in Table 6-7 below the data fields that were present in EnerTrek that are not present in DSMT, as well as assess the importance of their inclusion.

Table 6-7: AOGWP Protocol A Findings

Data field	Description	Importance	Rationale
HVAC system configuration	Data field specified the presence/absence of space cooling, heating system and system type, etc.	Medium	Past data showed that there were homes with central heating but with a window AC for cooling. This affects the calculability of electric cross-fuel NEBs. If a home has a window AC, then the home is still eligible for NEBs from air sealing and ceiling insulation but not from duct sealing. This is a small factor (1% of total AOG customers which had claimable NEBs in PY2020 had window units) but still requires tracking for accurate NEB calculation. This factor is more important for this to be addressed in electric programs to address heat pump versus electric resistance heating – lower variation in gas programs that have gas furnace has a program requirement.
Electric Utility	Data field specified the which electric utility serves the customer (OG&E, SWEPCO, or AR Valley Electric Co-op).	High	Necessary to address whether the project is eligible for cross-fuel NEBs.
Stories	How many stories the home is.	Medium	This parameter is needed to calculate Minimum Ventilation Rate for air sealing measures.
Total Occupants	How many occupants are in the home	Low	This parameter has not been used in savings analyses.
Act 1102 Eligibility	Data fields for 65+ and income, showing a home as Act 1102 qualified	Low	This is screened and shown separately elsewhere.

Customer, Premise, Cost, and Vendor Information

Each of these factors was assessed individually based on the guidelines stated in AR TRM V8.2. 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, and full names. In PY2021, 98.3% of all projects had complete customer information. No email addresses were tracked, however.
- 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.
- Key parameters (square footage, duct/blower test values, AC system tons) were tracked. Secondary parameters (home stories, for example) were not tracked.

Measure Specific Information

The content of tracking data was found to include sufficient information for all measures in PY2021. There were no large issues with measure specific information in the PY2021 program tracking data.

6.2.9 Impact of Home Assessments

The Evaluators reviewed the measure installations energy savings from each tier of participants in the AOGWP. The Evaluators key findings from this review were:

- **Assessment homes displayed higher measure update and savings than residencies which were install-only.** In PY2021, assessment homes installed an average of 2.45 measures and had average savings of 330.13 therms. Homes which received measures, but no assessment installed an average of 2.79 measures and average 257.54 therms. Homes with assessments showed 12% higher savings in PY2021 compared to PY2020.

  These results are summarized in Figure 6-5. The measure counts exclude line items from program tracking data pertaining to assessment rebates or health and safety measures and are inclusive only of energy-saving measure installations.

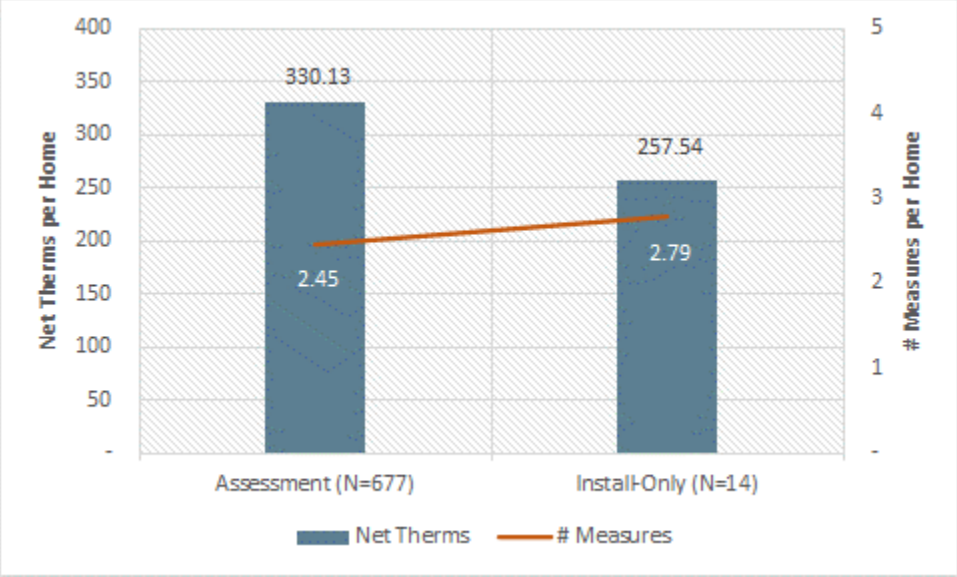


Figure 6-5: Installation & Savings by Participant Type

- **Performance rates differed by contractor.** The Evaluators reviewed the projects completed by each trade ally. Key performance metrics are detailed below.

Table 6-8: Trade Ally Performance Indicators

Trade Ally	# Homes	% Program Savings	Therms / Home	Measures / Home	% Projects with Assessments
Trade Ally #1	136	11.6%	194	1.88	94.7%
Trade Ally #2	133	23.1%	394	2.32	97.7%
Trade Ally #3	162	32.5%	455	2.95	97.6%
Trade Ally #4	263	32.8%	283	2.51	100.0%
Trade Ally Name Missing	1	0%	0	0	N/A

To investigate this further, the Evaluators reviewed what percent of projects by each trade ally included duct sealing, air sealing, or ceiling insulation project. As shown in Figure 6-6, there are broad discrepancies in terms of the types of measures installed by each trade ally.

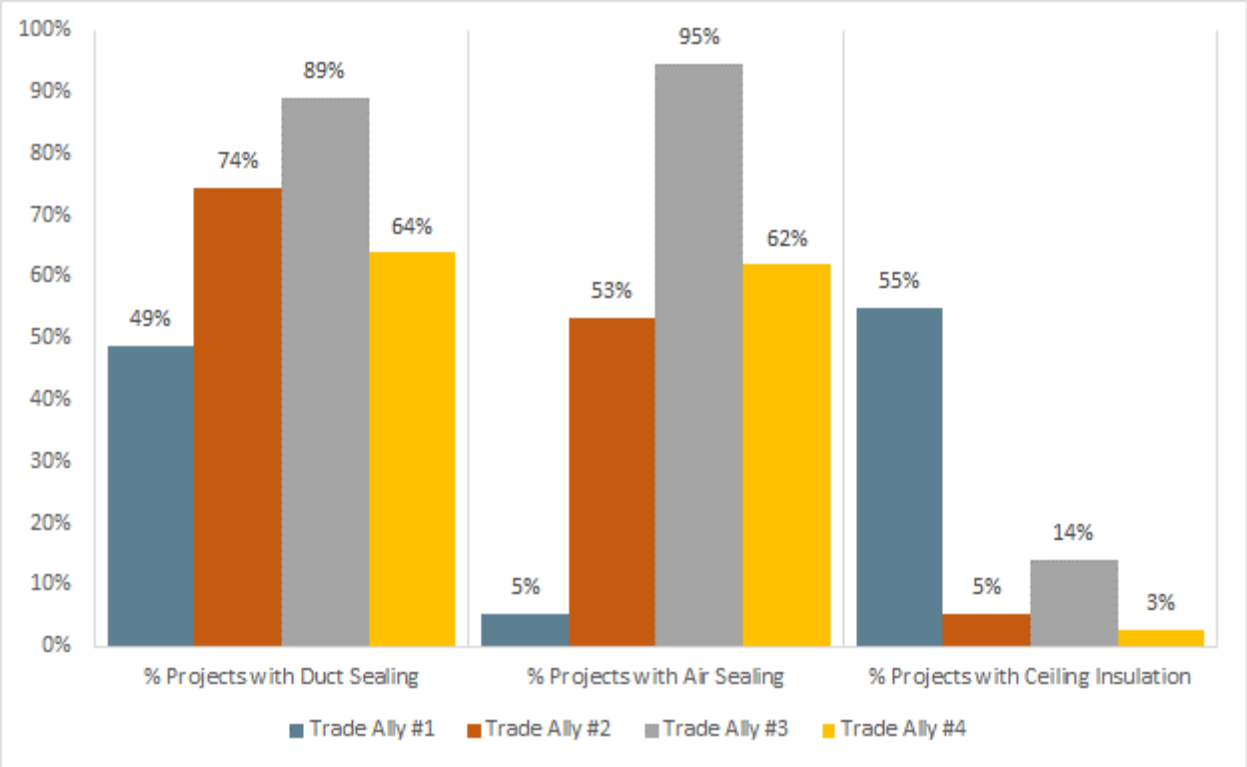


Figure 6-6: Percent of Projects with Key Measures by Trade Ally – PY2021

For context, Figure 6-7 presents the percent of projects with each major weatherization measure in PY2021 compared to PY2020. Though more savings have come from duct sealing, the percent of projects with duct sealing has nonetheless declined along with air sealing and ceiling insulation, as the average number of measures per-project has declined.

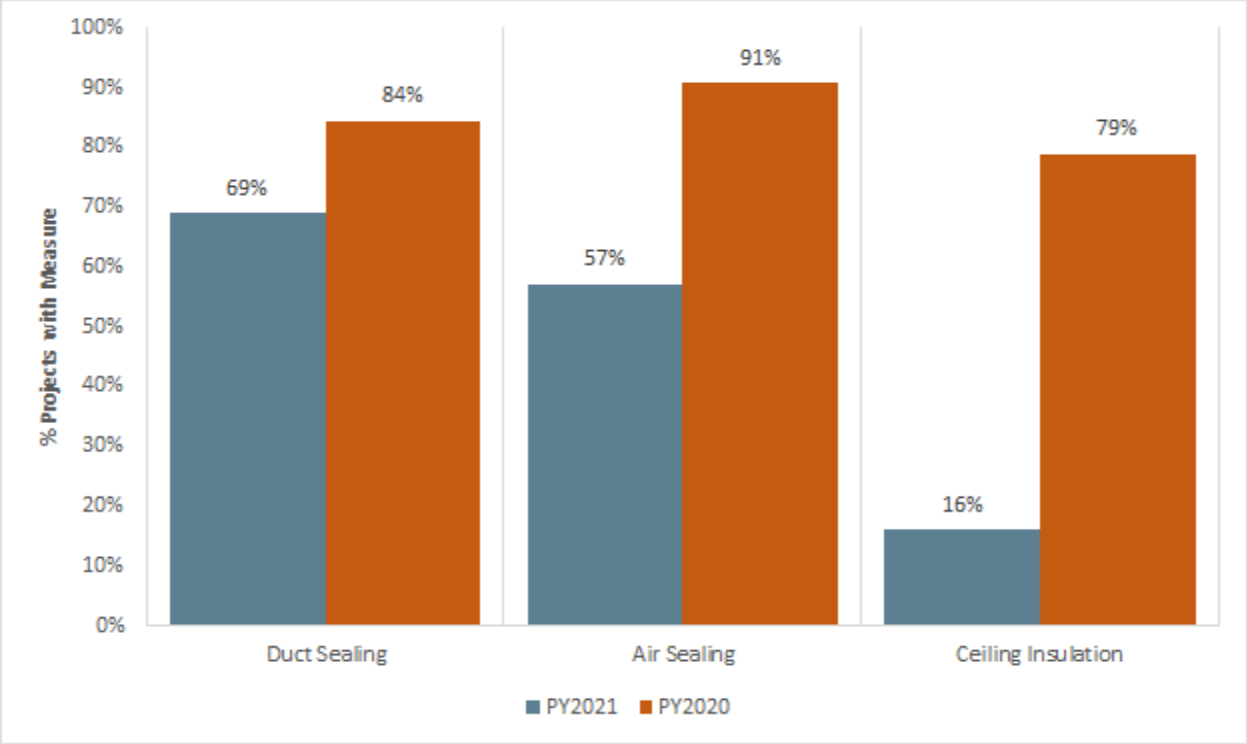


Figure 6-7: Percent of Projects with Key Measures– PY2021 vs. PY2020

AOG and CLEAResult staff noted that there were supply shortages for insulation materials which may have affected Trade Allies' ability to deliver this measure. However, this shortage does not affect duct sealing or air sealing. Historically, the acquisition cost of savings by measure has had a clear pattern in terms cost per therm from core weatherization measures:

- Highest: duct sealing
- Middle: air sealing
- Lowest: ceiling insulation

Prior to PY2021, the program paid based on work completed. With the move to performance payment in PY2021, projects are more likely to be single-measure (though with higher per-project CFM reductions for duct sealing and air sealing than observed in prior program years). Given this, it is possible that trade allies may be omitting savings opportunities.

The Evaluators recommend that CLEAResult and AOG address this issue of project comprehensiveness with Trade Allies. Possible strategies include:

1. Acceleration payments for homes based on measure count.
2. Performance benchmarks based on measure count (variable based on number of weatherization measures versus number of direct install measures.

3. Program-funded training in other weatherization measures should the Trade Ally lack technical background (such as instruction on operation of a blower door or duct blaster).

This could also be supplemented with QA visits to single-measure projects from PY2021 that address not just the quality of the work completed but also test for eligibility for the two weatherization improvements that were not installed.

6.2.10 Participant Survey Response

The Evaluators surveyed 47 participants in the CWA program. These surveys were to collect data on participant experience with the program including sources of program awareness, motivations for participating, and satisfaction with the program. Furthermore, the evaluators collected demographic information on the respondents during the survey.

Respondents were more limited than observed in prior years. The program contact data was limited to phone numbers, and the Evaluators have noted decreased willingness to participate in telephone surveys in recent years. The Evaluators recommend the addition of email addresses in future program tracking data.

6.2.10.1 Program Awareness

Program awareness is driven mostly by word-of-mouth from past participants.

Forty-three percent (n=17) of respondents learned about the program from friends or relatives. Other sources of information included mailed information from AOG (17.5%, n=7), and social media (10%, n=4) (Figure 2). Just over a quarter of respondents (27.7%, n=13) reported seeing social media posts about the energy efficiency programs and energy saving tips on their bill.

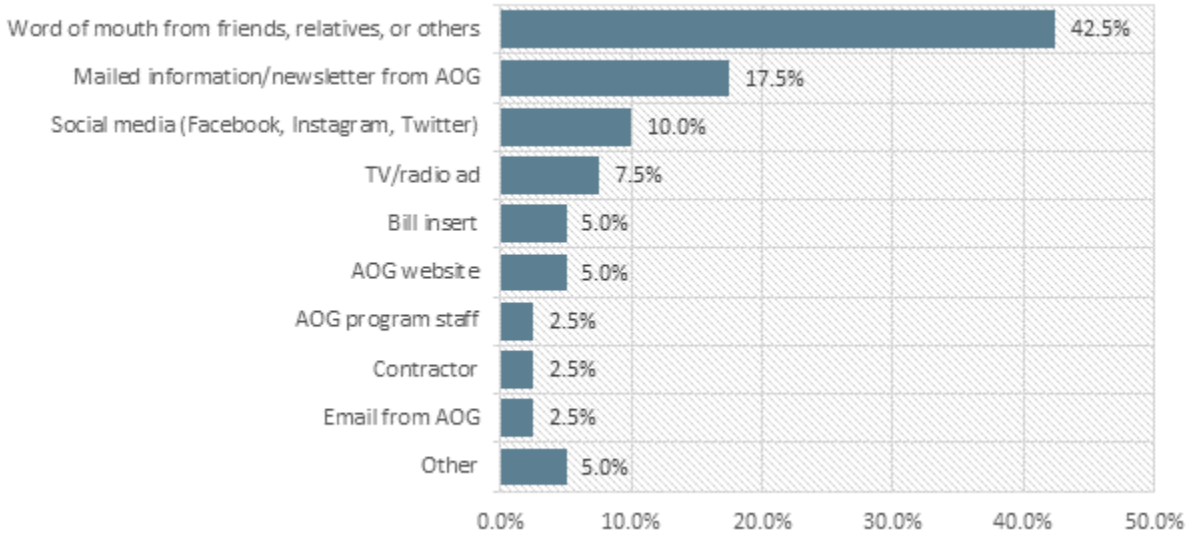


Figure 6-8: Sources of Program Awareness

6.2.10.2 Reasons for Participation

More than a third of respondents wanted to participate in the program to reduce their monthly utility bill (38.3%, n=18). Other popular reasons included to save energy, to improve the value of their home, and program paid for improvements. All responses are summarized in Table 6-9 below.

Table 6-9: CWA Reasons for Participation

Why did you decide to participate in the program?	Percent of Respondents (n = 47)
To reduce my monthly utility bill	38.3%
The program paid for the improvements	17.0%
A contractor recommended it	6.4%
A friend, relative, or neighbor recommended it	4.3%
To help the environment or because it was the right thing to do	6.4%
To improve the value of your home	25.5%
Save energy	31.9%
Other	4.3%

6.2.10.3 Home Energy Assessment

Almost all the respondents received a home energy assessment (95.7%, n=45). About three-quarters of those respondents scheduled their home energy assessment (75.6%, n=34) and almost all of them found it somewhat easy (20.6%, n=7) or very easy (73.5%, n=25) to schedule.

The majority of respondents were home during the home assessment (95.3%, n=36) and at least a third received some information from the assessor during the assessment (Figure 6-9).

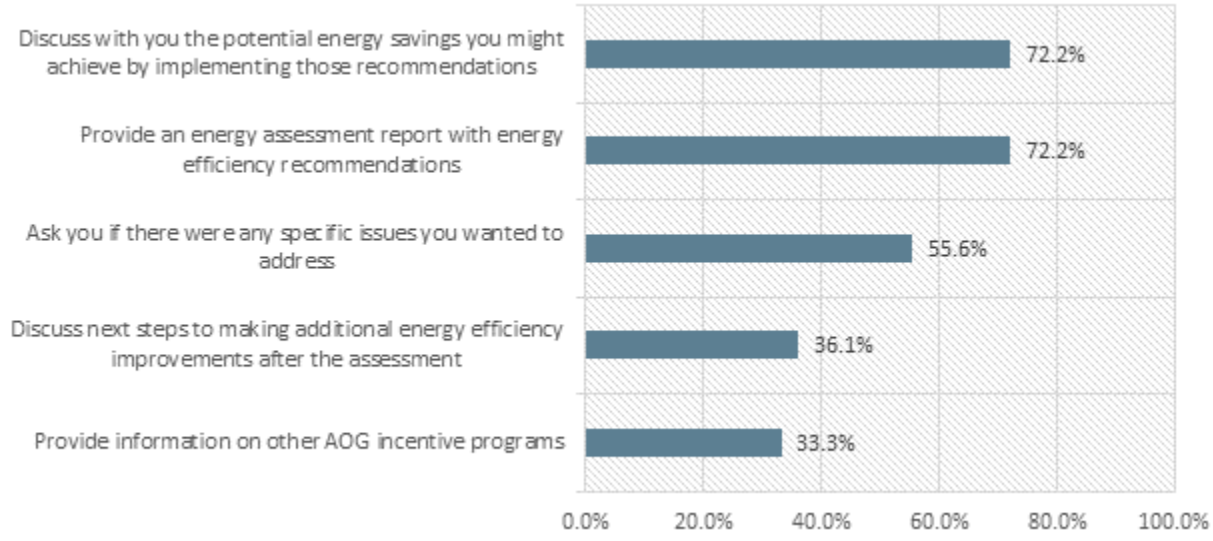


Figure 6-9: Interactions with Home Assessor (n=36)

Among those twenty-three respondents who reported receiving a home energy assessment report, almost two-thirds found the report to be helpful or very helpful (Figure 6-10). Suggestions for how to improve the home energy assessment report include: providing more information and recommendations, providing quotes and referrals, as well as providing some general maintenance tips.

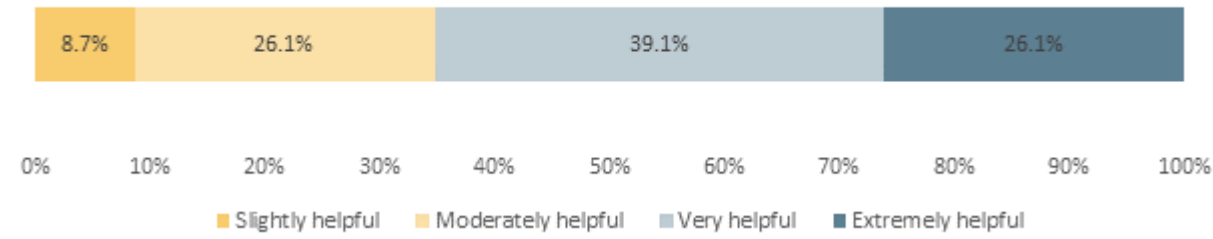


Figure 6-10: Utility of Home Assessment Report (n=23)

6.2.10.4 Satisfaction

Just under a quarter of respondents indicated the energy savings from the program are about what they expected (23.4%, n=11) (Figure 6-11). Two respondents reached out to AOG during program participation with issues and questions; one respondent noted the response was not at all thorough nor timely.

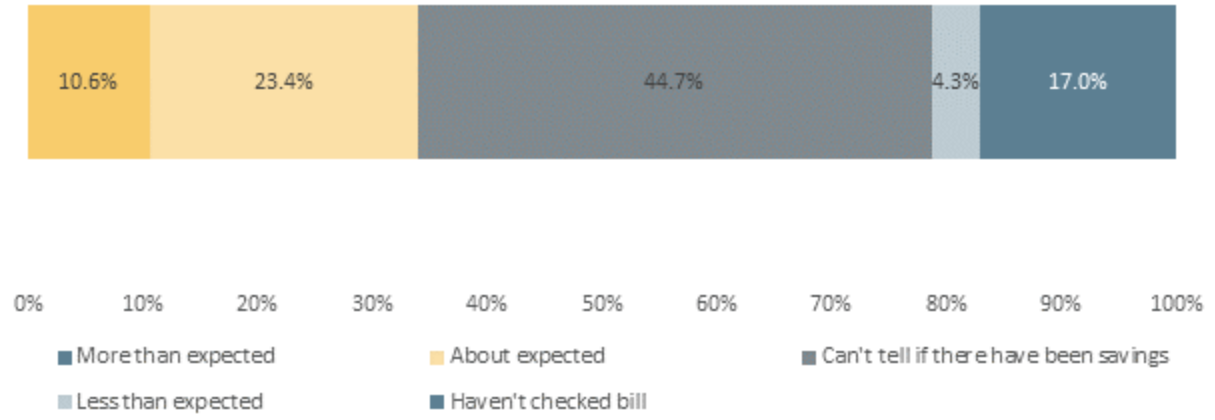


Figure 6-11: Energy Savings from Bill (n=47)

In general, respondents were satisfied with AOG as their natural gas provider as well as the residential weatherization program, though satisfaction with the program is significantly lower than that observed in PY2020.

The percent "very satisfied" with the program declined from 91% to 70% from PY2020 to PY2021.

Though more than two-thirds (69.6%) were very satisfied with the overall program experience and over half (56.8%) were very satisfied with the performance of the equipment installed (Figure 6-12), the Evaluators note that the percent expressing that they are "Very Satisfied' with the program has dropped from 91% to 70%. Respondents who were unsatisfied expressed frustration that no or not all of the improvements were made, as well as with their high energy bill.

The Evaluators endeavored to identify specific causes of dissatisfaction and did so by regressing satisfaction scores (denominated as a dummy indicator 1/0 variable for "Very Satisfied") against multiple possible sources: indicators for specific trade allies, measure counts (as a proxy for retrofit comprehensiveness), presence / absence of specific weatherization measures. From these factors, no specific statistically significant driver of lower customer satisfaction could be identified. No single factor appears to drive customer satisfaction down compared to others, but the program's lower satisfaction score compared to PY2020 is itself statistically significant at 90% confidence.

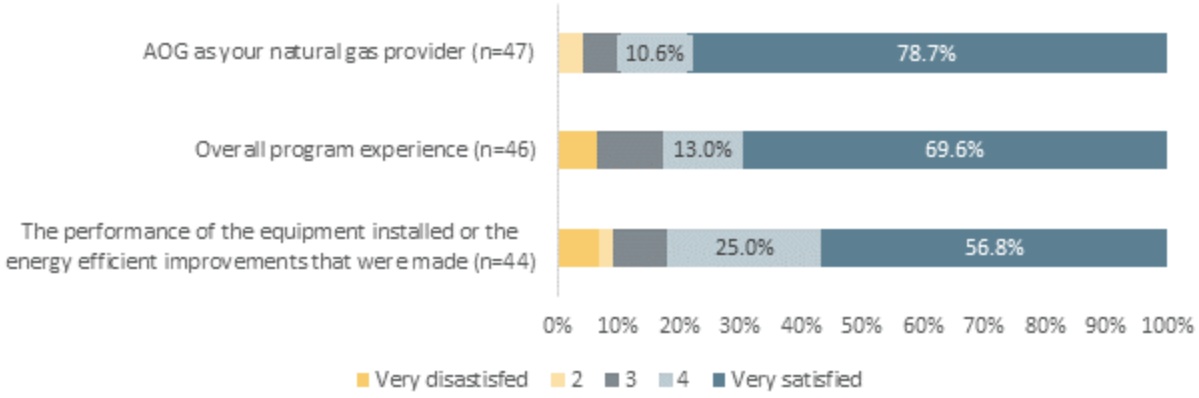


Figure 6-12: Utility & Program Satisfaction

Many respondents provided positive feedback about AOG and the residential weatherization program

More than half of respondents (60.9%, n=28) indicated that they consider AOG a trusted recourse for energy saving and almost three-quarters (73.3%, n=33) noted they would recommend AOG's programs and services to others. Almost two-thirds (64.4%, n=29) of respondents strongly agreed that participating in the weatherization program increased their satisfaction with the utility and just over a quarter (27.3%, n=12) have taken additional energy savings steps since participation (Figure 6-13). Almost seventy-percent (69.8%, n=30) indicated they are somewhat likely or very likely to complete an energy efficiency home improvement project in the future.

Like many natural gas utilities, AOG has faced commodity cost increased in 2021 that manifest in higher rates. This factor is likely confounding satisfaction results as customers' bills can increase even as energy use drops depending on the relative magnitude of impact of weatherization versus retail rate increases. After a multi-year stretch of stable (and in some cases declining) natural gas commodity costs, cost increases began occurring in earnest in the latter half of 2021 and has accelerated further in Q1 of 2022. This factor will need to be accounted for in future satisfaction survey efforts to address whether the customer satisfaction scores are reflective of their experience with the program itself or are being colored by dissatisfaction occurring as a result of gas commodity cost increases.

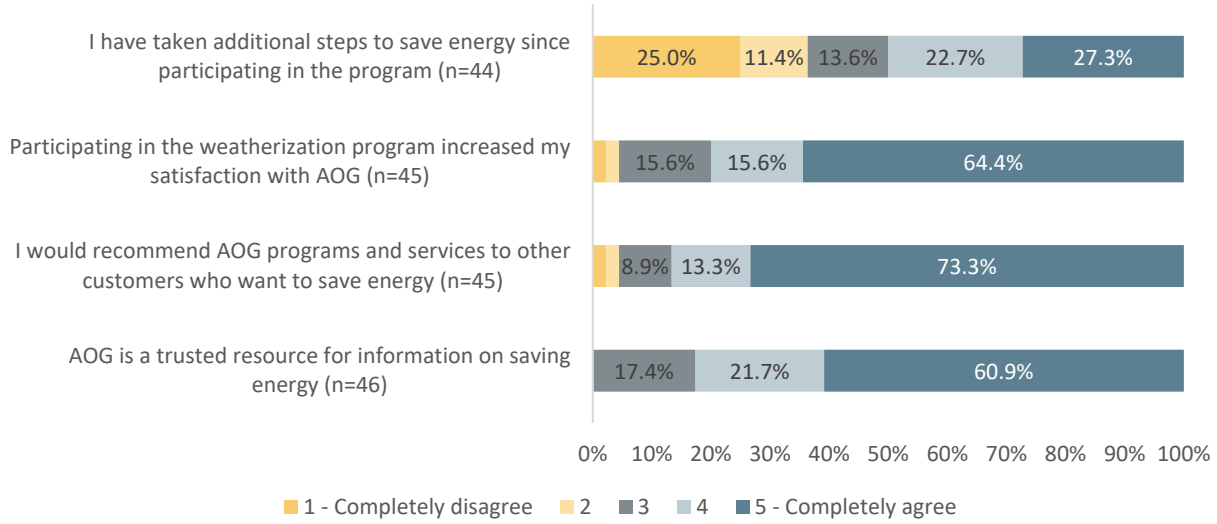


Figure 6-13: Additional Satisfaction Questions

6.3 AOGWP Impact Evaluation

The evaluation effort of the AOGWP included the following:

- *Desk Review of Residential Calculations.* The Evaluators utilized TRM V8.2 values in assessing savings from measures included in the program.
- *Field Verification.* The Evaluators conducted field data collection at 35 homes.
- *Free-ridership Estimation.* Free-ridership rates were developed from current-year survey efforts.

6.3.1 NEBS Summary

Table 6-10 summarizes the NEBs credited to the AOGWP. Propane savings are unchecked as measures that would provide it are only installed in homes with natural gas space heating. If a home has propane heating, its heating benefits are paid for by OG&E and credited to OG&E as a NEB.

Table 6-10: AOGWP Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	Avoided Replacement Cost
Air Infiltration	✓			
Ceiling Insulation	✓			
Duct Sealing	✓			
Faucet Aerator		✓		
LEDs	✓			✓
Low Flow Showerhead		✓		

Water savings from low flow devices are calculated using TRM V8.2 protocols. Electric savings are calculated in a similar manner and credited to AOG when the participant is served by a municipal or rural co-op utility.

6.3.2 Tracking Review

The impact evaluation began with a review of program tracking data. The tracking data included had a single row for each customer, with multiple columns detailing savings by measure. Table 6-11 summarizes ex ante savings by measure for the AOGWP.

Table 6-11: AOGWP Ex Ante Summary

Measure	Ex Ante Therms
Air Infiltration	52,644
Ceiling Insulation	15,899
Duct Sealing	189,686
Faucet Aerator	264
Low Flow Showerhead	670
LEDs	(2)
Total	**259,161**

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 allowable baseline insulation is R-22.

6.3.3 Field Verification Procedures

ADM conducted field verification at 35 homes in the AOGWP. Measures included in this sample were as follows:

- Air Infiltration: 19 homes
- Ceiling Insulation: 1 home
- Duct Sealing: 29 homes, 32 HVAC systems
- LEDs: 12 homes

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

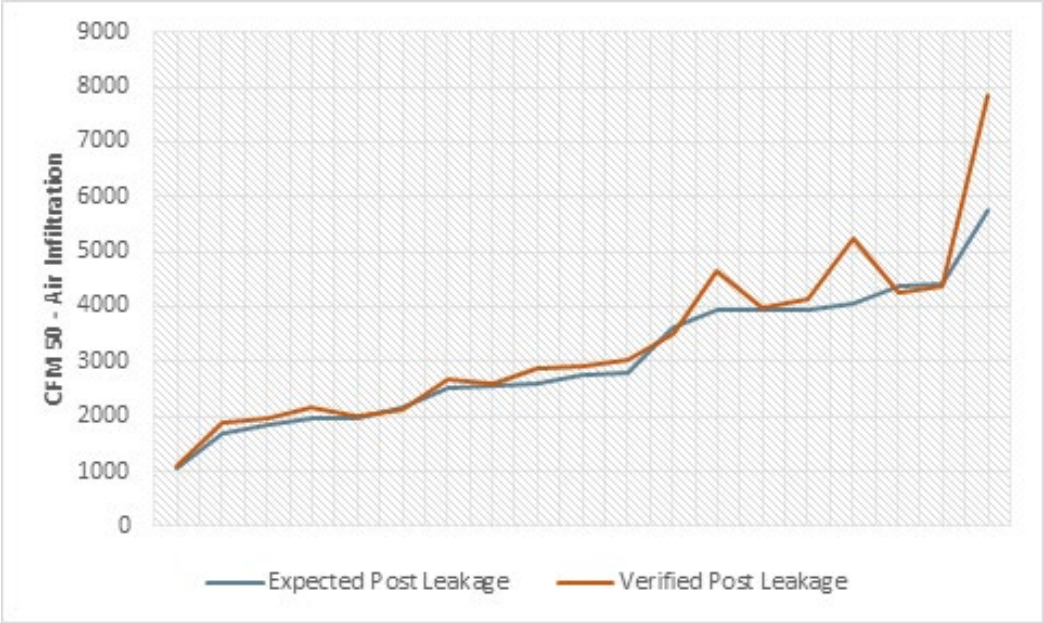


Figure 6-14: Air Infiltration Field Data Collection Results (n=19)

The Evaluators found higher infiltration than shown in ex ante estimates, particularly in homes with higher ex ante post-retrofit infiltration values. This resulted in an overall in-service rate (ISR) of 80.63%.

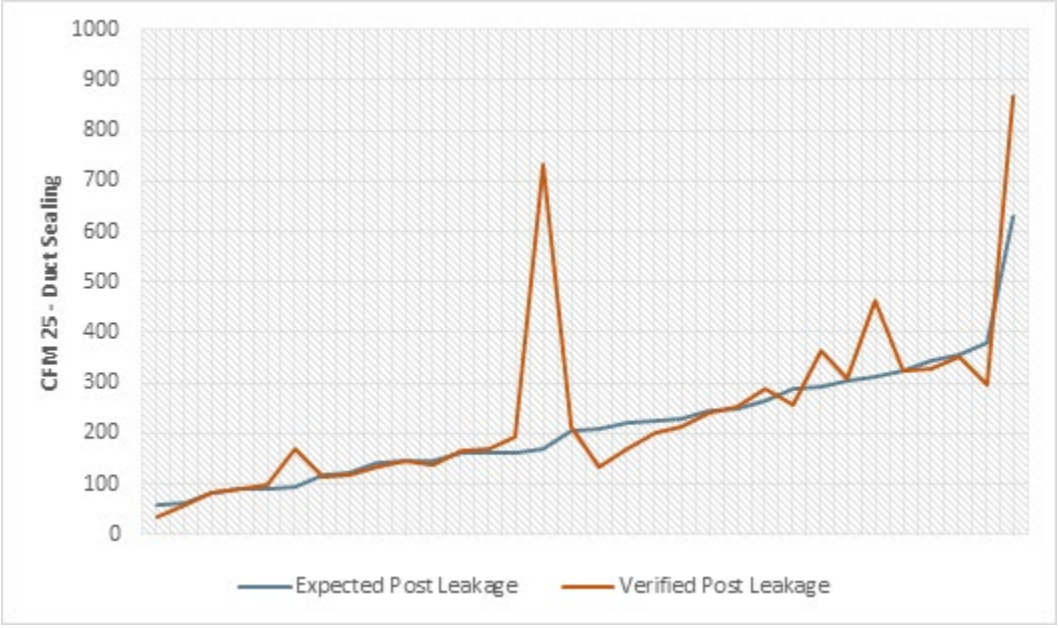


Figure 6-15: Duct Sealing Field Data Collection Results (n=32)

The Evaluators found higher infiltration than shown in ex ante estimates. This resulted in an overall in-service rate (ISR) of 92.24%.

6.3.4 Free-ridership

The scoring mechanism for major measure free-ridership is summarized in Figure 6-16.

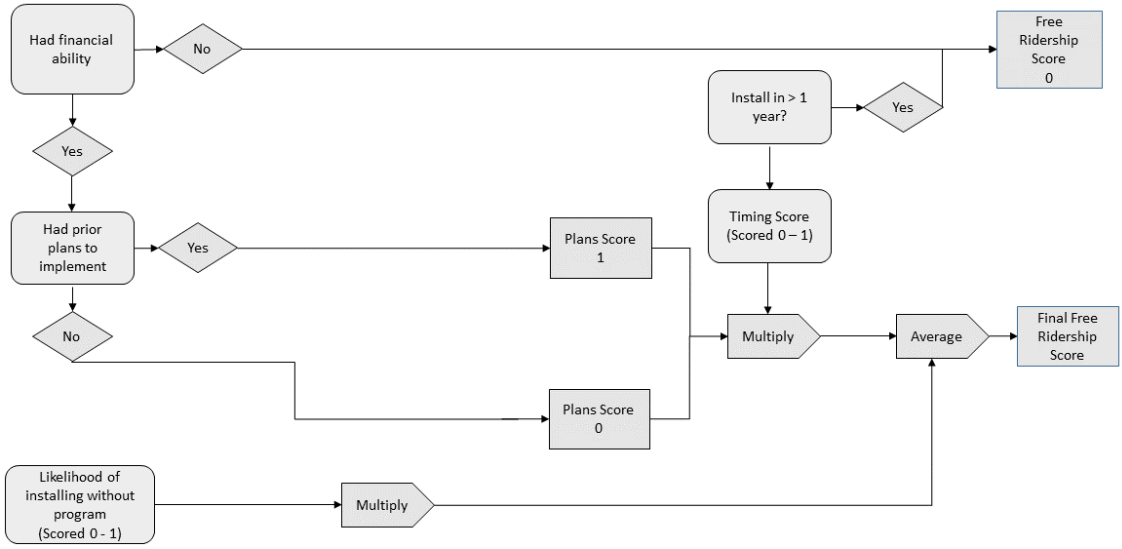


Figure 6-16: Major Measure Free-ridership

To assess the program's influence on major measures (i.e., duct sealing, air sealing, and insulation), program participants were asked questions regarding:

- If they could afford to install the equipment if it had not been provided for free through the program;
- If they had plans to complete the project;
- The likelihood of installing the equipment if it had not been provided for free; AND
- The timing of the project in the absence of the program.

The procedures for developing a free-ridership score based on the survey responses are summarized below.

In this methodology, financial ability 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. Respondents that reported they could have afforded to implement the improvements were assigned an overall free-ridership score based on a prior plan score, a likelihood of installing the measure in the absence of the program, and a timing score.

Prior Plans and Deferred Free-ridership

The prior plans score was based on a response to a question regarding the presence of plans. Specifically, respondents were considered to have had prior plans if they answered "Yes" to the following question:

- Prior to learning about the program, did you have plans to implement the [Measure]?

The program influence on the timing of the project was incorporated into the estimation of free-ridership in one of two ways. First, consistent with the Arkansas TRM definition of free-ridership, respondents who indicated that the project would have been completed in more than one year if the program were not available were assigned a free-ridership score of 0. For all other respondents, the plans score was factored by the program impact on timing. Specifically,

- If the respondent stated that they would have installed the measure in 6 months to one year, then the prior plans score was reduced by one-half.
- If the respondent stated that they would have installed the measure at the same time or within 6 months of when it was installed, the prior plans score was not adjusted.

Likelihood of Implementing Measure without Program

A likelihood of installing the measure in the absence of the program was developed based on respondents stated likelihood of installing a measure if the financial support was not provided or if the measure had not been recommended through the energy assessment. Specifically, responses to this question were scored as follows:

- Very likely: 1
- Somewhat likely: .75
- Neither particularly likely nor unlikely: .5
- Somewhat unlikely: .25
- Very unlikely: 0

The likelihood score was based on the lower value of the likelihood of installing the measure if the program financial support was not available or if the measure was not recommended through the energy assessment.

The overall free-ridership score for participants with the financial ability to install the measures was based on the average of the prior plans and the likelihood scores.

6.3.4.1 Direct Install Measures Free-ridership Methodology

The approach to estimating free-ridership for the direct install measures was similar to the approach described above but differed in three regards. First, because the direct install measures are relatively low-cost items, financial ability is less likely to be a factor for participants. Second, because of their relatively low cost and the ability to easily self-install the items, it is unlikely that participants would have had plans to install the equipment for an extended period. As such, the free-ridership methodology did not factor in financial ability or the program's impact on the projects timing. Third, for LED light bulbs, which respondents received several of, the respondent's plans may have been to install fewer than the total number of bulbs received through the program. The average percent of the bulbs received that these respondents reported installing was used to adjust the free-ridership score for respondents that were not asked this question.

The free-ridership scoring is summarized in Figure 6-17. Under this approach, a respondent was considered to have prior plans to implement the measure if they 1) stated that they had prior plans and 2) that they had previously purchased that measure type.

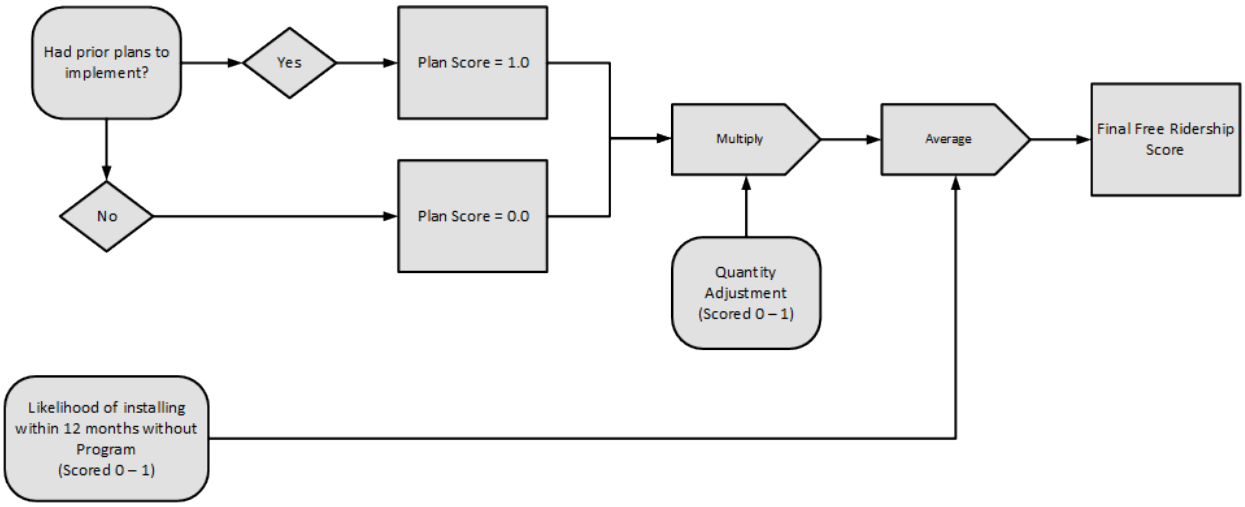


Figure 6-17: Direct Install Free-ridership

6.3.4.2 NTGR Results

The Evaluators performed surveys to determine NTGRs. The resulting NTGRs were as follows:

- Weatherization improvements: 93.33%
- LEDs: 75.00%
- Other DI measures: 75.00%.

6.3.5 Ex Post Savings

Table 6-12 presents the gross savings results of the evaluation of the PY2021 AOGWP.

Table 6-12 AOGWP: Ex Post Gross Savings Summary

Measure	Ex Ante Therms	Ex Post Therms	EUL	Lifetime Therms
Air Infiltration	52,644	44,173	11	485,901
Ceiling Insulation	15,899	17,409	20	348,171
Duct Sealing	189,686	181,217	18	3,261,913
Faucet Aerator	264	262	10	2,620
Low Flow Showerhead	670	670	10	6,701
LEDs	(2)	(62)	19	(1,171)
Total	**259,161**	**243,669**	**16.8**	**4,104,136**

Net savings are summarized in Table 6-13.

Table 6-13: AOGWP Program Net Savings Summary

	Free-ridership Rate		Net Annual Savings		Net Realization Rate	EUL	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post			
Air Sealing	6.00%	6.70%	49,485	41,227	83.3%	11	453,492
Ceiling Insulation	6.00%	6.70%	14,945	16,247	108.7%	20	324,948
Duct Sealing	6.00%	6.70%	178,305	169,130	94.9%	18	3,044,344
Faucet Aerator	48.00%	25.00%	137	197	143.1%	10	1,965
Low Flow Showerhead	48.00%	25.00%	348	503	144.2%	10	5,025
LEDs	48.00%	25.00%	-1	-46	4444.0%	19	-878
Total	**6.15%**	**6.73%**	**243,220**	**227,257**	**93.4%**	**14**	**3,828,896**

6.3.6 Water & Electric NEBs

Water NEBs are calculated in the manner described in Section 5.5.7.

Table 6-14: AOGWP Ex Post Net Water Savings

Measure Category	Net Annual Water Saving (Gallons)	Lifetime Net Water Savings (Gallons)	Monetized Benefit
Total	165,548	1,655,483	$10,945

The Evaluators calculated electric savings for the weatherization program per AR TRM V8.2 Volume 1, Section II, Protocol L1. This was only credited to AOG if the residence was not listed as having been jointly incentivized by SWEPCO or OG&E. Total avoided costs are in Table 6-15. Benefits were monetized using OG&E's filed avoided energy and capacity costs, due to the significant overlap in service area between AOG and OG&E.

Table 6-15: AOGWP Ex Post Net Electric Savings

Measure Category	Net Annual kWh	Net Peak kW	Lifetime Net kWh	Monetized Benefit
Air Sealing	25,451	19.05	279,965	$28,135
Ceiling Insulation	27,843	16.90	556,850	$45,443
Duct Sealing	265,516	131.11	4,79,284	$325,940
Faucet Aerator	0	0.00	0	$0
Low Flow Showerhead	0	0.00	0	$0
LEDs	5,420	0.68	102,981	$4,323
Total	**324,230**	**169.74**	**5,719,080**	**$430,841**

6.3.7 Avoided Replacement Cost

To calculate avoided replacement costs (ARCs) and incremental costs for LEDs in the AOGWP, the AR TRM V8.2 Protocol L calculator was used with the following assumptions: 1) replacement-on-burnout for all bulbs and 2) EUL for LEDs is 19 years [1]. LED costs were sourced from OG&E program tracking data where available. For direct install LEDs, the Evaluators assumed that the incentive was equal to the total cost of equipment and labor. In cases where project cost was not available and the project was not direct install, the Evaluators cited costs from IL TRM v6.0 Volume 3[18].

Table 6-16 shows the avoided replacement costs for LEDs in PY2021. The total avoided replacement cost for the AOGWP program was $775.20.

The natural gas penalty for LEDs was calculated and incorporated into program net savings estimates. It is not included here as it is the primary fuel for AOG, rather than a cross-fuel, and thus is not a NEB. The resulting natural gas penalty can be seen in Table 6-12.

Table 6-16: AOGWP Ex Post ARC

Measure Category	ARC Per Bulb	Total Bulbs	Total Monetized Benefit
LEDs	$3.42	227	$775.20

[18] http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_3_Res_020817_Final.pdf

6.4 Conclusions

Changes in program administration resulting from the hand-off from AOG internal implementation to third-party implementation by CLEAResult	The program met 105% of its net savings goal while spending 44% of its program budget.
	The program TRC has increased from 1.79 to 3.01.
	The three trade allies that had been in the program since inception were replaced with four new trade allies.
	The program migrated from per-measure payments to per-therm payments.
	The program migrated from year-round implementation to seasonal implementation with focused geographic pushes by trade allies.
	The program installed 2.45 measures at $685 per home, compared to 4.38 measures at $1,528 per home in PY2020.
Changes in tracking data from Frontier EnerTrek system to CLEAResult System	Program tracking data now presents an individual measure in each line item, with multiple rows of data per home. This simplifies the process for energy savings calculations in the evaluation
	Program tracking is missing low- and medium-importance data fields, including cooling system type, total home stories, and Act 1102 eligibility criteria.
	Program tracking is missing high-importance data fields, including overlapping electric utility, and participant email addresses.
Changes in measures & services after hand-off to CLEAResult	Savings per home increased from 266 to 329 therms per home.
	Program NTGR remains high, differing by <1% from PY2020 to PY2021.
	The percent of homes receiving each of the three core weatherization measures has declined – this includes duct sealing (18% decline), air sealing (37%), and ceiling insulation (80%).
	The percent of respondents “Very Satisfied” with the program overall declined from 91% to 70%.

6.5 Recommendations

Update program tracking to incorporate requested fields	Requested fields include: Electric utility Email address Home stories
Modify performance-payment scheme to better-incentivize comprehensive projects	Direct payment per-therm results in projects focusing on fewer high-return measures. The program should address this with incentives for deeper retrofits. Options include (1) differing values per therm by measure (analogous to electric utility C&I programs paying higher incentives for non-lighting), (2) payment accelerators for multiple measures, (3) program requirements tied to comprehensiveness
Investigate causes of reduced customer satisfaction	The percent indicating that they are "very satisfied" declined from 91% to 70%. Though 70% is still high satisfaction, the large shift from PY2020 to PY2021 is a cause for concern. The Evaluators could not identify specific drivers of dissatisfaction, in that satisfaction rates were lower across trade allies and showed no relationship to project comprehensive ness or presence or absence of specific measures. There may be other confounding factors as AOG faced commodity cost increases in 2021; this should be researched further to address whether customer satisfaction is being driven by issues internal to or external to the program.
Address decline in project comprehensiveness, tailored to identifiable issues by each trade ally	The decline in project comprehensiveness could be attributable to multiple factors. Recommendations to address this include: (1) Conduct training for trade allies to ensure technical capability (for example, ensuring that trade allies can capably use a duct blaster or blower door (2) Conduct QA/QC audits of new trade allies' projects that had been completed in PY2021 to identify rate of missed / ignored opportunities for energy savings and instruct trade allies to follow up and provide all eligible major measures. (3) Release funding allocations on a quarterly basis (or half-year basis) based on trade ally compliance with comprehensiveness guidelines.
Schedule two rounds of seasonal outreach, split between the early and latter parts of the program year	The program shifted to seasonal outreach and installation, as program trade allies are used by CLEAResult in multiple service territories. 75% of program savings occurred from September through November. The Evaluators recommend that CLEAResult schedule two seasonal pushes. An earlier seasonal push will allow for earlier QA/QC of work performed by the new program trade allies.

7. Low Income Pilot Program

The Low Income Pilot Program (LIPP) launched in PY2020 to comply with Act 1102. LIPP is an extension of the Consistent Weatherization Approach (CWA) targeted to customers who meet the income eligibility requirements of the Low Income Home Energy Assistance Program (LIHEAP). 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 are then provided at no cost to the customer.

Direct install measures include:

- Faucet aerators;
- Low flow showerheads; and
- LEDs.

Weatherization measures include:

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

The program offers direct installation of LEDs in municipal/co-op-served homes that are otherwise eligible for weatherization measures. AOG opted to offer this to ensure a consistent offering for their customers. This benefit is possible due to the APSC guidance on NEBs allowing for the claiming of cross-fuel savings.

Additionally, the program offers a maximum of $500 per participating residence for health and safety (H&S) improvements. Health and safety funding is eligible to go to carbon monoxide detectors, smoke detectors, or other required standards.

7.1 Program Overview

The LIPP is implemented by CLEAResult with trade ally assistance. In PY2021, the program had $80,003 in budget allocated. Table 7-1 summarizes the first-year performance as a standalone program.

Table 7-1: AOG LIPP Performance against Goals

Program Year	Budget			Net Therms		
	Spent	Allocated	% Spent	Ex Post	Goal	% Achieved
2020	$69,830	$79,689	88%	13,951	10,088	138%
2021	$61,679	$80,003	77%	13,102	10,088	130%

7.1.1 Participation Summary

The LIPP had 42 participants in PY2021, down from 48 in PY2020. Figure 7-1 summarizes the share of program savings contributed by each measure. Most savings came from duct sealing, ceiling insulation, and air sealing. There was a .46 therm penalty due to the direct installation of LEDs in homes served by Arkansas Valley Electric Cooperative.

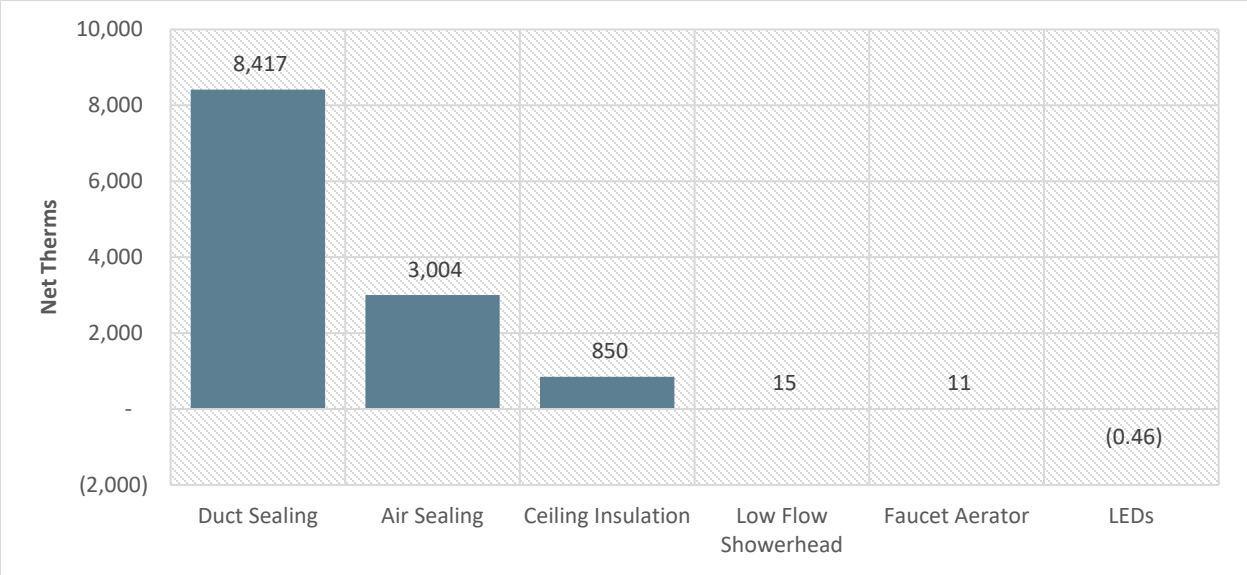


Figure 7-1: Program Net Savings by Measure

In addition, incentives were provided for 42 assessments (100% of participants).

7.1.2 Contractor Participation

In PY2021, the LIPP used four trade allies that were under contract with CLEAResult to administer the weatherization services.

7.2 LIPP Process Evaluation

AR TRM V8.2 Protocol C addresses the criteria used to determine the timing and conditions needed for a process evaluation, and the following tables summarize the program in the context of these requirements.

Table 7-2: Determining Process Evaluation Timing

Component	Determination
New and Innovative Components	No. The program design has been maintained from PY2020
No Previous Process Evaluation	No. The program received a limited process evaluation PY2020
New Vendor or Contractor	Yes. Program implementation was assigned to CLEAResult beginning in the PY2021 program year.

Table 7-3: Determining Process Evaluation Conditions

Component	Determination
Are program impacts lower or slower than expected?	No. The program has met its savings goals.
Are the educational or informational goals not meeting program goals?	No. Program awareness within the customer market has increased, and educational efforts have been successful.
Are the participation rates lower or slower than expected?	No. The program has consistently met its participation goals.
Are the program's operational or management structure slow to get up and running or not meeting program administrative needs?	No. The prior process evaluation found these structures to be operating efficiently with adequate resources.
Is the program's cost-effectiveness less than expected?	No. The program's cost-effectiveness was at expected levels.
Do participants report problems with the programs or low rates of satisfaction?	Unknown. No prior survey completed.
Is the program producing the intended market effects?	Yes. Non-program contractors are being informed of opportunities within the non-participant market. Surveyed participants also appear more aware of energy efficiency in general.

The Evaluators conducted a limited process evaluation for LIPP due to small program size and budget. This included a survey effort with participants and a review of changes observes as a result of CLEAResult's administration of the program.

7.2.1 LIPP Metrics Summary

The key LIPP metrics are presented in Table 7-4.

Table 7-4: LIPP Program Metrics Summary

Metric	Value	
	PY2020	PY2021
Program Name	Low Income Pilot Program	Low Income Pilot Program
CWA Implementation	The LIPP is implemented directly by AOG with the use of a closed network of pre-approved trade allies. The program coordinates heavily with OG&E and AOG. Of particular note, AOG has opted to fund installation of LEDs in customer premises that are served by municipal or co-op utilities.	The LIPP is implemented directly by CLEAResult under contract with AOG with the use of a closed network of pre-approved trade allies. The program coordinates heavily with OG&E and AOG. Of particular note, AOG has opted to fund installation of LEDs in customer premises that are served by municipal or co-op utilities.
Total Audits Completed	46	42
Total Submitted Projects	48	42
Conversion Rate	95.8%	100%
Measures installed per-project	4.33	1.67
Cost per participant	$0 cost to participants. AOG paid $1,455 per home	$0 cost to participants. AOG paid $623 per home
Percent of contractors promoting program	100%	100%

7.2.2 Act 1102 Pilot Evaluation Metrics

Table 7-5 shows how AOG has met the Act 1102 Pilot evaluation metrics.

Table 7-5: ACT 1102 Metrics

Topic Area	Metric	Tracked by AOG	Reported by Evaluators
Marketing Efforts	Track how program is marketed	Yes	Yes
	Identify effectiveness of each method	No	Yes
	Indicate if and how utility is working with CAP agency/social service agency	No	N/A
Site Visit Assessment	Track if customer qualifies as LI, Age or Both	Yes	Yes
	Catalog measures not installed and why	No	No
	Track if customer is receiving benefits from other programs	No	No
	Track NEBs such as eliminating arrearages, collectibles, LIHEAP payments, etc.	Yes	Yes
Deferred Homes	Identify if program referral methods were left behind	No	Yes
	Identify reasons for deferral	No	No
	Track health and safety repairs completed	Yes	Yes
	Identify any measures installed	Yes	Yes
	Identify if home was tracked to CAP agency	No	No
	Track reasons for customer denial in program	No	No
Post Installation	Track participation in other utility programs	No	No
	Assess participant's satisfaction with all aspects of the pilot program	No	Yes
	Track number of times a participant was visited	Yes	Yes
	Track number of hours spent in the home	No	No
	Calculate average project cost-effectiveness	Yes	Yes
	TRC for each project	No	No
	SIR for each project	Yes	Yes
	Cost range of projects	Yes	Yes
	Average cost of projects	Yes	Yes
	Track home type	Yes	Yes
	Identify neighborhoods where the pilot would be effective	Yes	No
	Identify methods to certify age/income	Yes	Yes

7.2.1 Prior Recommendation Response

The prior recommendations and their status are as follows:

Table 7-6: Weatherization Prior-Year Recommendation Tracking

Recommendation	AOG Response	Status
Consider increasing referral rates to the Low Income Pilot Program.	Have not increased goal, but have gone over it. Willing to increase in conjunction with PWC based on joint action.	Reviewed & rejected
Consider increasing LIPP funding	Have not increased goal, but have gone over it. Willing to increase in conjunction with PWC based on joint action.	Under consideration
Consider pursuing H&S NEBs (non-energy benefits)	CLEAResult expanded H&S measures offered in low income weatherization program	Recommendation adopted

7.2.1 Participation Timing

Figure 7-2 summarizes the premises by month as determined by the date services were provided. The AOGWP had a seasonal push from September through November, and 69% of LIPP project occurred in this timeframe. Program operations were discontinued once goal was met.

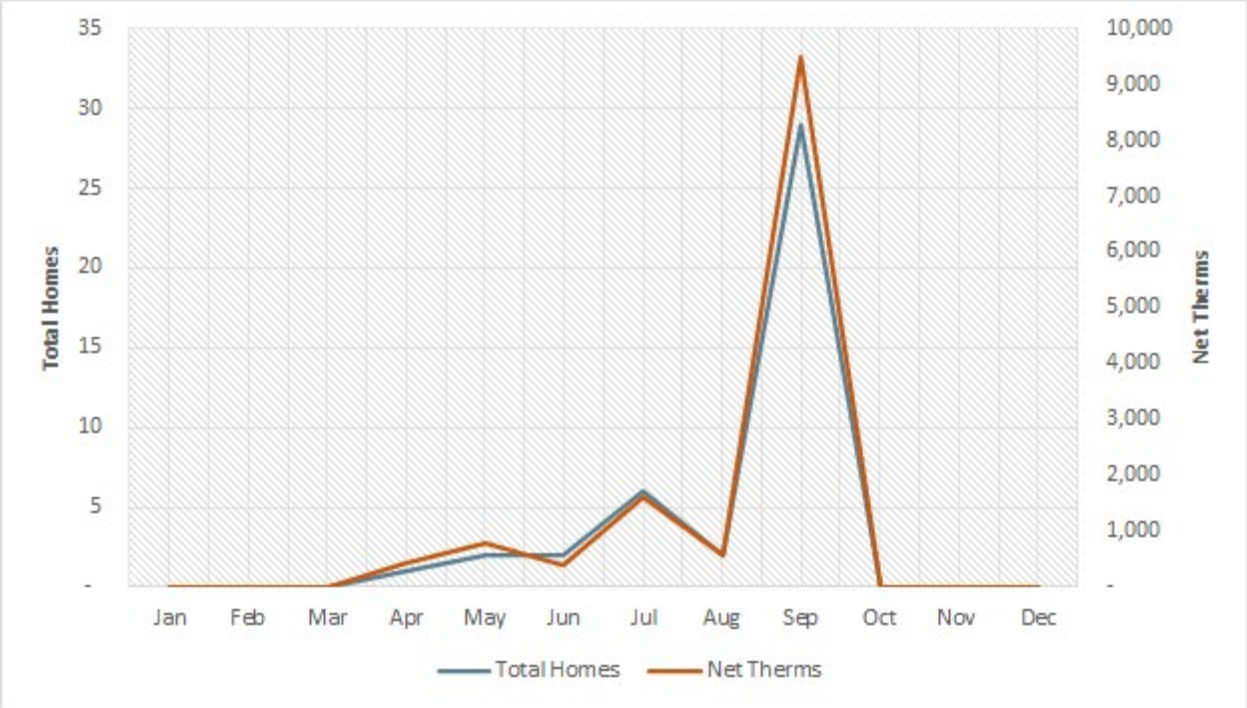


Figure 7-2: LIPP Premises by Month

7.2.2 Data Collection Activities

The process evaluation of the AOG Weatherization Program 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:
  - *AOG Program Staff*. The Evaluators interviewed staff at AOG involved in the administration of the AOG Weatherization Program.
  - *CLEAResult Program Staff*. The Evaluators interviewed staff at CLEAResult that conduct implementation of the program
- *Participant Surveying*. The Evaluators surveyed 10 participants in the AOGWP, collecting feedback on their experiences with the program.

Table 7-6 summarizes the data collection for this process evaluation effort. This includes the titles, role, and sample sizes for data collection.

Table 7-7: AOG LIPP Data Collection Summary

Target	Component	Activity	n	Sample Precision	Role
AOG Program Staff	Director of Energy Efficiency Programs	Interview	1	N/A	The Director of Energy Efficiency manages financial, contractual, and regulatory matters across the AOG portfolio.
	Senior Manager of Energy Efficiency Programs	Interview	1	N/A	The Senior Manager of Energy Efficiency conducts day-to-day management and oversight of implementation and marketing efforts by CLEAResult.
CLEAResult Program Staff	Senior Manager	Interview	1	N/A	The Senior Manager at CLEAResult manages the day-to-day implementation, marketing, rebate processing, and QA/QC for the program.
Program Participants	Single Family Participants	Survey	10	±22.8%	This survey was conducted on a sample of single-family owner-occupants which participated in the program.

7.2.3 Program Theory & Design

The Low Income program is reported to be run much like the AOGWP program with CLEAResult handling the day-to-day operations with the trade allies and customers. The interview participants said that there have not been any additional measures added to the Low Income program offerings; it was mentioned that several other utilities had adopted carbon monoxide detectors in PY2021 for their Low Income programs, but AOG was already offering this measure. The program met its participation goal of 35 homes as well as its savings goals.

7.2.4 Program Administration

The AOGWP is managed by the following staff:

- AOG Staff:
  - Director of Energy Efficiency Programs – overall contractual oversight, financial management.
  - Senior Manger of Energy Efficiency Programs – Day-to-day project management and oversight of CLEAResult.
- CLEAResult Staff:
  - Senior Manager of Energy Efficiency Programs – Day-to-day project management, over-sight of Trade Allies, program administration, marketing, delivery, and QA/QC.

Prior to the transition to CLEAResult, the program paid incentives that were fixed based on the type of measure installed. This has changed to a per-Therm performance payment in PY2021.

7.2.5 Program Implementation & Delivery

There are three distinct program channels for the LIPP:

- **Assessment.** The Assessment is a comprehensive audit which includes conducting duct blast and blower door testing. This testing is needed to pre-qualify a home for duct sealing and air sealing improvements. To qualify for an assessment, a home must have natural gas space heating and must have been built prior to 2009. These customers also receive all eligible direct install measures.
- **Installation without Assessment.** Further, in some instances trade allies would perform a limited weatherization effort without a complete Assessment. This would occur in instances where a home received one measure in a prior year but did not receive all eligible measures.

- **Direct Install Only.** If a home has electric space heating but natural gas water heating, or otherwise does not qualify for weatherization improvements, the LIPP would still provide direct installation of faucet aerators, low flow showerheads, pipe wrap, tank wrap, or LEDs where appropriate.

AOG enrolls participants through its online portal, its customer call center, and through outreach by program trade allies. The online registration portal is straightforward and captures the information needed for program qualification (year built) and whether the customer is served by an electric investor-owned utility or by a muni/co-op. The fields use drop-down menus wherever possible in order to ensure ease of use.

7.2.6 Marketing

The LIPP is marketed to trade allies and to end-use customers. AOG works very closely with OG&E in jointly administering the program in their largely overlapping service territory. Figure 7-3 shows the website advertisement for the program.

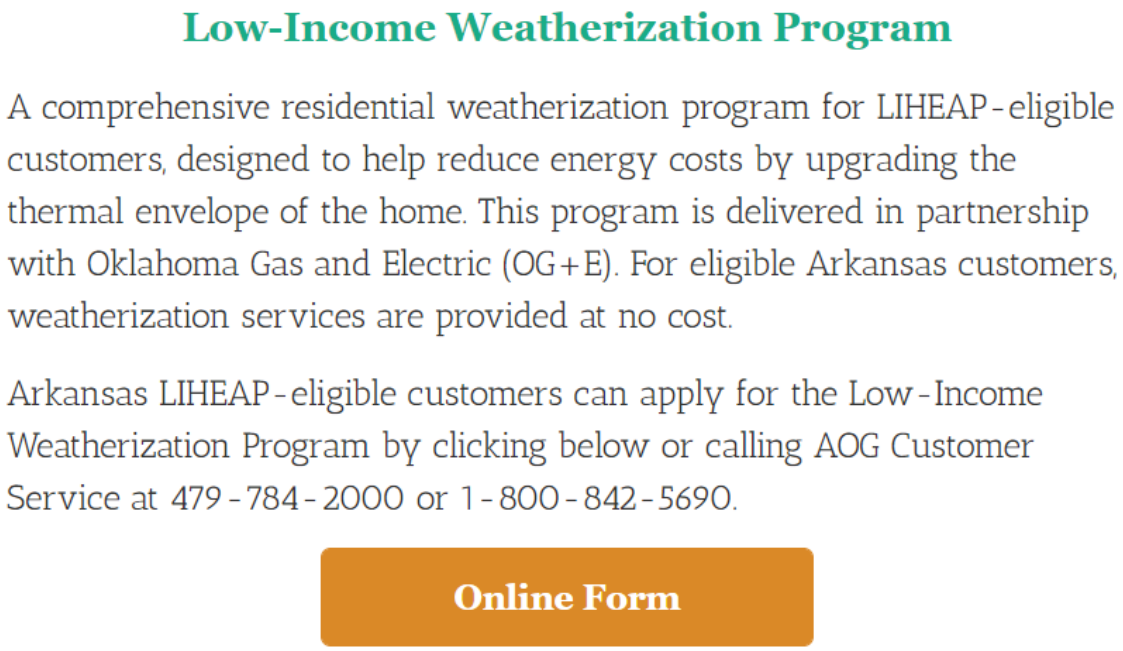


Figure 7-3: AOG LIPP Website Marketing

7.2.7 Adherence to Protocol A

The tracking system for the LIPP used the exact same structure and layout as the AOGWP system (see Section 6.2.8). When additional fields became necessary for the LIPP, they were

also added to the AOGWP tracking database as the operation of both programs is easier with one unified dataset layout.

The comments pertaining to missing data fields for the AOGWP apply to the LIPP as well.

7.2.8 Key Project Statistics

The Evaluators reviewed PY2020 and PY2021 LIPP projects to assess differences in customer characteristics and project outcomes. Key findings are summarized in Table 7-8.

Table 7-8: Key Participant Statistics

Metric Group	Metric	PY2020	PY2021	2020 to 2021 % Change
Participant Overall	Net Therms/Participant	291	312	7%
	Total Gas Project Cost	$1,518	$623	-59%
	Health & Safety Cost	$141	$18.00	-87%
	$/Net Therm	$5.21	$2.00	-62%
Housing Characteristics	Home Total Sq. Ft.	1,539	1,623	5%
	AC Size (Tons)	3.03	3.08	2%
Gross Savings Parameter	Attic Insulation Sq. Ft.	1,119	1,893	69%
	Duct Leakage Reduction	33	255	673%
	Air Infiltration Reduction	1,011	1,396	38%
	LEDs Installed	23	3.0	-87%

Key impact parameters increased in most respects; per-project CFM reductions in duct sealing and air sealing, square feet of insulation installed, and savings per home are all markedly higher and savings acquisition cost has decreased. However, H&S spending has also decreased.

7.2.9 Contractor Performance

The Evaluators reviewed the projects completed by each trade ally. Key performance metrics are detailed below.

Table 7-9: Trade Ally Performance Indicators

Program Element	# Homes	Therms / Home	Measures / Home	% Projects with Assessments
Trade Ally #1	5	435	1.40	100.0%
Trade Ally #2	3	306	1.33	100.0%
Trade Ally #3	21	380	1.86	100.0%
Trade Ally #4	13	170	1.54	100.0%

Figure 7-4 presents the percent of projects with each major weatherization measure in PY2021 compared to PY2020. Though more savings have come from duct sealing, the percent of

projects with duct sealing has nonetheless declined along with air sealing and ceiling insulation as the average number of measures per-project has declined.

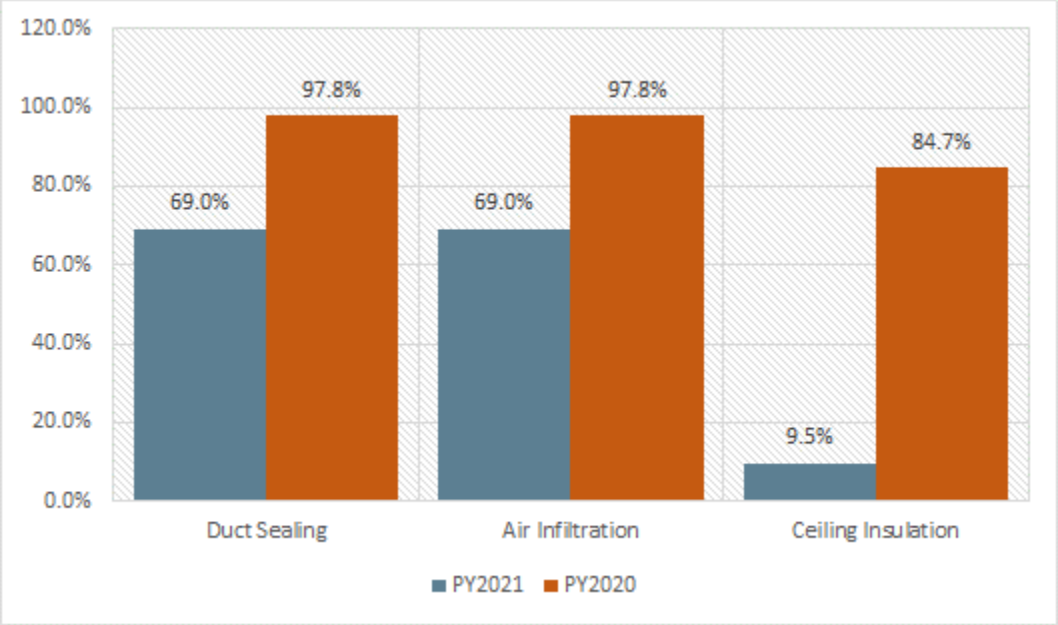


Figure 7-4: % Projects with Each Measure

AOG and CLEAResult staff noted that there were supply shortages for insulation materials which may have affected Trade Allies' ability to deliver this measure. However, this shortage does not affect duct sealing or air sealing.

Prior to PY2021, the program paid based on work completed. With the move to performance payment in PY2021, projects are more likely to be single-measure (though with higher per-project CFM reductions for duct sealing and air sealing than observed in prior program years). Given this, it is possible that trade allies may be omitting savings opportunities.

The Evaluators recommend that CLEAResult and AOG address this issue of project comprehensiveness with Trade Allies. Possible strategies include:

1. Acceleration payments for homes based on measure count.
2. Performance benchmarks based on measure count (variable based on number of weatherization measures versus number of direct install measures.
3. Program-funded training should the Trade Ally lack specific technical background (such as instruction on operation of a blower door or duct blaster).

This could also be supplemented with QA visits to single-measure projects from PY2021 that address not just the quality of the work completed but also test for eligibility for the two weatherization improvements that were not installed

7.2.10 Health and Safety Measures

Act 1102 specifies required spending on health and safety (H&S) improvement in LIPP homes. AOG was already including H&S measures prior to Act 1102, such as appliance combustion testing, carbon monoxide alarms, and smoke detectors.

In PY2021, H&S spending averaged $18 per-participant, decreased from $141 per participant PY2020. In PY2021, 4.7% of participants received any H&S improvements, down from 87.0% in PY2020. The trade ally network had complete turnover from PY2020 to PY2021, and the new trade ally network to-date has not provided H&S improvements for most participants.

The Evaluators note that the assessments in the LIPP include appliance combustion testing. This is a health and safety improvement in that it identifies potential carbon monoxide risks associated with improper appliance combustion.

7.3 LIPP Impact Evaluation

The evaluation effort of the LIPP included the following:

- *Desk Review of Residential Calculations.* The Evaluators utilized TRM V8.2 values in assessing savings from measures included in the program.
- *Field Verification.* The Evaluators conducted field verification at eight participant homes.
- *Free-ridership Estimation.* Free-ridership rates were developed from a literature review of low income program NTG practices.

7.3.1 NEBS Summary

Table 7-10 summarizes the NEBs credited to the LIPP.

Table 7-10: LIPP Non-Energy Benefits

Measure	Electric Savings	Water Savings	Propane Savings	Avoided Replacement Cost
Air Infiltration	✓			
Ceiling Insulation	✓			
Duct Sealing	✓			
Faucet Aerator		✓		
Low Flow Showerhead		✓		
LEDs	✓			✓

Water savings from low flow devices are calculated using TRM V8.2 protocols. Electric savings are calculated in a similar manner and credited to AOG when the participant is served by a municipal or rural co-op utility. Though propane savings are hypothetically claimable, the

program design requires natural gas space heating or gas water heating for the applicable measures to be installed and as such no propane savings occur.

7.3.2 Tracking Review

The impact evaluation began with a review of program tracking data. The tracking data included had a single row for each customer, with multiple columns detailing savings by measure. Table 7-11 summarizes ex ante savings by measure for the LIPP.

Table 7-11: LIPP Ex Ante Summary

Measure	Ex Ante Therms
Air Infiltration	2,707
Ceiling Insulation	616
Duct Sealing	9,576
Low Flow Showerhead	28
Faucet Aerator	21
Total	**12,948**

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 allowable baseline insulation is R-22.

The Evaluators found the following tracking data discrepancies:

Table 7-12: LIPP Impact Summary by Major Measure

Ceiling Insulation – Inconsistent application of TRM V8.2 multipliers	Projects with baseline R values of 0-1 and 2-4 were calculated correctly. However, projects with baseline R-values from 5-8 and 9-15 had incorrect per-square foot multipliers. Correcting this resulted in 147% realization for this measure.
Air Infiltration – missing ex ante savings values	The Evaluators found that deemed savings calculations for air infiltration were generally correct. However, there were four projects where tracking data erroneously entered in zero savings. The Evaluators concluded these to be valid projects and entered savings for them. This resulted in 115% realization for this measure, despite that the Evaluators had applied a 93% in-service rate adjustment based on field data collection.
Duct Sealing – no adjustments required	The Evaluators found that duct sealing calculations were performed correctly in the program tracking data. However, realization was 95.7% for this measure due to the application of the in-service rate adjustment based on field data collection.

7.3.3 Field Verification Procedures

ADM conducted field verification at eight homes in the LIPP. Measures included in this sample were as follows:

- Air Infiltration: 7 homes
- Duct Sealing: 7 homes

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

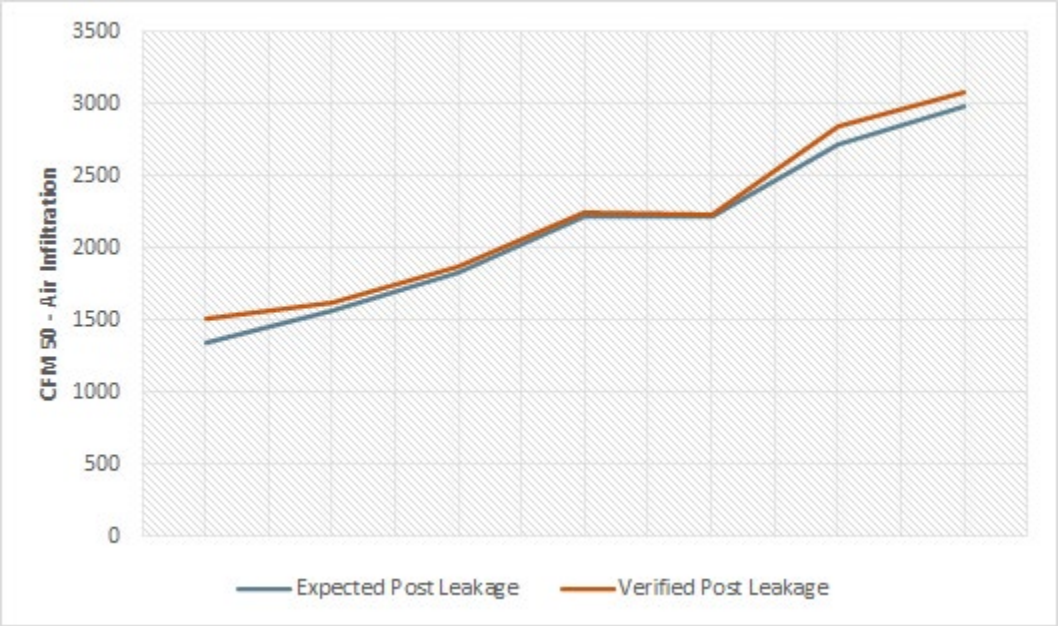


Figure 7-5: Air Infiltration Field Data Collection Results (n=7)

The Evaluators found higher infiltration than shown in ex ante estimates. This resulted in an overall in-service rate (ISR) of 95.7%.

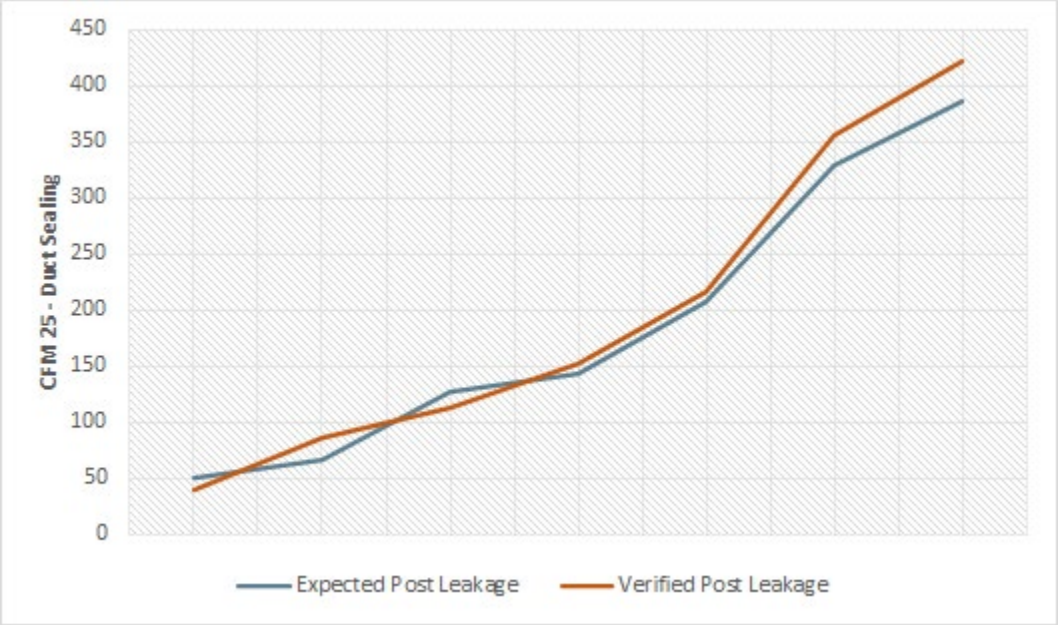


Figure 7-6: Duct Sealing Field Data Collection Results (n=7)

The Evaluators found higher infiltration than shown in ex ante estimates. This resulted in an overall in-service rate (ISR) of 92.9%.

7.3.4 Free-ridership

The Evaluators assigned a NTG of 100%, keeping with industry best practices for low income weatherization programs as specified in the Department of Energy Uniform Methods Project[19].

7.3.5 Ex Post Savings

Table 7-13 gross savings results of the evaluation of the PY2021 LIPP.

Table 7-13 LIPP: Ex Post Gross Savings Summary

Measure	Ex Ante Therms	Ex Post Therms	EUL	Lifetime Therms
Air Infiltration	2,707	3,196	11	35,153
Ceiling Insulation	616	904	20	18,075
Duct Sealing	9,576	8,954	18	161,174
Faucet Aerator	21	21	10	210
Low Flow Showerhead	28	28	10	284
LEDs	0	(1)	19	(17)
Total	**12,948**	**13,102**	**16.40**	**214,879**

Net savings are summarized in Table 7-14.

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

Table 7-14: LIPP Program Net Savings Summary

Measure	Free-ridership Rate		Net Annual Savings		Net Realization Rate	EUL	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post			
Air Infiltration	0.0%	0.0%	2,707	3,196	118.1%	11	35,153
Ceiling Insulation	0.0%	0.0%	616	904	146.7%	20	18,075
Duct Sealing	0.0%	0.0%	9,576	8,954	93.5%	18	161,174
Faucet Aerator	0.0%	0.0%	21	21	100.1%	10	210
Low Flow Showerhead	0.0%	0.0%	28	28	101.5%	10	284
LEDs	0.0%	0.0%	0	(1)	N/A	19	(17)
Total	**0.0%**	**0.0%**	**12,948**	**13,102**	**101.2%**	16.4	**214,879**

7.3.6 Water & Electric NEBs

Water NEBs are calculated in the manner described in Section 5.3.10.

Table 7-15: LIPP Ex Post Net Water Savings

Measure Category	Net Annual Water Saving (Gallons)	Lifetime Net Water Savings (Gallons)	Monetized Benefit
Total	11,787	117,870	$779

The Evaluators calculated electric savings for the weatherization program per AR TRM V8.2 Volume 1, Section II, Protocol L1. This was only credited to AOG if the residence was not listed as having been jointly incentivized by SWEPCO or OG&E. Total avoided costs is in Table 7-16. Benefits were monetized using OG&E's filed avoided energy and capacity costs, due to the significant overlap in service area between AOG and OG&E.

Table 7-16: LIPP Ex Post Net Electric Savings

Measure Category	Net Annual kWh	Net Peak kW	Lifetime Net kWh	Monetized Benefit
Air Sealing	2,480	1.85	27,276	$2,732
Duct Sealing	14,046	10.14	17,872	$23,358
Ceiling Insulation	894	0.57	252,834	$1,506
LEDs	89	0.01	1,690	$71
Total	**17,508***	**12.57**	**299,671***	**$27,667**
***Sums differ due to rounding**				

7.3.7 Avoided Replacement Cost

To calculate avoided replacement costs (ARCs) and incremental costs for LEDs in the AOGWP, the AR TRM v8.2 Protocol L calculator was used with the following assumptions: 1) replacement-on-burnout for all bulbs and 2) EUL for LEDs is 19 years [1]. LED costs were sourced from OG&E program tracking data where available. For direct install LEDs, the Evaluators assumed that the incentive was equal to the total cost of equipment and labor. In

cases where project cost was not available and the project was not direct install, the Evaluators cited costs from IL TRM v6.0 Volume 3[20].

Table 7-17 shows the avoided replacement costs for LEDs in PY2021. The total avoided replacement cost for the LIPP program was $13.60.

The natural gas penalty for LEDs was calculated and incorporated into program net savings estimates. It is not included here as it is the primary fuel for AOG, rather than a cross-fuel, and thus is not a NEB.

Table 7-17: LIPP Ex Post ARC

Measure Category	ARC Per Bulb	Total Bulbs	Total Monetized Benefit
LEDs	$4.53	3	$13.60

[20] http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_3_Res_020817_Final.pdf

7.4 Conclusions

Changes in program administration resulting from the hand-off from AOG internal implementation to third-party implementation by CLEAResult	The program met 132% of its net savings goal while spending 77% of its program budget.
	The program TRC has increased from 1.97 to 2.09.
	The three trade allies that had served the program in PY2020 were replaced with four new trade allies
	The program migrated from per-measure payments to per-therm payments.
	The program migrated from year-round implementation to seasonal implementation with focused geographic pushes by trade allies.
	The program installed 1.67 measures at $623 per home, compared to 4.33 measures at $1,455 per home in PY2020
Changes in tracking data from Frontier EnerTrek system to CLEAResult System	Program tracking data now presents an individual measure in each line item, with multiple rows of data per home. This simplifies the process for energy savings calculations in the evaluation
	Program tracking is missing low- and medium-importance data fields, including cooling system type, total home stories, and basis for Act 1102 eligibility criteria
	The Evaluators found air sealing projects with blank savings entries, as well as errors in savings calculations for ceiling insulation with baseline R value > 4.
	Program tracking is missing high-importance data fields, including overlapping electric utility, electric rebate data, and participant email addresses
Changes in measures & services after hand-off to CLEAResult	Savings per home increased from 303 to 317 therms per home.
	Savings per-instance of each measure has increased: Duct Sealing: 154% Air Sealing: 35% Ceiling Insulation: 152%
	The percent of homes receiving each of the three core weatherization measures has declined – this includes duct sealing (29% decline), air sealing (29%), and ceiling insulation (89%)
Health & Safety Measure Delivery	The percent of respondents “Very Satisfied” with the program overall declined from 91% to 70%.

7.5 Recommendations

Update tracking to include requested fields	This includes electric utility, email address, and home stories
Correct calculation issues in program tracking	This addresses missing savings entries as well as erroneous multipliers for ceiling insulation
Modify performance-payment scheme to better-incentivize comprehensive projects	Direct payment per-therm results in projects focusing on fewer high-return measures. The program should address this with incentives for deeper retrofits. Options include (1) differing values per therm by measure (analogous to electric utility C&I programs paying higher incentives for non-lighting), (2) payment accelerators for multiple measures, (3) program requirements tied to comprehensiveness
Impose greater H&S requirements on trade allies	4.7% of program participants received any H&S measures. There two possible scenarios for this: 1: Program trade allies are visiting homes that need H&S, but are not delivering them – this would require further training or performance requirements to be imposed. 2: Program trade allies are not visiting homes that need H&S- This would mean the program needs to readdress how it targets participants, if the program is not reaching customers with H&S issues. AOG, CLEAResult, and the Evaluators should collaborate to diagnose this matter, and provide guidance to the trade allies as appropriate
Address decline in project comprehensiveness, tailored to identifiable issues by each trade ally	The decline in project comprehensiveness could be attributable to multiple factors. Recommendations to address this include: (1) Conduct training for trade allies to ensure technical capability (for example, ensuring that trade allies can capably use a duct blaster or blower door (2) Conduct QA/QC audits of new trade allies' projects that had been completed in PY2021 to identify rate of missed / ignored opportunities for energy savings and instruct trade allies to follow up and provide all eligible major measures. (3) Release funding allocations on a quarterly basis (or half-year basis) based on trade ally compliance with comprehensiveness guidelines.
Schedule two rounds of seasonal outreach, split between the early and latter parts of the program year	The program shifted to seasonal outreach and installation, as program trade allies are used by CLEAResult in multiple service territories. 75% of program savings occurred from September through November. The Evaluators recommend that CLEAResult schedule two seasonal pushes. An earlier seasonal push will allow for earlier QA/QC of work by the new program trade allies.
Add combustion safety testing as an H&S measure.	The LIPP currently provides appliance combustion safety testing. The Evaluators recommend separating this cost from the overall assessment cost and assigning the H&S label to it as a separate measure.

8. Appendix A: Site Reports

This appendix contains the individual site reports for C&I Solutions:

- EA-0000352588
- EA-0000429856

The Evaluators note that for the following projects, savings are claimed in PY2021 but no M&V report is provided as M&V data collection & analysis is ongoing:

- EA-0000447432
- EA-0000363835
- EA-0000447256

Program	C&I Solutions
Project ID	EA-0000429856
Facility SIC Code	2026 – Fluid Milk
Measures	Pipe Insulation
Annual Consumption	134,020 therms

Project Background

The participant is a dairy processing facility that received incentives from AOG for:

- ECM #2 – Pipe Insulation

Most of the facilities gas usage is from their two boilers. The boilers are used for pasteurizing, process heating, and hot water generation.

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:

- Annual operating hours for the site are 2,600 hours
- Combustion efficiency is 82.0% (for both pre-retrofit and post-retrofit condition)

Pipe 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/).

Measurement and verification activities are based on the following assumptions:

- Insulation thickness: 1.5 inch and 2 inch
- Insulation material type: 850°F Min. Fiber Pipe and Tank, Type IIIB, C1393-14
- Process temperature is 338°F
- The average annual ambient air temperature was 75°F

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

$$\textbf{Annual Therms Savings} = \frac{\textbf{Heat Loss } \left(\frac{\textbf{Btu}}{\textbf{hr}}\right) \textbf{ x Annual Operating Hours } \left(\frac{\textbf{hrs}}{\textbf{yr}}\right)}{\textbf{Boiler Efficiency x 100,000 } \left(\frac{\textbf{BTU}}{\textbf{CCF}}\right)}$$

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency

100,000 Btu/CCF = conversion factor (BTU/yr to CCF/yr)

Pipe/Valve Insulation Parameters

Entry #	Description	Pipe or Valve	Quantity	Pipe Length / Valve Equivalent Length (ft)	Diameter (in)
1	1.5" steam pipe on vats	Pipe	1	213	1.5
2	1.5" fittings on vats	Fitting	1	143	1.5
3	2" steam pipe on vats	Pipe	1	33	2
4	2" fittings on vats	Fitting	1	24	2

Measure Life

Estimated Useful Life for by Measure

Measure	EUL
Pipe Insulation	20 years

Calculated Savings:

Pipe Insulation

Pipe Insulation Annual Energy Savings

Entry #	Description	Pipe or Valve	Temperature (°F)	Pre Heat Loss	Post Heat Loss	Therms Savings
1	1.5" steam pipe	Pipe	338	408	50	2,420
2	1.5" fittings	Fitting	338	408	50	1,625
3	2" steam pipe	Pipe	338	501	57	466
4	2" fittings	Fitting	338	501	57	339
					Total:	**4,848**

Overall project savings are as follows:

Overall Project Savings

Measure	Expected Annual therms Savings	Realized Annual therms Savings	Realization Rate	Lifetime therms Savings
Pipe Insulation	4,848	4,848	100%	96,970
Total	**4,848**	**4,848**	**100%**	**96,970**

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of $10,600. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

Annual Therms Savings	Cost per Therm	Annual Energy Cost Savings	Incremental Cost	Base Incentive	Adjusted Incentive	Payback w/Incentive	Payback w/o Incentive
4,848	$0.537	$2,603.38	$10,600	$4,364	$4,364	2.39	4.07

Program C&I Solutions
Project ID EA-0000352588
Facility SIC Code 8211 – Elementary and Secondary Schools
Measures Steam Trap Replacement

Project Background

The participant is a K-12 school that received incentives from Arkansas Oklahoma Gas for:

- ECM #1 - Steam trap replacement

The steam system serves the school'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:

- Feed water temperature is 200°F
- Combustion efficiency is 84.0% (for both pre-retrofit and post-retrofit condition)

Steam Trap Repairs

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

Steam Trap Replacement Parameters

Steam Trap #	Orifice Size (in.)	Inlet Pressure (psig)	Outlet Pressure (psig)	Service (Drip/Process)	Feedwater Temperature (°F)	Boiler Efficiency	Operating Hours
1	11/32	10	2.0	Coil/Process	200	84%	4,380
2	9/32	10	2.0	Tracer/Drip	200	84%	7,300
3	3/16	10	2.0	Tracer/Drip	200	84%	7,300
4	9/32	10	2.0	Tracer/Drip	200	84%	7,300
5	3/32	10	2.0	Coil/Process	200	84%	4,380
6	3/32	10	2.0	Coil/Process	200	84%	4,380
7	3/32	10	2.0	Coil/Process	200	84%	4,380
8	1/8	10	2.0	Coil/Process	200	84%	4,380
9	1/4	10	2.0	Tracer/Drip	200	84%	7,300
10	8/73	10	2.0	Tracer/Drip	200	84%	7,300

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 the system is pressurized (hrs/yr)

H_{fg} = latent heat of evaporation (BTU/lb) found in Table 3

EC_{Base} = combustion efficiency of boiler (%), 84.0%

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)

Measure Life

Estimated Useful Life by Measure

Measure	EUL
Steam Trap Replacement	5 years

Calculated Savings:

Steam Trap Replacement

Steam Trap Replacement Savings

Steam Trap #	Discharge Rate (lbs/hr)	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Latent Heat of Evaporation, H_{fg} (BTU/lb)	Therms Savings
1	36	1,161	168	993	1,863
2	46	1,161	168	993	3,968
3	20	1,161	168	993	1,380
4	46	1,161	168	993	2,976
5	3	1,161	168	993	140
6	3	1,161	168	993	124
7	3	1,161	168	993	118
8	6	1,161	168	993	186
9	36	1,161	168	993	1,553
10	7	1,161	168	993	362
				Total:	**12,672**

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 Replacement	12,672	12,672	100.0%	63,358
TOTAL	**12,672**	**12,672**	**100.0%**	**63,358**

Measure Cost, Incentive, & Payback

The Evaluators reviewed the invoices associated with this project and verified a cost of $10,137. Measure payback is summarized in the table below.

Cost, Incentive, and Payback

Annual Therms Savings	*Cost per Therm*	*Annual Energy Cost Savings*	*Incremental Cost*	*Base Incentive*	*Adjusted Incentive*	*Payback w/Incentive*	*Payback w/o Incentive*
12,672	0.55	$6,969.60	$20,339	$10,137	$10,137	1.4	2.9

9. Appendix B: Deferred Replacement Cost Calculations

This appendix presents the calculations of deferred replacement costs for residential and commercial tankless water heaters, furnace early retirement, and LEDs.

	Inputs			
Measure Type=	Res Tankless (ROB + NC)			**Notes**
Nominal Discount Rate=	6.2%			
Inflation Rate=	1.9%			
Real Discount Rate=	4.2%			
	Program	**Baseline**		
Equipment Type=	Tankless WH	Storage WH		
Effective UsefulLife=	20	11		
Remaining Useful Life=				
PW(EUL)=	13.35	8.67		
PW(RUL)=				
Installed Cost=	$1,219	$614		
Deferred Replacement Cost=		$ 331.98		
PWF Formula=		$ 331.98		
Incremental Cost=	$ 273.02			
	Assumptions:	**Tech Cost**	**Labor**	**Total Cost**
	Tankless Year 1 Full Cost	$1,219		$1,219
	Storage Tank Year 12 Full Cos	$755		$755
	Storage Tank 2018 Cost	$614		$614
	Source: Illinois TRM			

Figure 9-1: Residential Tankless WH Deferred Replacement Cost Calculation

	Inputs		
Measure Type=	C&I Tankless (ROB + NC)		
Nominal Discount Rate=		7.0%	
Inflation Rate=		1.9%	
Real Discount Rate=		5.0%	
		Program	**Baseline**
Equipment Type=	Tankless WH		Storage WH
Effective UsefulLife=		20	15
Remaining Useful Life=			
PW(EUL)=		13.35	10.96
PW(RUL)=			
Installed Cost=		$1,219	$614
Deferred Replacement Cost=			$ 123.13
PWF Formula=			$ 133.74
Incremental Cost=	$	481.87	

Assumptions:	Tech Cost	Labor	Total Cost
Tankless Year 1 Full Cost	$1,219		$1,219
Storage Tank Year 16 Full Cos	$814		$814
Storage Tank 2018 Cost	$614		$614
Source: Illinois TRM			

Figure 9-2: C&I Tankless WH Deferred Replacement Cost Calculation

	Inputs	
Measure Type=	Furnace Early Replacement	
Nominal Discount Rate=	5.00%	
Inflation Rate=	1.9%	
Real Discount Rate=	3.0%	
	Program	Baseline
Equipment Type=	HE Furnace	SE Furnace
Effective UsefulLife=	20	20
Remaining Useful Life=		5
PW(EUL)=	20.00	20.00
PW(RUL)=		5.00
Installed Cost=	$ 2,548	$ 2,011
Deferred Replacement Cost=		$ 1,390.29
PWF Formula=		$ 1,508

Figure 9-3: Furnace Early Retirement

LEDs	Inputs			
Measure Type=	ROB: Original EISA			
Nominal Discount Rate=	6.2%			
Inflation Rate=	1.9%			
Real Discount Rate=	4.22%			
	Program	Baseline		
Equipment Type=	LED	Halogen		
Effective UsefulLife=	19	2		
Remaining Useful Life=				
PW(EUL)=	$12.89	1.88		
PW(RUL)=				
Installed Cost=	$7.37	$1.25		
Deferred Replacement Cost=		$ 7.32		
PWF Formula=		$ 7.32		
Incremental Cost=	-$1.20			
		Tier I	Tier II	
Equipment Type=	LED	Halogen	CFL	
Effective UsefulLife=	19	2	7	
Remaining Useful Life=				
Last Year of Tier I Baseline=	4	4		
PWF(EUL)=	12.89	1.88	5.95	
PWF(Tier I)=	3.61	1.88		
PWF(Tier II)=	12.89	5.95		
Installed Cost=	$7.37	$1.25	$2.17	
Avoided Replacement Cost=	$4.53	$1.15	$3.38	
PWF Formula=	$ 3.68	$ 1.15	$ 2.53	
Incremental Cost=	$1.58			

Figure 9-4: Direct Install LED Deferred Replacement Cost Calculation

10. Appendix C: Sample TRM Calculations

10.1 Residential Furnaces (TRM V8.2 Section 2.1.3

According to Arkansas TRM V8.1, savings for residential furnaces are calculated as follows:[21]

$$\textbf{Annual Therm Savings} = \textbf{Heat load} \times \left({}^{1}/_{AFUE_{base}} - {}^{1}/_{AFUE_{eff}}\right)$$

$$\textbf{Heat load} = \frac{{}^{therms}/_{site\ area}}{year} \times \textbf{site area}$$

Where:

Site area = square footage of the project site. If site area is unknown, use installed capacity (BTUh)/30 (BTUh /ft^2).

$AFUE_{base}$ = baseline efficiency of the furnace, 80% AFUE.

$AFUE_{eff}$ = efficiency of the new furnace installed, in AFUE.

Table 10-1 summarizes the heating load multipliers per square foot from the TRM V8.2.

Table 10-1: TRM V8.2 Annual Furnace Heating Load

Vintage	Heating Load (Therms/Ft.2/Year)			
	Zone 9 – Fayetteville	Zone 8 – Fort Smith	Zone 7 – Little Rock	Zone 6 – El Dorado
1979 & Earlier	.404	.360	.336	.296
1980-1989	.303	.270	.252	.222
1990-1999	.202	.180	.168	.148
2000 & Later	.152	.135	.126	.111

Example savings calculations are as follows:

- Retrofit – 90,000 Input BTU furnace, 95% AFUE
- Output BTU = 90,000 x .95 = 85,500
- Square Feet = 85,500 / 30 = 2,450
- Year built: 1986
- Location: Fort Smith, Zone 8.

[21] Arkansas TRM v8.0 Volume 2, Page 44

$$\boldsymbol{Retrofit\ Therms\ Savings = 2{,}450 ft.^2 \times .270 \frac{Therms}{ft.^2} \times \left(\frac{1}{.80} - \frac{1}{.95}\right)}$$
$$\boldsymbol{= 130.56\ Therms}$$

The same furnace in a new construction project would save:

$$\boldsymbol{NC\ Therms\ Savings = 2{,}850 ft.^2 \times .135 \frac{Therms}{ft.^2} \times \left(\frac{1}{.80} - \frac{1}{.95}\right) = 75.94\ Therms}$$

10.2 Residential Water Heater Replacement (TRM V8.2 Section 2.3.1)

Energy savings values for storage tank water heaters were developed using installed Energy Factor ratings as determined by the Gas Appliance Manufacturers Association Directory of Certified Water Heating Products. Tank sizing must follow AHRI standards.

In TRM V8.2 Savings are calculated as:[22]

$$\boldsymbol{therm_{Savings} = \frac{\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right)}{Conversion\ Factor}}$$

Where:

$\boldsymbol{\rho}$ = Water density, 8.33 lbs./gal.

$\boldsymbol{C_p}$ = Specific heat of water, 1 BTU/lb·°F

$\boldsymbol{V}$ = Estimated annual hot water use (gal per year)

$\boldsymbol{T_{SetPoint}}$ = Water heater set point, if unavailable, use 120°F

$\boldsymbol{T_{Supply}}$ = Average supply water temperature

$\boldsymbol{EF_{pre}}$ = Baseline value

$\boldsymbol{EF_{post}}$ = Energy Factor of new water heater

$\boldsymbol{Conversion\ Factor}$ = 100,000 BTU = 1 therm

Baseline energy factors are summarized in Table 10-2.

[22] Arkansas TRM V8.2, Volume 2. Pg. 122-135

Table 10-2: Residential Water Heating Baseline Uniform Energy Factors

Draw Pattern	Equivalent Gallons	Baseline UEF
Very Small	20	.3056
Low	30	.5412
Medium	40	.5803
High	50	.6270

Volume estimates are provided in Table 10-3.

Table 10-3: TRM V8.2 Estimated Annual Hot Water Use

Weather Zone	Tank Size (Gal) of Replaced Water Heater			
	40	50	65	80
9	18,401	20,911	25,093	30,111
8	18,331	20,831	24,997	29,996
7	18,267	20,758	24,910	29,892
6	17,815	20,245	24,293	29,152

Supply water temperatures are presented in Table 10-4

Table 10-4: Residential Water Supply Inlet Temperatures

Weather Zone		Supply Water Temperature
9	Fayetteville	65.6
8	Fort Smith	66.1
7	Little Rock	67.8
6	El Dorado	70.1

Example savings calculations are as follows:

- Retrofit – 199,000 Input BTU Tankless Water Heater, 96% UEF
- High Draw Pattern
- Location: Fort Smith, Zone 8.

$$\boldsymbol{Therms\ Savings} = \frac{\mathbf{1} \times \mathbf{8.33} \times \mathbf{20,831} \times (\mathbf{120} - \mathbf{66.1}) \times \left(\frac{\mathbf{1}}{\mathbf{.627}} - \frac{\mathbf{1}}{\mathbf{.96}}\right)}{\mathbf{100,000}}$$

$$= \mathbf{51.74}\ \boldsymbol{Therms}$$

10.3 Smart Thermostats (TRM V8.2 Section 2.1.12)

The savings multipliers for smart thermostats are shown in Table 10-5[23].

Table 10-5: Smart Thermostat Deemed Savings Factors

Baseline	Therms/Ft.^{2}	kWh/Ft.^{2}
Manual	.037	.450
Programmable	.009	.113
Default	.033	.399

10.4 Commercial Furnaces (TRM V8.2 Section 3.1.9)

Therms savings calculations for commercial furnaces apply more facility-specific information than the residential methodology. Savings were calculated as follows:[24]

$$\textbf{Therms Savings} = \frac{\textbf{BTU Capacity} * \textbf{EFLH}_H * \left(\frac{1}{\textbf{Effic}_{pre}} - \frac{1}{\textbf{Effic}_{post}}\right)}{100{,}000\ \textbf{Therms/BTU}}$$

The EFLH for a facility is a function of facility type and weather zone. The TRM V6.1 EFLH values are summarized in Table 10-6.

Table 10-6: EFLH Values[25]

Building Type	Zone 6	Zone 7	Zone 8	Zone 9
Assembly	615	854	915	1032
College/University	674	936	1002	1130
Fast Food Restaurant	287	439	472	549
Full Menu Restaurant	178	321	362	438
Grocery Store	692	941	1001	1129
Health Clinic	641	878	915	1045
Lodging	391	589	637	722
Large Office (>30k Ft^2)	816	1020	1060	1157
Small Office (<30k Ft^2)	351	534	564	644
Religious Worship	575	798	854	963
Retail	781	1043	1133	1287
School	777	1030	1094	1236

For example, if a Small Office in Fort Smith (Zone 8) installed a 70,000 BTU 96% AFUE Furnace, the resulting therms savings are calculated as:

[23] AR TRM V8.2 Vol. 2.0 Pg. 83

[24] Arkansas TRM V8.2, Pg. 252

[25] Arkansas TRM V8.2 Volume 2, Table 478. Pg. 526.

$$\boldsymbol{Therms\ Savings = \frac{70,000\ BTU * 564\ EFLH * \left(\frac{1}{.80} - \frac{1}{.96}\right)}{100,000\ BTU/Therm} = 82.24\ Therms}$$

10.5 Commercial Water Heaters (TRM V8.2 Section 3.3.1)

Therms savings for commercial water heaters are calculated as:[26]

$$\boldsymbol{therms\ Savings = \frac{\rho * C_P * V * \left(T_{SetPoint} - T_{Supply}\right) * \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right) * Days/Year}{Conversion\ Factor}}$$

Where:

P = Water Density, 8.33 lbs/Gallon

C_P = Specific Heat of Water, 1 BTU/Lb. F

V = Average daily hot water use (gallons)

$T_{setpoint}$ = Water Heater setpoint, 140 deg. F

T_{supply} = Supply water temperature, 58 deg. F

EF_{pre} = Energy factor of existing water heater (.62 - .0019V)

EF_{post} = Energy factor of installed water heater

Days/Year = Days per year of operation

Conversion Factor = 100,000 BTU = 1 therm

The required facility-specific inputs are volume and days/year. Volume can be calculated on the basis of square footage of the facility or from units served. Table 10-7 presents the volume and days of usage values for a facility by square footage.[27]

[26] Arkansas TRM V8.2, Volume 2. Pg. 357-368

[27] Ibid

Table 10-7: Hot Water Requirements by Facility Size

Building Type	Gallons / Unit / Day	Unit	Units / 1,000 ft.^{2}	Applicable Days / Year	Gallons / 1,000 ft.^{2} / Day
Small Office	1	Person	2.3	250	2.3
Large Office	1	Person	2.3	250	2.3
Fast Food Rest.	.7	Meal/Day	784.6	365	549.2
Sit-down Rest.	2.4	Meal/Day	340	365	816
Retail	2	Employee	1	365	2.0
Grocery	2	Employee	1.1	365	2.2
Warehouse	2	Employee	.5	250	1.0
Elementary School	.6	Person	9.5	200	5.7
Jr. High/High School	1.8	Person	9.5	200	17.1
Health	90	Patient	3.8	365	342.0
Motel	20	Unit (Room)	5	365	100.0
Hotel	14	Unit (Room)	2.2	365	30.8
Other	1	Employee	.7	250	.7

Table 10-8 presents the volume and days of usage values by unit produced or person served.

Table 10-8: Hot Water Requirements by Unit or Person

Building Type	Size Factor	Average Daily Demand
Dormitories	Men	13.1 Gal. per Man
	Women	12.3 Gal. per Woman
Hospitals	Per Bed	90.0 Gal. per Patient
Hotels	Single Room with Bath	50.0 Gal. per Unit
	Double Room with Bath	80.0 Gal. per Unit
Motels	# Units:	
	Up to 20	20.0 Gal. per Unit
	21 to 100	14.0 Gal. per Unit
	101 and Up	10.0 Gal. per Unit
Restaurants	Full Meal Type	2.4 Gal. per Meal
	Dive-in Snack Type	0.7 Gal. per Meal
Schools	Elementary	0.6 Gal. Per Student
	Secondary and High School	1.8 Gal. Per Student

10.6 Commercial Faucet Aerators (TRM V8.2 Section 3.3.2)

Savings are calculated as follows:[28]

$$\boldsymbol{Annual\ Therms} = [(\boldsymbol{F_B} * \boldsymbol{U_B}) - (\boldsymbol{F_P} * \boldsymbol{U_P}) * \boldsymbol{Days} * (\boldsymbol{T_H} - \boldsymbol{T_C}) * \boldsymbol{C_H} * \boldsymbol{C_G}/\boldsymbol{Eff_G}]$$

$$\boldsymbol{Peak\ Therms} = \boldsymbol{P} * [(\boldsymbol{F_B} * \boldsymbol{U_B}) - (\boldsymbol{F_P} * \boldsymbol{U_P}) * (\boldsymbol{T_H} - \boldsymbol{T_C}) * \boldsymbol{C_H} * \boldsymbol{C_G}/\boldsymbol{Eff_G}]$$

[28] Arkansas TRM V8.2, Volume 2. Pg. 369-372

The inputs for this equation are defined in Table 10-9.

Table 10-9: DI Aerator Savings Calculation Parameters

Parameter	Description	Value
F_B	Baseline Flow Rate (GPM)	2.2
F_P	Post Flow Rate (GPM)	≤ 1.5
Days	Annual operating days for the facility[29]	
	Prison	365
	Hospital, Nursing Home	365
	Dormitory	274
	Multifamily	365
	Lodging	365
	Commercial	250
	School	200
T_C	Average supply (cold) water temperature (deg. F)	Zone 9: 65.6
		Zone 8: 66.1
		Zone 7: 67.8
		Zone 6: 70.1
T_H	Average mixed hot water temperature (deg. F)	105
U_B	Baseline water Usage Duration	
	Prison	30 min/day/unit
	Hospital, Nursing Home	3 min/day/unit
	Dormitory	30 min/day/unit
	Multifamily	3 min/day/unit
	Lodging	3 min/day/unit
	Commercial	30 min/day/unit
	School	30 min/day/unit
U_P	Post Water Usage Duration (assumed)	= U_B
C_H	Unit Conversion: 8.33 BTU/Gallons/deg. F	8.33
C_G	Unit Conversion: 1 Therm/100,000 BTU	1/100,000
Eff_G	Efficiency of Gas Water Heater	.8

These values translate into per-faucet savings values by facility type, detailed in Table 10-10 and Table 10-11 for 1.0 and 0.5 GPM aerators, respectively.[30]

[29] For facilities that operate year-round: conservatively assume operating days of 360/year; for schools open weekdays except summer: 360 x (5/7) x (9/12) = 193; for dormitories with few occupants in the summer: 360 x (9/12) = 270; and for normal commercial buildings: 360 x (5/7) = 257

[30] Table values interpolated based on data in Arkansas TRM V8.2, Volume 2. Pg. 369-372

Table 10-10: 1.0 GPM Commercial Aerator Savings

Facility Type	Fayetteville (Zone 9)	Fort Smith (Zone 8)	Little Rock (Zone 7)	El Dorado (Zone 6)
Prison	53.91	53.22	50.90	47.75
Hospital / Nursing Home	5.35	5.32	5.09	4.78
Dormitory	40.47	39.95	38.21	35.85
Multifamily	5.35	5.32	5.09	4.78
Lodging	5.35	5.32	5.09	4.78
Commercial	36.92	3645	34.86	32.71
School	29.54	29.16	27.89	26.16

Table 10-11: 0.5 GPM Commercial Aerator Savings

Facility Type	Fayetteville (Zone 9)	Fort Smith (Zone 8)	Little Rock (Zone 7)	El Dorado (Zone 6)
Prison	76.37	75.40	72.10	67.65
Hospital / Nursing Home	7.64	7.54	7.21	6.76
Dormitory	57.33	56.60	54.13	50.78
Multifamily	7.64	7.54	7.21	6.76
Lodging	7.64	7.54	7.21	6.76
Commercial	52.31	51.64	49.39	46.33
School	41.85	41.31	39.51	37.07

10.7 Pre-Rinse Spray Valves (TRM V8.2 Section 3.8.11)

Low-flow pre-rinse spray valves PRSVs were also direct-installed at a wide range of facility types with food service applications. The savings per unit for these were calculated as follows:[31]

$$\boldsymbol{Annual\ Therms} = [(\boldsymbol{F_B} * \boldsymbol{U_B}) - (\boldsymbol{F_P} * \boldsymbol{U_P})] * \boldsymbol{Days} * (\boldsymbol{T_H} - \boldsymbol{T_C}) * \boldsymbol{C_H} * \boldsymbol{C_G}/\boldsymbol{Eff_G}$$

$$\boldsymbol{Peak\ Therms} = \boldsymbol{P} * [(\boldsymbol{F_B} * \boldsymbol{U_B}) - (\boldsymbol{F_P} * \boldsymbol{U_P})] * (\boldsymbol{T_H} - \boldsymbol{T_C}) * \boldsymbol{C_H} * \boldsymbol{C_G}/\boldsymbol{Eff_G}$$

Table 10-12 presents the definition of these parameters.[32]

[31] Arkansas TRM V8.2, Volume 2. Pg. 514-517
[32] Ibid

Table 10-12: Pre-Rinse Spray Valves Savings Calculation Parameters

Parameter	Description	Value
F_B	Baseline Flow Rate (GPM)	2.25
F_P	Post Flow Rate (GPM)	1.28
Days	Annual operating days for the facility[33]	
	Fast Food Restaurant	365
	Casual Dining Restaurant	365
	Institutional	365
	Higher Education	274
	School / K-12	200
T_C	Average supply (cold) water temperature (deg. F)	Zone 9: 65.6
		Zone 8: 66.1
		Zone 7: 67.8
		Zone 6: 70.1
T_H	Average mixed hot water temperature (deg. F)	120
U_B	Baseline water Usage Duration	
	Fast Food Restaurant	45 min/day/unit
	Casual Dining Restaurant	105 min/day/unit
	Institutional	210 min/day/unit
	Higher Education	210 min/day/unit
	School / K-12	105 min/day/unit
U_P	Post Water Usage Duration (assumed)	= U_B
C_H	Unit Conversion: 8.33 BTU/Gallons/deg. F	8.33
C_G	Unit Conversion: 1 Therm/100,000 BTU	1/100,00
Eff_G	Efficiency of Gas Water Heater	.8

10.8 Commercial Low Flow Showerheads (TRM V8.2 Section 3.3.5)

Savings are calculated as follows:[34]

$$\boldsymbol{Annual\ therms} = \frac{\boldsymbol{8.33 * C_p * \Delta V * \left(T_{HW} - T_{Suppy}\right) * \left(\frac{1}{E_t}\right)}}{\boldsymbol{100,000\ BTU/therm}} * \boldsymbol{\frac{days}{year}}$$

$$\boldsymbol{Peak\ therms} = \frac{\boldsymbol{8.33 * C_p * \Delta V * \left(T_{HW} - T_{Suppy}\right) * \left(\frac{1}{E_t}\right)}}{\boldsymbol{100,000\ BTU/therm}} * \boldsymbol{P}$$

In this formula, $\boldsymbol{\Delta V}$ is calculated as follows:

[33] For facilities that operate year-round: conservatively assume operating days of 360/year; for schools open weekdays except summer: 360 x (5/7) x (9/12) = 193; for dormitories with few occupants in the summer: 360 x (9/12) = 270; and for normal commercial buildings: 360 x (5/7) = 257

[34] Arkansas TRM V8.2, Volume 2. Pg. 381-388

$$\Delta V = U * N * (Q_b - Q_p) * F_{HW}$$

Where:

U = average shower duration (7.8 minutes)

N = Number of showers per showerhead per day

Q_b = Baseline flow rate (2.5 GPM);

Q_p = Installed flow rate (in GPM); and

F_{HW} = Hot Water Fraction (share of water which is from the water heater)

The inputs for this equation are defined in Table 10-13

Table 10-13: DI Showerhead Savings Calculation Parameters

Parameter	Description	Value
F_B	Baseline Flow Rate (GPM)	2.2
F_P	Post Flow Rate (GPM)	≤ 1.5
Days	Annual operating days for the facility	
	Hospital, Nursing Home	365
	Lodging	365
	Commercial	250
	24 Hour Fitness Center	365
	School	200
T_C	Average supply (cold) water temperature (deg. F)	Zone 9: 65.6
		Zone 8: 66.1
		Zone 7: 67.8
		Zone 6: 70.1
T_H	Average mixed hot water temperature (deg. F)	120
U_P	Post Water Usage Duration (assumed)	= U_B
C_G	Unit Conversion: 1 Therm/100,000 BTU	1/100,00
E_T	Efficiency of Gas Water Heater	.8

Table 10-14: Daily Hot Water Reduction

Installed Flow Rate	Weather Zone	Hospital / Nursing	Lodging	Commercial Employee Shower	24 Fitness Center	Schools
2.0 GPM	9	2.5	3.5	1.9	56.3	2.0
	8	2.5	3.5	1.9	56.1	2.0
	7	2.5	3.5	1.8	55.4	2.0
	6	2.4	3.4	1.8	54.4	2.0
1.75 GPM	9	3.8	5.3	2.8	84.4	3.1
	8	3.8	5.3	2.8	84.1	3.1
	7	3.7	5.2	2.8	83.1	3.0
	6	3.6	5.1	2.7	81.5	3.0
1.5 GPM	9	5.0	7.1	3.8	112.6	4.1
	8	5.0	7.0	3.7	112.2	4.1
	7	4.9	6.9	3.7	110.8	4.0
	6	4.9	6.8	3.6	108.7	.9

10.9 Commercial Door Air Infiltration (TRM V8.2 Section 3.2.11.)

Savings are calculated as follows[35]:

$$\boldsymbol{Annual\ therms} =$$

$$\frac{\left(\boldsymbol{CFM_{pre,day} * Hours_{day} + CFM_{pre,night} * Hours_{night}}\right)\left(\boldsymbol{CFM_{reduction} * 1.08 * \Delta T * \frac{1.0kW}{ton}}\right)}{\boldsymbol{80\%\ AFUE * \frac{100,000Btu}{therm}}}$$

$$\boldsymbol{Peak\ therms} = \boldsymbol{Annual\frac{therms}{ELFH_H}}$$

The inputs for this equation are defined in Table 10-15.

[35] Arkansas TRM V8.2, Volume 2. Pg. 350-356

Table 10-15: DI Door Infiltration Savings Calculation Parameters

Parameter	Description	Value
CFM_{pre}	Calculated pre-retrofit air infiltration rate (ft^3/min)	
CFMreduction	Average infiltration reduction	79%
ΔT	Change in temperature across gap barrier	
$Hours_{day}$	12-hour cycles per day, per month	4,380 hours
$Hours_{night}$	12-hour cycles per day, per month	4,380 hours
$EFLH_H$	Equivalent full-load hours	See table below

Table 10-16: $EFLH_H$ By Weather Zone

Building Type	Zone 6	Zone 7	Zone 8	Zone 9
Assembly	575	798	855	824
College/University	630	874	936	902
Fast Food Restaurant	288	440	474	455
Full Menu Restaurant	181	328	370	336
Grocery Store	688	935	995	965
Health Clinic	646	885	922	895
Lodging	389	587	635	605
Large Office (>30k Sq.ft)	811	1,014	1,054	1,036
Small Office (≤30k Sq.ft)	353	538	568	538
Religious Worship	537	745	798	769
Retail	780	1,041	1,131	1,099
School	774	1,026	1,089	1,064

These values translate into per linear foot savings values by weather zone, detailed in the table below.

Table 10-17: Deemed Annual Therm Savings per Linear Foot

Weather Zone	Gap Width (inches)			
	1/8	1/4	1/2	3/4
Zone 9	5.34	10.80	21.43	32.16
Zone 8	4.64	9.38	18.62	27.96
Zone 7	3.91	7.92	15.71	23.58
Zone 6	2.89	5.86	11.62	17.44