CenterPoint Oklahoma Demand Programs Annual Report 2020

May 1, 2020

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Executive Summary

On October 7, 2010, CenterPoint Energy Resources Corp. d/b/a CenterPoint Energy Oklahoma Gas ("CenterPoint Oklahoma" or the "Company") proposed a comprehensive portfolio of Conservation Improvement Programs ("CIP," and as a whole, the "CIP Portfolio") in response to the Oklahoma Corporation Commission's ("OCC" or the "Commission") Rules for Demand Programs, OAC § 165:45-23-1 et seq. On March 25, 2011, the Commission approved the program portfolio in Order No. 583869 in Cause No. PUD 201000148, and CenterPoint Oklahoma began to implement the program portfolio thereafter in 2011. On February 1, 2012, the Commission approved modifications and additions to the Company's previously approved CIP portfolio in Order No. 593649 in Cause No. PUD 201100149. On August 13, 2013, the Commission approved an updated CIP portfolio for program years ("PY") 2014 - 2016 in Order No. 616573 in Cause No. PUD 201300085. On October 26, 2016, the Commission approved an updated CIP portfolio for PY 2017 - 2019, in Order No. 657250 in Cause No. PUD 201600263. On August 8, 2019, the Company requested approval of an updated comprehensive CIP Portfolio for PY 2020 - 2022. The OCC approved this request on December 10, and CenterPoint Oklahoma began delivery of this CIP Portfolio on January 1, 2020, in Order No. 706092 in Cause No. PUD 201900060.

This report is filed in response to the Commission's reporting requirements specified in OAC § 165:45-23-7, which requires the Company to report the performance of its energy efficiency programs for the preceding program year. Consistent with the requirements, this report will outline the activities and results of the Company's CIP Portfolio performance for PY 2020.

CenterPoint Oklahoma implemented and administered the following CIP programs in PY 2020:

- **CenterPoint Energy Education Program (CEEP)** - Educates residential and commercial customers about their energy usage and provides low-cost to no-cost tips on how to conserve energy.
- **Residential Home Energy Reports Program** - An educational and behavioral change program which provides individualized information and recommendations regarding energy usage through Home Energy Reports, sent to approximately 39,551 CenterPoint Oklahoma customers. The direct mail Home Energy Reports utilize energy usage data with customer demographic, housing, and GIS data to develop specific, targeted recommendations that educate and motivate customers to reduce their energy consumption.
- **Natural Gas Equipment Program** - Promotes the installation and use of high-efficiency natural gas appliances that include water heaters, space heaters, clothes dryers, and gas ranges, as well as self-install smart thermostats for residential customers. Commercial customers are encouraged to install high-efficiency natural gas water and space heating.

Inducements are offered to customers with an active account with CenterPoint Oklahoma and includes the following components:

- Water Heater - CenterPoint Oklahoma provides a $500 inducement to customers who upgrade their water heater to a tankless system and also provides a $900 inducement to customers who switch from electric resistance water heating to natural gas tankless water heating system. Plumbers that install gas tankless systems for a natural gas water heater upgrade or an electric to natural gas conversion are eligible for a $50 trade ally incentive for every qualifying inducement.

- Natural Gas Furnace - Furnace inducements range from $300 to $500 to residential and commercial customers that purchase and install high-efficiency natural gas furnaces. Customers that switch from electric resistance heating and heat pumps to a more efficient natural gas furnace as their primary heating source receive a $2,000 inducement. Customers who receive a rebate for a qualifying furnace are also eligible for an additional $50 incentive when a qualified Smart Thermostat is installed.

- Clothes Dryer - Provides up to a $450 inducement to qualified residential customers for the purchase and installation of natural gas dryers. A $50 trade ally incentive is also available for each qualifying inducement.

- Cooking Range - Provides up to a $300 inducement to residential customers who replace electric cooking ranges with more efficient natural gas ranges. In addition, a $50 trade ally incentive is offered to encourage trade allies to stock and sell natural gas cooking ranges.

- Multi-Unit Market Transformation - Promotes efficient water heating and space heating solutions to multi-unit developers through inducements ranging from $900 to $2,000. Trade ally rebates are also available at $50 for qualified equipment installations.

- **High Efficiency Homes Program** - Provides a $1,000 inducement to customers or builders who construct new homes equipped with efficient natural gas appliances.

- **Low-Flow Showerhead and Faucet Aerator Program** - Provides residential customers with free low-flow showerhead and faucet aerator kits that, when installed, will conserve water, reduce energy usage, and save customers money.

- **Low-Income Saving Homes Program –** Provides weatherization retrofits that will improve the efficiency and comfort of CenterPoint Oklahoma's low-income and hard to reach residential customers.

- **Natural Gas Commercial & Industrial ("C&I") Solutions Program** – Administered by CLEAResult, the Natural Gas C&I Solutions Program provides financial incentives and technical consulting assistance designed to help commercial and industrial customers identify, develop and implement cost effective energy efficiency solutions at their facilities. The Natural Gas C&I Solutions Program also provides prescriptive rebates for qualified boiler and foodservice equipment purchases. The program contains the following components:

    - Direct-Install - Measures target small to mid-size commercial customers. It is a turnkey equipment replacement program designed to reduce customer energy usage costs through the installation of low-flow pre-rinse spray valves, faucet aerators, showerheads, weather-stripping, and steam traps.

    - No-Cost Facility Audit - Program representatives will perform a valuable no-cost facility audit, to determine if any natural gas is being used inefficiently and help identify cost-effective solutions to reduce energy waste and save money.

    - Custom Project Measures - target commercial and industrial customers. Projects identified will be eligible for custom incentives based on final program design, after applying documented and defensible calculated energy savings.

    Prescriptive Programs Include:

    - Commercial Food Service Program – For the PY 2020 - 2022, the Commercial Food Service Program is now under the C&I Solutions umbrella and administered by CLEAResult. This Program promotes the reduction of natural gas energy usage for commercial food service customers via inducements ranging from $300 to $2,400 for the purchase and installation of qualified new energy efficient food service equipment. Trade ally incentives ranging from $45 to $225 are also available for qualifying equipment.

    - Commercial Boiler Program - For PY 2020 - 2022, the Commercial Boiler Program is now under the C&I Solutions umbrella and administered by CLEAResult. This Program encourages commercial

customers to install efficient natural gas boilers via inducements ranging from $1,400 to $2,000 per MMBTU of input for the purchase of qualified new energy efficient boilers. Additionally, inducements are available for the purchase and installation of boiler burner replacements. A $200 trade ally incentive is available for qualifying boilers rated at 83% to 91% efficient, and a $300 trade ally incentive is available for boilers rated at 92% efficiency or higher

In PY 2020, the CIP Portfolio produced net energy savings of 102,507 Mcf. The programs generated a net economic benefit of $1,269,358 and helped participants save money through a combination of prescriptive and custom rebates, direct-install measures, energy usage reports, and facility audits. Key insights from PY 2020 program delivery include:

- **Natural Gas Equipment program experienced a decrease in participation** – The decline in participation is attributed to the impacts of the COVID-19 pandemic which is explained below in a later section.
- **Demand for fuel-switching rebates remains high** – In PY 2020, 149 participants utilized the Company's fuel-switching rebates available for natural gas space heating, water heating equipment, and multi-family programs. Also, 29 participants received rebates for natural gas dryers and ranges. These fuel-switching rebates remain strong inducements for customers to utilize high-efficiency natural gas equipment in their homes and businesses.
- **High Efficiency Homes Program participation continues to grow** – In PY 2020, inducements were provided for 57 new homes equipped with high-efficiency natural gas heating equipment, water heating equipment, and a third natural gas appliance. The Company's ongoing efforts to educate builders on the value of the program continue to influence builders to install efficient natural gas equipment in new homes.
- **Natural Gas Commercial Solutions Program** – PY 2020 was another year of strong growth for the Company's Natural Gas Commercial Solutions Program. The direct-installation measures continued to be an effective inducement to drive commercial energy savings at no cost to participants. The custom portion of the program provided participants with technical assistance, recommendations, and financial inducements to implement energy saving measures such as insulation upgrades, burner retrofits, waste heat recovery, as well as equipment controls. There was a total of 15 pieces of equipment rebated through the Food Service and Boiler portion of the program. The program delivered energy savings of 41,524 Mcf, which was 115% of the program's original savings goal.
- **Home Energy Reports behavioral savings remain strong** – The messaging provided through the Home Energy Reports program continues to be an effective channel to educate customers, modify behavior, and drive energy savings. In PY 2020, the program delivered

net energy savings of 42,399 Mcf, and reports were also used to cross-promote other program offerings in the Company's CIP Portfolio.

Figure 1: Energy Savings by Program Year

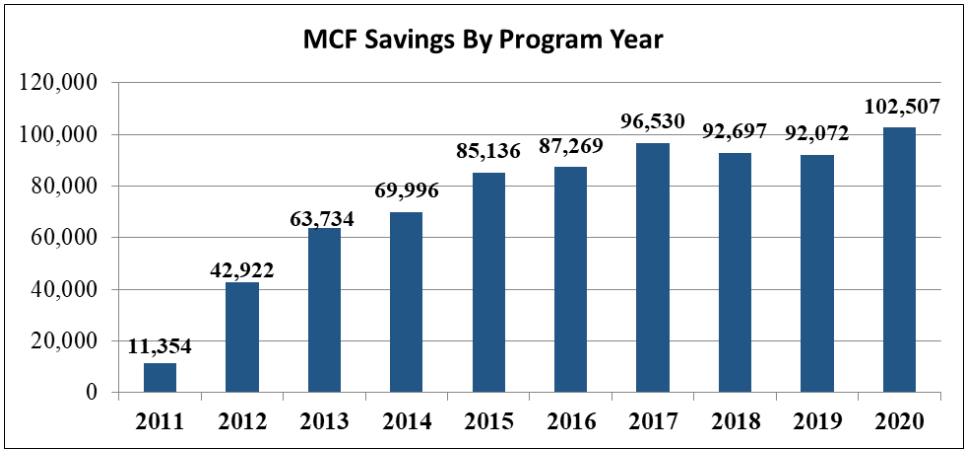
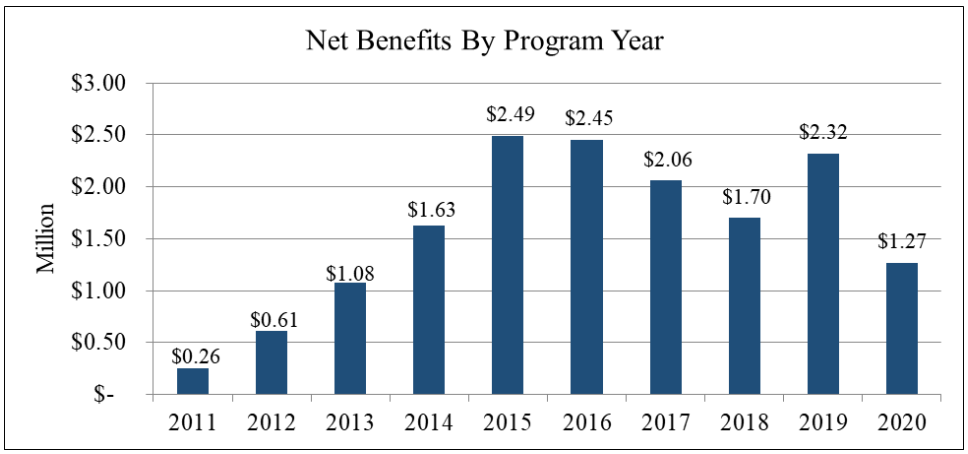


Figure 2: Net Benefits by Program Year



The remainder of this report is organized according to the OCC's reporting requirements specified in OAC § 165:45-23-7(c).

§ 165:45-23-7(c)(1): Demand Programs by Customer Category

OAC § 165:45-23-7(c)(1): The name of Demand Program listed by Category

Table 1 lists the customer categories (by class) served by each Conservation Improvement Program delivered by CenterPoint Oklahoma in PY 2020.

Table 1: Programs & Customer Categories

Program	Customer Category Served			
	Residential	Commercial CS-1	Commercial CS-2	Commercial LCS
Natural Gas Equipment Program	✓	✓	✓	✓
Low Flow Showerhead/Aerator	✓			
Home Energy Report	✓			
High Efficiency Home	✓			
Low Income Saving Homes	✓			
Natural Gas Commercial Solutions Program		✓	✓	✓
CenterPoint Energy Education Program	✓	✓	✓	✓

§ 165:45-23-7(c)(2): Programs and Date Started

OAC § 165:45-23-7(c)(2): a list of all programs and the date each program started.

Upon OCC approval of the first CIP Portfolio on March 25, 2011, CenterPoint Oklahoma began the delivery of the following energy efficiency programs:

- CenterPoint Energy Education Program (CEEP)
- Residential Home Energy Reports
- Water Heating
- Space Heating Systems
- Low-Flow Showerhead and Faucet Aerator
- Commercial Boiler
- Commercial Food Service

The OCC approved a modified CIP Portfolio on February 1, 2012, and CenterPoint Energy began the delivery of the following programs for 2012:

- Multi-Unit Market Transformation
- Clothes Dryer

On August 13, 2013, the OCC approved a new CIP Portfolio triennial plan for PY 2014 - 2016. In January of 2014, CenterPoint Oklahoma began implementing this triennial plan, which included the previously approved programs along with the following additional programs and program updates:

- Electronic Ignition Hearth
- Cooking Range
- New Home Construction
- Residential Energy Audit
- Furnace Tune Ups (addition to Space Heating Program)

On October 26, 2016, the OCC approved a new CIP Portfolio triennial plan for PY 2017 - 2019. In January of 2017, CenterPoint Oklahoma began implementing this new triennial plan, which includes modifications to previously approved programs and discontinues implementation of the Electronic Ignition Hearth and Residential Energy Audit Programs delivered in 2014-2016.

On December 10, 2019, the OCC approved a new CIP Portfolio triennial plan for PY 2020 - 2022. On January 1st of 2020, CenterPoint Oklahoma began implementation of the new triennial plan, which included the consolidation of the natural gas clothes dryer, natural gas cooking range, and multifamily program into the Natural Gas Equipment program as measures. A residential low-income program was also added to the portfolio. Finally, the boiler and foodservice programs were consolidated into the Commercial and Industrial Program as measures.

§ 165:45-23-7(c)(3): Customer Participation

OAC § 165:45-23-7(c)(3): The number of Participating Customers per Demand Program.

Listed on Table 2 is CenterPoint Oklahoma's PY 2020 CIP Portfolio participation results which had a total of 43,145 participants and measures installed.

Table 2: Participation by Program

Program	Participants
Natural Gas Equipment Program	822
Low Flow Showerhead/Aerator	936
Home Energy Report	39,551
High Efficiency Home	57
Low Income Saving Homes	59
Natural Gas Commercial Solutions Program	1,720
CenterPoint Energy Education Program	NA
Total	**43,145**

Listed on Table 3 is CenterPoint Oklahoma's PY 2020 CIP Portfolio with total number of eligible customers and distinct customer totals by program with percentage analysis of district customers who participated and did not participate in the programs

Table 3: Participation vs. Nonparticipation

Program	Total Customers	Direct Participants	% Participants	% Nonparticipants
Natural Gas Equipment Program[1]	98,515	822	0.83%	99.17%
Low Flow Showerhead/Aerator[2]	89,019	936	1.05%	98.95%
Home Energy Report[2]	89,019	39,551	44.43%	55.57%
High Efficiency Home[2]	89,019	57	0.06%	99.94%
Low Income Saving Homes[2]	89,019	59	0.07%	99.93%
Natural Gas Commercial Solutions Program[3]	10,720	33	0.31%	99.69%
CenterPoint Energy Education Program[4]	99,739	99,739	100%	0%

165:45-23-7(c)(4-6): Projected & Actual Energy Savings

OAC § 165:45-23-7(c)(4): By Demand Program, approved projected energy savings (in decatherms) as approved;

[1]Customer class includes RES and GS-1 (Dec. 2020)
[2]Customer class includes residential only (Dec. 2020)
[3]Custom class include GS-1, CS-1, TSO (Dec. 2020)
[4]All rate classes (Dec. 2020)

OAC § 165:45-23-7(c)(5): The gross energy savings (in decatherms) and performance of each Demand program; and

OAC § 165:45-23-7(c)(6): The verified energy savings (in decatherms) by Demand Program and methods used to verify.

Table 4 compares the projected savings to the gross and net savings achieved in 2020 for each program.

Table 4: Projected, Gross, and Net Energy Savings by Program

Program	2020 Projected Annual Savings (MCF)	2020 Annual Gross Savings Achieved (MCF)	2020 Annual Net Savings Achieved (MCF)
Natural Gas Equipment Program	19,348	13,847	11,593
Low Flow Showerhead/Aerator	3,979	2,485	1,251
Home Energy Report	48,920	42,399	42,399
High Efficiency Home	2,340	1,019	875
Low Income Saving Homes	7,500	4,865	4,865
Natural Gas Commercial Solutions Program	36,181	42,078	41,524
CenterPoint Energy Education Program	NA	NA	NA
Total	118,267	106,694	102,507

Energy Savings and Methodology

The energy savings methodologies and inputs outlined in the Arkansas Technical Reference Manual (TRM) were used to calculate energy savings for all programs resulting in energy savings. The TRM can be found on the Arkansas Public Service Commission's website.[2] All the weather zones in CenterPoint Oklahoma's service territory are included in the TRM, so any climate differences between the two states have been appropriately considered.

CenterPoint Oklahoma also modified the data and methodologies provided in the Arkansas TRM to calculate energy savings from fuel switching activities. The energy savings utilized in electric to gas applications consider the full fuel cycle of energy and account for the source of the fuel in addition to the site emissions. The Arkansas TRM was used to calculate site and baseline emissions. For heating systems, the electric baseline was an air source heat pump (HSPF 8.2) with

[2] http://www.apscservices.info/EEInfo/TRM v8.01.pdf.

back-up electric resistance heating used for 11% of the heating load. For water heating systems, the standard electric water heater efficiencies were utilized.

In PY 2020, ADM Associates (ADM) conducted the Evaluation, Measurement, and Verification (EM&V) of CenterPoint Oklahoma's CIP Portfolio. ADM's review included a process evaluation and an impact evaluation to determine the verified and net savings attributable to the Company's PY 2020 program activities. The 2020 EM&V Report completed by ADM can be found in Appendix A of this report.

§ 165:45-23-7(c)(7): Education Programs

OAC § 165:45-23-7(c)(7): For Education Programs measurements of outreach efforts, including pre-program and post-program results and copies of evaluations, surveys, focus group results, and other measurement techniques used to gauge the effectiveness of education efforts.

As part of their PY 2020 EM&V effort, ADM conducted participant surveys to determine how customers became aware of the Company's programs. These survey results are provided in ADM's EM&V Report, and they provide insights on which outreach efforts were the most effective at creating program awareness.

§ 165:45-23-7(c)(8): Levelized Cost

OAC § 165:45-23-7(c)(8): The levelized cost per decatherm for the Demand Portfolio, Demand Programs, and by customer sector, including all assumptions used to make the calculation.

The levelized cost for the Company's PY 2020 CIP Portfolio was $3.55 per Mcf. This is a reduction of $0.68 cents from PY 2019. CenterPoint Oklahoma used the following methodology to calculate the levelized cost:

Levelized TRC Cost =

$$\frac{\textit{Capital Recovery Factor} * (\textit{Total Program Administrator Costs} + \textit{Total Participant Costs (net of incentives)})}{\textit{Annual Energy Savings (MCF)}}$$

Where:

Capital Recovery Factor $= [A * (1 + A)^{(B)}]/[(1 + A)^{(B)} - 1]$

A *= Discount Rate (Societal Rate)*

B *= Weighted Average Life of Savings*

Tables 5 and 6 provide details on the levelized cost at the program, customer sector, and portfolio levels.

Table 5: Levelized Cost by Program

Total Resource Cost Test and TRC Levelized Cost By Program		Net Energy Savings	Total Resource Cost Test (TRC)		
		Annual Net Energy Savings	Total Net Benefits	TRC	TRC Levelized Cost
Program	Savings Type	MCF	$	Ratio	($/MCF)
Natural Gas Equipment - Residential	Natural Gas	6,700	$ 50,063	1.08	$ 6.00
Natural Gas Equipment - Residential	Electric to Gas Fuel Switch	3,899	$ 4,742	1.02	$ 5.48
Natural Gas Equipment - GS-1	Natural Gas	908	$ (37,250)	0.69	$ 8.73
Natural Gas Equipment - GS-1	Electric to Gas Fuel Switch	86	$ (240)	0.97	$ 6.27
Natural Gas Equipment - CS-1	Natural Gas	0	$ -	NA	NA
Natural Gas Equipment - CS-1	Electric to Gas Fuel Switch	0	$ -	NA	NA
Natural Gas Equipment - Total		**11,593**	**$ 17,315**	**1.02**	**$ 6.06**
Natural Gas Commercial Solutions - GS-1	Natural Gas	22,446	$ 1,664,773	9.17	$ 0.64
Natural Gas Commercial Solutions - CS-1	Natural Gas	15,023	$ (273,141)	0.80	$ 7.01
Natural Gas Commercial Solutions - LCS-1	Natural Gas	4,056	$ 74,848	1.47	$ 3.60
Natural Gas Commercial Solutions - Total		**41,524**	**$ 1,466,480**	**1.84**	**$ 3.11**
Low Flow Showerhead/Aerator	**Natural Gas**	**1,251**	**$ (15,897)**	**0.77**	**$ 6.40**
Residential Home Energy Reports	**Natural Gas**	**42,399**	**$ (31,784)**	**0.84**	**$ 4.85**
High Efficiency Homes	**Natural Gas**	**875**	**$ (37,604)**	**0.69**	**$ 8.86**
Low Income Savings Homes	**Natural Gas**	**4,865**	**$ 281,969**	**6.96**	**$ 0.81**
CenterPoint Energy Education Program - Res	Educational Program	0	$ (36,106)	NA	NA
CenterPoint Energy Education Program - GS-1	Educational Program	0	$ (10,710)	NA	NA
CenterPoint Energy Education Program - CS-1	Educational Program	0	$ (6,284)	NA	NA
CenterPoint Energy Education Program - LCS	Educational Program	0	$ (1,389)	NA	NA
CenterPoint Energy Education Program Total	**Educational Program**	**0**	**$ (54,488)**	**NA**	**NA**
Total Portfolio		**102,507**	**$ 1,625,991**	**1.50**	**$ 3.55**

Table 6: Levelized Cost by Customer Sector

Total Resource Cost Test and TRC Levelized Cost By Customer Sector	Net Energy Savings	Total Resource Cost Test (TRC)		
Customer Sector	Annual Net Energy Savings MCF	Total Net Benefits $	TRC Ratio	TRC Levelized Cost ($/MCF)
Residential	59,989	$ 215,382	1.16	$ 4.40
Commercial GS-1	23,440	$ 1,616,574	5.70	$ 1.03
Commercial CS-1	15,023	$ (279,425)	0.80	$ 7.04
Commercial LCS	4,056	$ 73,459.60	1.45	$ 3.63
Total Portfolio	**102,507**	**$ 1,625,991**	**1.50**	**$ 3.55**

§ 165:45-23-7(c)(9): Reduced Emissions and Water Consumption

OAC § 165:45-23-7(c)(9): The amount of reduced emissions and water consumption experienced by the utility, including all assumptions and calculation details, during the Demand Program period for the current program year.

Reduced Emissions

CenterPoint Oklahoma utilized the United States Environmental Protection Agency's Greenhouse Gas Equivalencies Calculator[3] to estimate the impact of reduced emissions attributable to the 102,507 93,170 in Mcf savings delivered through the PY 2020 CIP Portfolio. Overall, the Company's programs reduced carbon dioxide (CO_2) emissions by 5,107 metric tons. This is equivalent to:

Greenhouse gas emissions from:

- 1,222 passenger vehicles driven for one year; or
- 14,121,399 miles driven by an average passenger vehicle.

Carbon dioxide emissions from:

- Annual energy use of 615 homes;
- 5,644,784 pounds of coal burned; or
- 574,670 gallons of gasoline consumed.

Reduced Water Consumption

Table 7 CenterPoint Oklahoma calculated the reduction in water consumption delivered through the Low-Flow Showerhead and Faucet Aerator Program. Based on the count, by weather zone, of

[3] epa.gov/energy/greenhouse-gas-equivalencies-calculator?unit=MCF&amount=102,507

each low-flow equipment type, an estimated annual reduction in gallons of water use was calculated.

Table 7: Reduced Water Consumption

Annual Water Savings Low Flow Showerhead And Faucet Aerator Program			
Measure	Equipment Count	Gross Water Savings (Gallons)	Net Water Savings (Gallons)
Bathroom Aerator	569	294,163	283,279
Kitchen Aerator	567	162,842	156,817
Showerhead	1,290	3,367,306	3,242,716
C&I Direct-Install	1,720	371,643	371,643
Total	4,146	4,195,954	3,682,811

§ 165:45-23-7(c)(10): Portfolio Budget & Total Annual Gas Revenue

OAC § 165:45-23-7(c)(10): The Demand Portfolio funding as a percent of total annual gas revenue

Table 8 displays the PY 2020 CIP Portfolio budget as a percentage of CenterPoint Oklahoma's 2020 revenue.

Table 8: Demand Portfolio Funding as a Percent of Total Annual Gas Revenue

2020 Net Energy Savings (MCF)	2020 Natural Gas Usage (MCF)	Energy Savings %Annual Gas Usage
102,507	7,383,323	1.39%

§ 165:45-23-7(c)(11): Portfolio Energy Savings & Annual Gas Usage

OAC § 165:45-23-7(c)(11): The Demand Portfolio Net source energy savings as a percent of total gas annual usage

Table 9 displays the PY 2020 CIP Portfolio net energy savings as a percentage of CenterPoint Oklahoma's 2020 natural gas throughput.

Table 9: Demand Portfolio Savings as a Percent of Total Natural Gas Usage

2020 Portfolio Budget	2020 Revenue	Demand Portfolio Funding % Total Revenue
$2,406,413	$73,833,222	3.26%

§ 165:45-23-7(c)(12): Projected Program Costs

OAC § 165:45-23-7(c)(12): The projected program costs;

These costs should be separated into the following categories to allow review of spending:

(i) Administrative costs;
(ii) Inducements: direct payments and other inducements
(iii) Educations and marketing costs;
(iv) Program delivery costs; and
(v) EM&V costs

Table 10 provides the PY 2020 budgets for each program by cost category.

Table 10: Program Budgets by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$20,000	$878,750	$60,000	$130,000	$35,000	$1,123,750
Low Flow Showerhead and Faucet Aerator	$6,000	$20,713	$25,000	$54,752	$3,832	$110,297
Residential Home Energy Reports	$4,000	$0	$0	$181,910	$1,200	$187,110
High Efficiency Homes Program	$6,000	$105,000	$5,000	$18,491	$2,500	$136,991
Low Income Saving Homes	$10,000	$150,000	$15,000	$40,000	$10,000	$225,000
Natural Gas Commercial Solutions	$15,000	$318,976	$40,000	$150,000	$24,287	$548,264
CenterPoint Energy Education Program	$0	$0	$75,000	$0	$0	$75,000
Total Program Costs	**$61,000**	**$1,473,439**	**$220,000**	**$575,154**	**$76,819**	**$2,406,413**

§ 165:45-23-7(c)(13): Actual Program Costs

OAC § 165:45-23-7(c)(13): The projected program costs;

These costs should be separated into the following categories to allow review of spending:

(i) Administrative costs;
(ii) Inducements: direct payments and other inducements
(iii) Educations and marketing costs;
(iv) Program delivery costs; and
(v) EM&V costs

Table 11 provides the actual PY 2020 expenditures for each program by cost category.

Table 11: Program Spending by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$17,814	$504,000	$25,074	$123,359	$35,670	$705,916
Low Flow Showerhead and Faucet Aerator	$5,344	$6,893	$18,108	$42,064	$4,330	$76,740
Residential Home Energy Reports	$3,563	$0	$0	$189,218	$7,940	$200,720
High Efficiency Homes Program	$5,344	$28,720	$11,339	$17,589	$4,023	$67,015
Low Income Savings Homes	$8,907	$161,403	$0	$35,627	$2,813	$208,749
Natural Gas Commercial Solutions	$13,360	$285,101	$49,673	$297,320	$35,544	$680,998
CenterPoint Energy Education Program	$0	$0	$54,488	$0	$0	$54,488
Total Program Costs	**$54,331**	**$986,117**	**$158,681**	**$705,177**	**$90,319**	**$1,994,625**

§ 165:45-23-7(c)(14-15): Incentives

OAC § 165:45-23-7(c)(14): Projected incentives – including projected cost effectiveness tests;

OAC § 165:45-23-7(c)(15): Actual calculated incentives – including workpapers and working spreadsheets (formulas, calculations, linkages, and assumptions) or for updated cost effectiveness tests, in sufficient detail to allow review of cost effectiveness calculations

CenterPoint Oklahoma's calculated incentive is $165,031 based on the results of its PY 2020 CIP Portfolio. Pursuant to OAC § 165:45-23-8, eligibility to receive an incentive requires that the Company's Demand Portfolio reach a goal ratio (Verified savings divided by Projected Savings) of at least 80% and achieve a total resource cost test benefit/cost ratio of greater than one. For PY 2020, the Company is eligible for an incentive because CenterPoint Oklahoma's CIP portfolio goal ratio was 87% and it achieved a cost/benefit ratio of 1.50.

Table 12 provides the calculation for the requested 2020 CIP Portfolio incentive.

Table 12 Incentive Calculation

Line No.	Incentive Calculation Input	
1	Projected Energy Savings (MCF)	118,267
2	Actual Portfolio Energy Savings (MCF)	102,507
3	Program Expenditure	$1,994,625
4	TRC Ratio	1.5
5	Portfolio Net Benefits	$1,269,358
6	Maximum Incentive, Percentage Net Benefits	15%
7	Goal Ratio (Line 2/Line 1)	86.67%
8	Maximum Eligible Incentive $ (Line 5 X Line 6 X Line 7)	$190,404
9	Incentive Cap Percentage Portfolio Expenditure	13%
10	Incentive Cap (Line 3 X Line 9)	$259,301
11	2020 Incentive	$165,031

§ 165:45-23-7(c)(16): Utility growth or reduction

OAC § 165:45-23-7(c)(16): The utility's annual growth or reduction in metered natural gas for the previous three years, with a calculation of the average growth or reduction rate over that entire period.

CenterPoint Oklahoma's metered sales volumes are provided by customer class in Table 13.

Table 13: Metered Sales Volumes (CCF) per Customer Class

Customer Class	2017	2018	2019	2020	Average Rate of Change Per Year
Residential	41,224,824	53,639,082	54,106,960	47,029,340	-6.36%
Commercial GS-1	12,892,967	13,715,340	11,860,902	9,443,865	-17.02%
Commercial CS-1	19,799,411	17,254,304	19,685,831	21,830,008	12.48%
TSO	19,799,411	50,120,091	51,583,016	47,980,262	-2.16%

§ 165:45-23-7(c)(17): Market Conditions

§ 165:45-23-7(c)(17): The most current information available comparing the base line and milestones to be achieved under market transformation programs with actual conditions in the market.

PY 2020 marked the first year of CenterPoint Oklahoma's updated CIP Portfolio. It remains important for the Company to evaluate market conditions to improve program performance in PY 2021 - 2022, as well as plan for the PY 2023 - 2025 CIP Portfolio.

In PY 2017, the Company combined its prescriptive rebates for space heating and water heating equipment into one program offering called the Natural Gas Equipment Program. As previously discussed, demand for fuel- switching inducements remained high, and these rebates continue to be an effective tool to influence the purchase and installation of efficient natural gas equipment. Regardless of whether the inducements were for fuel-switching or standard natural gas to natural gas retrofits, most of the program participants chose the highest efficiency option. In most cases, customers who received inducements for natural gas furnaces elected 95% or greater AFUE models rather than 90%-94.9% AFUE models, and the majority of water heating inducements were for tankless water heaters. In PY 2020 the clothes dryer, cooking range, and multifamily programs were consolidated into the gas equipment program as measures. These programs historically underperformed or experienced market volatility due to the rural nature of the Company's service territory. CenterPoint Oklahoma considered discontinuing the programs but decided to add them to the Natural Gas Equipment Program as value added measures to maintain comprehensiveness and support our customer attrition mitigation initiative.

The Low-Flow Program continued to see declines in participation due to the maturity of the program. To improve participation, self-install thermostats were added as a means to offer a new

measure that could drive traffic to the website. Marketing efforts were also increased to drive traffic to the website but had mixed results.

The Low-Income Saving Homes Program ("LISHP") is a program implemented by a third-party vendor in partnership with Public Service Company of Oklahoma ("PSO"). The LISHP is well received by CenterPoint Oklahoma customers, and the Company will be looking to build on its success.

The Home Energy Reports Program continues to see solid participation and good energy savings. The cost-effective program helps customers create habits that reduce energy consumption. Cross-platform marketing also helps promote energy savings in other programs. The promotion of other programs typically come in the form of direct mail and digital interactions.

The Natural Gas Commercial Solutions Program again proved to be a high performing program and delivered a substantial portion of the CIP Portfolio's energy savings and net economic benefits. Program participants included Transportation customers (newly eligible in PY 2018) and the projects completed by these customers achieved 41,524Mcf in energy savings.

§ 165:45-23-7(c)(18): Summary of Spending by Demand Program

OAC § 165:45-23-7(c)(18): By Demand Program, provide a summary of spending, including the following:

(A) Administrative Costs;
(B) Inducements, including direct payments and other inducements;
(C) Education and marketing costs;
(D) Program Delivery Costs; and
(E) EM&V Costs.

Table 14 provides the actual 2020 program expenditures by Demand Program and cost category.

Table 14: 2020 Program Spending by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$17,814	$504,000	$25,074	$123,359	$35,670	$705,916
Low Flow Showerhead and Faucet Aerator	$5,344	$6,893	$18,108	$42,064	$4,330	$76,740
Residential Home Energy Reports	$3,563	$0	$0	$189,218	$7,940	$200,720
High Efficiency Homes Program	$5,344	$28,720	$11,339	$17,589	$4,023	$67,015
Low Income Savings Homes	$8,907	$161,403	$0	$35,627	$2,813	$208,749
Natural Gas Commercial Solutions	$13,360	$285,101	$49,673	$297,320	$35,544	$680,998
CenterPoint Energy Education Program	$0	$0	$54,488	$0	$0	$54,488
Total Program Costs	**$54,331**	**$986,117**	**$158,681**	**$705,177**	**$90,319**	**$1,994,625**

§ 165:45-23-7(c)(19): Funds Planned versus Funds Expended

§ 165:45-23-7(c)(19): A statement of any funds that were committed but not spent during the year, by program, with an explanation for non-spending.

CenterPoint Oklahoma's PY 2020 CIP Portfolio expenses were $1,994,625, which is 83% of the approved budget of $2,406,413.

Program	Comment
Natural Gas Equipment Program	The program reached 63% of the planned budget with expenses at $705,916. The COVID-19 pandemic reduced participation mainly due to trade allies not being able to enter customer's homes in the initial stages of the COVID-19 pandemic. Stay-at-home orders limited opportunities staff to meet with trade allies and customers. The increased cost of materials and inventory constraints also contributed to the lower participation.
Low Flow Shower Aerator Program	The program expenses reached 70% of the planned budget. The program was heavily marketed but did not have the type of participation anticipated.
High Efficiency Homes	The program provides financial incentives to encourage builders to construct new homes that are equipped with efficient natural gas appliances. The program reached 49% of planned budget. In line with the gas equipment program, the new homes construction market experienced some challenges related to the COVID-19 pandemic and stay-at-home orders. Again, high construction materials costs and

	equipment inventory shortages reduced the number of participants in the program.
Low-Income Saving Homes	The program reached 93% of the planned budget. The program was mainly targeted at customers with a household income less than $50,000 a year and was very successful. The rebate budget was increased to accommodate a new more participants at the end of the year. Though the stay-at-home orders did initially halt the program, customer safety protocols were set in place to make certain customer received weatherization services without jeopardizing their health.
CenterPoint Energy Education Program	The program had a typical year reaching 73% of the planned budget. Educating customer and promoting the Company's CIP program continues to be a major part of our program as it reaches the most customers. Lower spend is due to leveraging more cost-effective ways to promote programs.

Table 14: Budgeted Funding and Actual Expenditures by Program

Program	Program Funds Budgeted	Program Funds Expended	% Budget Spent
Gas Equipment Program	$ 1,123,750	$ 705,916	**63%**
Low Flow Program	$ 110,297	$ 76,740	**70%**
Home Energy Report Program	$ 187,110	$ 200,720	**107%**
High Efficiency Home Program	$ 136,991	$ 67,015	**49%**
Low Income Saving Homes	$ 225,000	$ 208,749	**93%**
C&I Solutions	$ 548,264	$ 680,998	**124%**
CNP Education Program	$ 75,000	$ 54,488	**73%**
Total Program Costs	**$ 2,406,412**	**$ 1,994,626**	**83%**

§ 165:45-23-7(c)(20): Description of Each Demand Program

§ 165:45-23-7(c)(20): A detailed description of each Demand Program reflecting the scale of the program as part of the Demand Portfolio that includes the following:

(A) Number of customers served by each Demand Program or program category;
(B) Program or program category expenditures;
(C) Verified energy and peak demand savings achieved by the Demand Program or program category, when available; and
(D) A description of proposed changes in the Demand Program plans.

Detailed information related to 2020 expenditures, participation, energy savings, overall program scale, as well as recent or proposed changes is provided below for each program:

Natural Gas Equipment Program

The Natural Gas Equipment program is designed to promote efficient water heating and space heating solutions to residential and commercial consumers. Rebates are offered to consumers for high-efficiency furnaces, water heaters, furnace tune-ups, clothes dryers, cooking range, and smart thermostats.

CenterPoint Oklahoma does not propose any major changes to the program at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	740	12,495	11.71%	10,599	10.34%
GS-1	82	1,353	1.27%	994	0.97%
CS-1	0	0	0.00%	0	0.00%
Total	822	13,847	12.98%	11,593	11.31%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	16,132	456,423	22,707	111,714	32,303	$639,278	32.05%
GS-1	1,682	47,577	2,367	11,645	3,367	$66,638	3.34%
CS-1	0	0	0	0	0	$0	0.00%
Total	$17,814	$504,000	$25,074	$123,359	$35,670	$705,916	35.39%

Low-Flow Program

The Low-Flow Showerhead and Faucet Aerator Program provides customers with no-cost showerheads and faucet aerators that conserve water and reduce energy usage. Customers can order equipment through an online shopping cart, and the requested number of low-flow units are mailed, along with comprehensive installation directions.

CenterPoint Oklahoma does not propose any major changes to the program at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	936	2,485	2.33%	1,251	1.22%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$5,344	$6,893	$18,108	$42,064	$4,330	$76,740	3.85%

Home Energy Report

The Home Energy Reporting Program is a behavioral program that combines energy usage data with customer demographic, housing and GIS data to develop specific, targeted recommendations that educate and motivate consumers to reduce their energy consumption. Program participants receive this information through direct-mail and email reports.

CenterPoint Oklahoma continues to implement the Residential Home Energy Reports Program in its 2020 CIP Portfolio, and no major changes to the program are proposed at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	39,551	42,399	39.74%	42,399	41.36%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$3,563	$0	$0	$189,218	$7,940	$200,720	10.06%

High Efficiency Homes Program

The High Efficiency Home Program provides inducements to encourage builders to construct new homes that are equipped with efficient natural gas appliances. Builders or homeowners are eligible to receive a $1,000 rebate for new homes equipped with a primary heat source of 90% AFUE natural gas furnace, natural gas water heating, and at least one additional natural gas appliance.

The Company does not propose any program changes at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	57	1,019	0.96%	875	0.85%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$5,344	$28,720	$11,339	$17,589	$4,023	$67,015	3.36%

Low-Income Saving Homes Program

Provides weatherization retrofits that will improve the efficiency and comfort of CenterPoint Oklahoma's low-income and hard to reach residential customers.

CenterPoint Oklahoma does not propose any major changes to the program at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	59	48,649	45.60%	4,865	4.75%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$8,907	$161,403	$0	$35,627	$2,813	$208,749	10.47%

Natural Gas Commercial Solutions Program

The Natural Gas Commercial Solutions Program encourages Commercial and Industrial (C&I) customers to use natural gas efficiently by installing cost-effective energy efficient equipment, adopting energy-efficient designs, and using energy-efficient operations at their facilities. The program provides financial incentives to C&I customers installing or implementing cost-effective energy efficiency measures through the Direct-Install or Custom measure components of the program.

The Company does not propose any major changes to the program at this time.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
GS-1	1,338	22,939	21.50%	22,446	21.90%
CS-1	377	15,084	14.14%	15,023	14.66%
LCS - TSO	5	4,056	3.80%	4,056	3.96%
Total	1,720	42,078	39.44%	41,524	40.51%

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
GS-1	$6,875	$146,246	$25,561	$152,997	$18,290	$349,969	17.55%
CS-1	$5,304	$113,725	$19,720	$118,033	$14,111	$270,892	13.58%
LCS - TSO	$1,181	$25,130	$4,392	$26,290	$3,143	$60,137	3.01%
Total	$13,360	$285,101	$49,673	$297,320	$35,544	$680,998	34.14%

CenterPoint Energy Education Program (CEEP)

CEEP is an education and awareness program that has no directly attributable energy savings associated with program implementation.

CenterPoint Oklahoma continues to implement the CEEP in its 2018 CIP Portfolio and does not propose any major changes to the program at this time.

Program Expenditures

Customer Class	Admin	Inducement	Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$0	$0	$36,106	$0	$0	$36,106	1.81%
GS-1	$0	$0	$10,710	$0	$0	$10,710	0.54%
CS-1	$0	$0	$6,284	$0	$0	$6,284	0.32%
LCS	$0	$0	$1,389	$0	$0	$1,389	0.07%
Total	$0	$0	$54,488	$0	$0	$54,488	2.73%

§ 165:45-23-7(b)(21): Research and Development Activities

§ 165:45-23-7(c)(21): A list of research and development activities included in the demand portfolio, their status, and a report on the connection between each activity and effective energy efficiency programs.

CenterPoint Oklahoma did not conduct any research and development activities during PY 2020.

§ 165:45-23-7(c)(22): Program Implementers

§165:45-23-7(c)(22): Identification of program implementers, including names, job titles, business postal addresses, business electronic mail addresses, and business telephone numbers.

CenterPoint Oklahoma implements the following programs in-house: CEEP, Low-Flow Showerhead Program, and Natural Gas Equipment Program. Remainder of the programs are vendor implemented.

The contact information is:

Name of Program Implementer: Jose Laboy

Job Title: CIP Implementation Manager

Business Postal Address: 1400 Centerview Drive, Suite 100, Little Rock, AR 72211

Business Email Address: jose.laboy@centerpointenergy.com

Business Telephone Number: 501-377-4837

The Home Energy Reports program is implemented by Oracle Utilities (formerly Opower Inc.) with oversight and management by CenterPoint Oklahoma. The CenterPoint Oklahoma contact is as above and the Oracle contact is:

Name of Program Implementer: Rick Suber

Job Title: Service Delivery Manager

Business Postal Address: 2311 Wilson Blvd., 8th Floor, Arlington, VA 22201

Business Email Address: rick.suber@oracle.com

Business Telephone Number: 202-615-2094

CenterPoint Oklahoma manages the Low Flow Showerhead and Faucet Aerator program, but it utilizes the fulfillment services of Energy Federation, Inc. (EFI). The CenterPoint Oklahoma contact is as above and the EFI contact is:

Name of Program Implementer: Jed Crawford

Job Title: Regional Sales Manager

Business Postal Address: 2031 Progress Way, Kaukauna, WI 54130

Business Email Address: jcrawford@efi.org

Business Telephone Number: 800-876-0660 x. 4203

The Low-Income Saving Homes Program is delivered by our vendor Titan ES, in partnership with Public Service Company of Oklahoma ("PSO"). The Titan ES contact is:

Name of Program Implementer: Brad Cockings

Job Title: Program Manager

Business Postal Address: 9700 S. Pole Rd. Oklahoma City, OK 73160

Business Email Address: bcockings@titanes.us

Business Telephone Number: 405-632-1700

The Natural Gas Commercial Solutions Program is delivered by our vendor, CLEAResult. The CLEAResult contact is:

Name of Program Implementer: Shelly Baron

Job Title: Program Manager

Business Postal Address: One Allied Dr., Suite 1600, Little Rock, AR 72202

Business Email Address: shelly.baron@clearesult.com

Business Telephone Number: 501-221-4063

Conclusion

PY 2020 was the first year of the new triennial portfolio cycle spanning PY 2020 – 2022. The second quarter of PY 2020 was very challenging due to the COVID-19 pandemic and stay-at-home order, however all programs remained active except the Low-Income Saving Homes Program and the C&I Direct-Install Program. These two programs required contractors to enter the property, so visits were halted until safety protocols were put in place. Once protocols were in place, services resumed for both programs. The remainder of the programs experienced mixed results. The Home Energy Reports Program was not affected by the pandemic as the behavioral program was administered by mail and digital engagement. The Low-Flow Program suffered from market saturation, despite introducing the self-install thermostat. The measure was a success, but the savings generated were accounted for in the Natural Gas Equipment Program by design. The Company will evaluate the value of moving the self-install thermostat measure to the Low-Flow Program. As for the High Efficiency Homes Program, the new construction market was in a unique position when gauging the impacts of the response to the COVID-19 pandemic. New home construction continued, but builders experienced an increase in building material prices and shortages of equipment. These price increases created uncertainty in the market, but those EE opportunities should continue. The C&I Program had its best year ever due to the stay-at-home order. With idle facilities looking to upgrade equipment, the C&I Program was positioned well to perform audits, encourage equipment upgrades, and install measures to reduce energy consumption.

Overall, the Demand Portfolio achieved record savings for Oklahoma customers achieving 102,507 MCF in natural gas savings; however, the low avoided cost filed in the Demand Portfolio for PY 2020 - 2022 reduced the Program Administrator Cost Test ("PACT") net benefits dramatically. The low avoided cost will continue to impact the PACT in PY 2021 - 2022. As CenterPoint Oklahoma strives to grow its programs, insights from PY 2020 will help the Company better understand both the strengths of its CIP Portfolio, and the aspects that need improvement. The Company remains committed to building on its successes, addressing its challenges, improving its programs, and delivering a high-performing and comprehensive CIP Portfolio.

Appendix A – EM&V Report

Evaluation of CenterPoint Energy Oklahoma Program Year 2020 Demand Side Management Portfolio

Submitted to:

CenterPoint Energy Oklahoma

April 2021

ADM Associates, Inc.

Prepared by:

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Acknowledgements

We would like to thank the staff at CenterPoint Energy Oklahoma for their time and effort in contributing to the EM&V of the 2020 programs. This evaluation was conducted with regular coordination with staff at CenterPoint, 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 CenterPoint customers, implementation contractor staff and trade allies. As with the staff at CenterPoint, their active participation allowed for the evaluation team to collect all needed data for this effort.

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1. Executive Summary

This report is to provide a summary of the evaluation effort of the 2020 Demand Side Management (DSM) portfolio by CenterPoint Energy Oklahoma (CenterPoint). This evaluation was conducted by ADM Associates (the Evaluators). This report provides verified gross and net savings estimates for evaluated programs.

1.1 Summary of CenterPoint Demand Side Management Programs

In 2020, the CenterPoint DSM portfolio contained the following programs:

- Natural Gas Equipment Rebates Program;
- High Efficiency Homes Program;
- Commercial and Industrial Solutions Program;
- Home Energy Reports Program;
- Low Income Savings Home Program; and
- Low Flow Showerhead & Faucet Aerator Program.

1.2 Evaluation Objectives

The goals of the 2020 EM&V effort are as follows:

- For prescriptive measures, verify that savings are being calculated according to appropriate deemed savings protocols.
- 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.

1.3 Summary of Findings

1.3.1 Impact Findings

Error! Reference source not found. and 1-2 present the gross and net impact by program.

Table 1-1 Gross Impact Summary

Program	Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		Gross Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post	
Natural Gas Equipment Rebates	136,751	138,473	1,980,170	2,005,105	101.0%
High Efficiency Homes	10,096	10,195	186,896	188,729	104.2%
Commercial Solutions	420,806	420,785	5,280,440	5,280,176	100.0%
Home Energy Reports	423,991	423,991	423,991	423,991	100.0%
Low Income Savings Homes	48,693	48,649	833,112	832,215	99.9%
Low Flow Showerhead & Faucet Aerator	29,142	24,848	291,417	248,479	85.3%
Total	**1,069,479**	**1,066,941**	**8,996,027**	**8,978,695**	**99.8%**

Table 1-2 Net Impact Summary

Program	Annual Energy Savings (Therms)		Lifetime Energy Savings (Therms)		NTGR	Net Realization Rate
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Natural Gas Equipment Rebates	112,648	115,933	1,812,021	1,864,863	83.7%	102.9%
High Efficiency Homes	8,780	8,748	162,543	161,951	85.8%	99.6%
Commercial Solutions	415,263	415,243	5,223,034	5,222,782	98.7%	100.0%
Home Energy Reports	423,991	423,991	423,991	423,991	100.0%	100.0%
Low Income Savings Home Program	45,650	48,649	781,042	832,215	100.0%	106.6%
Low Flow Showerhead & Faucet Aerator	12,767	12,506	127,669	125,059	50.3%	98.0%
Total	**1,019,099**	**1,025,070**	**8,659,705**	**8,630,870**	**96.1%**	**100.6%**

The contribution to portfolio savings by program is summarized in Figure 1-1.

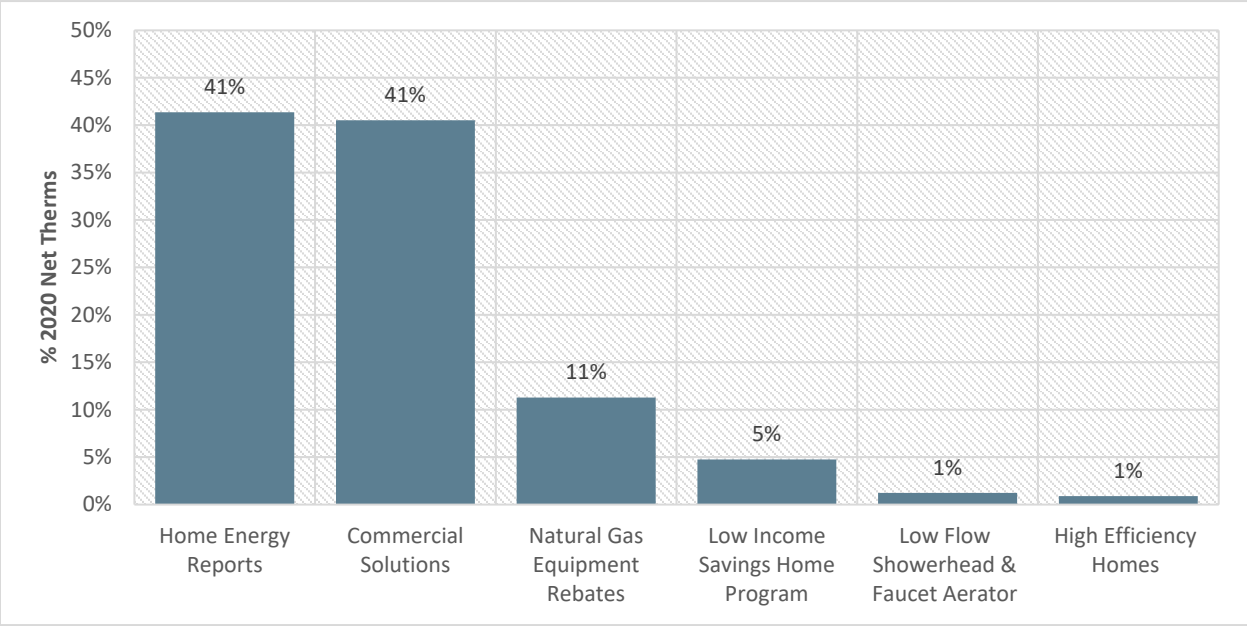

Figure 1-1 Contribution to Portfolio Net Savings by Program

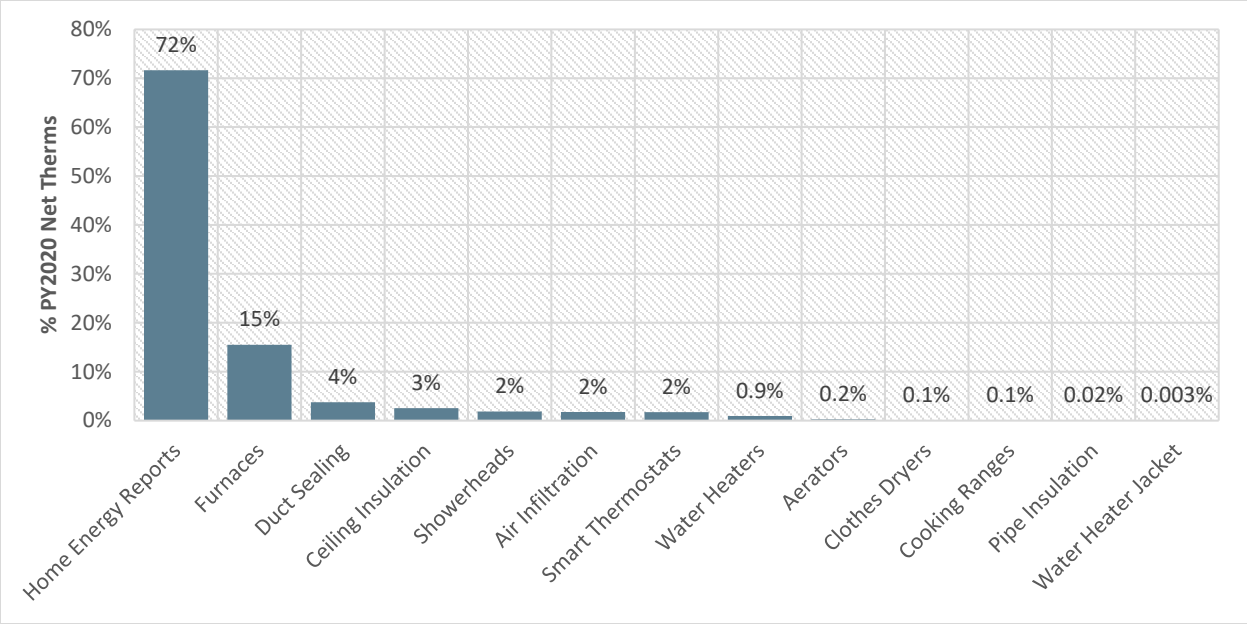

Figure 1-2 and Figure 1-3 summarize the share of savings by measure category for residential and non-residential segments, respectively.

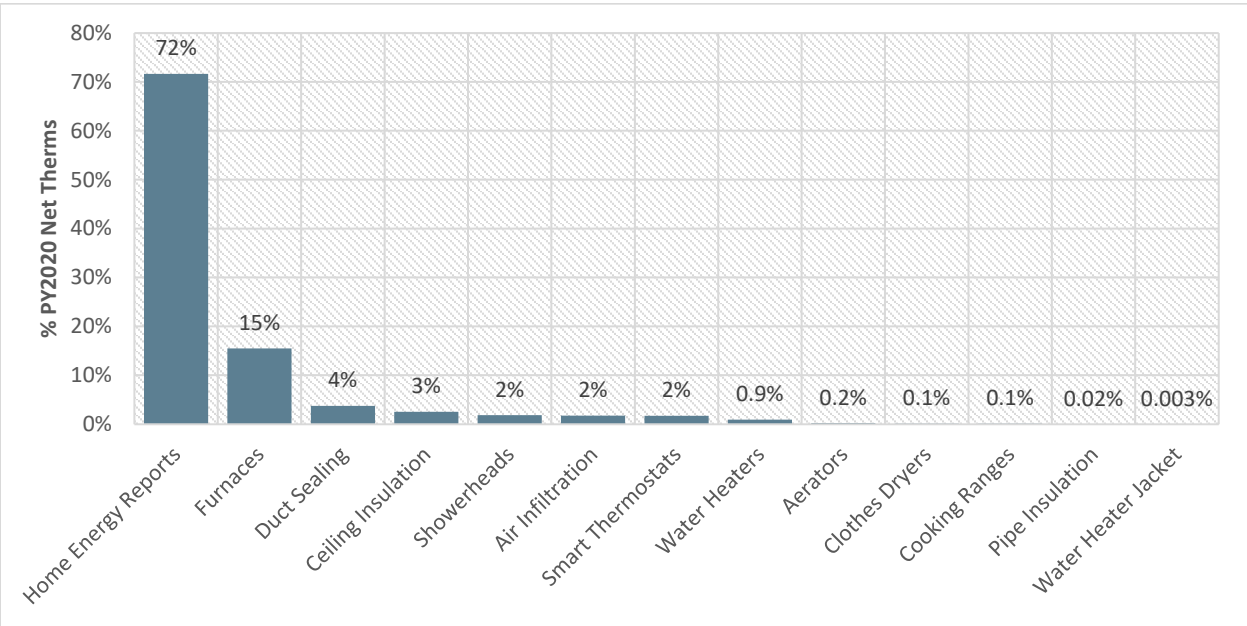

Figure 1-2 Residential Portfolio Savings Share by Measure

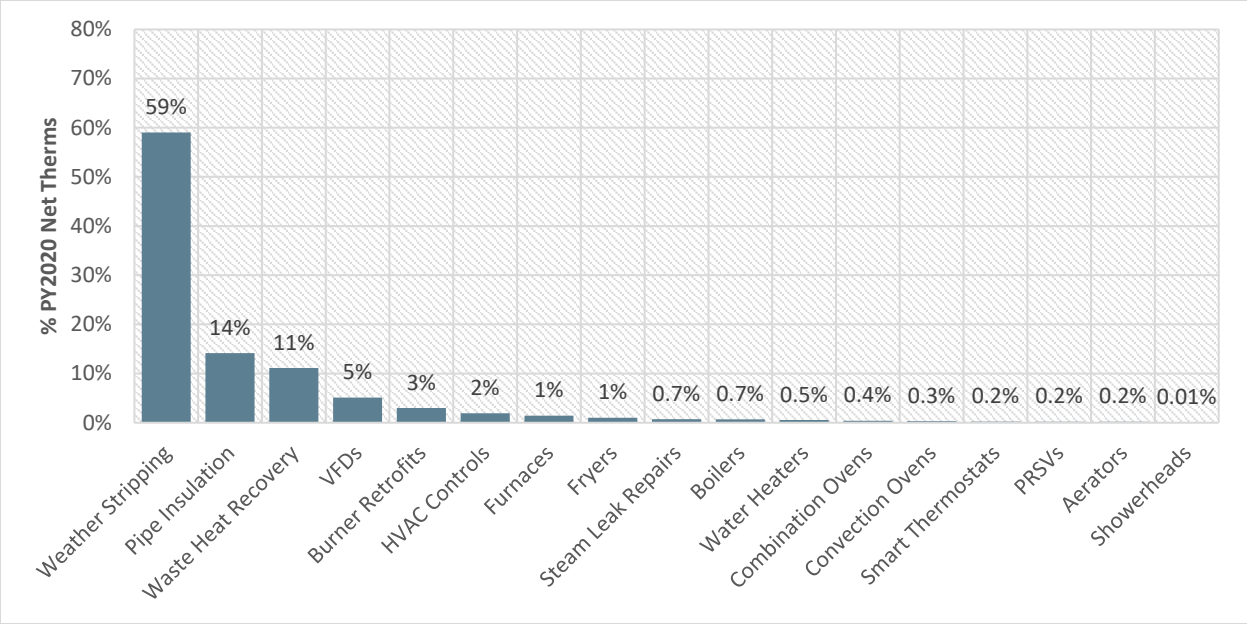

Figure 1-3 C&I Portfolio Savings Share by Measure

1.4 Summary of EM&V Effort

The evaluation effort consisted of:

- **Review of deemed savings calculations.** For all programs that apply deemed savings, the Evaluators conducted a detailed review on a census of projects to ensure that savings are up-to-date with the most recently-available deemed savings and applicable code inputs.
- **Analysis of custom projects.** Custom projects within the C&I Solutions Program accounted for 13% of portfolio-level savings. All custom projects received site-level analyses based on International Measurement & Verification Protocols (IPMVP).[1]
- **Analysis of bill impacts from Home Energy Reports.** The Home Energy Reports program accounted for 44% of total portfolio savings. The Evaluators conducted an analysis of impacts on customer bills applying methods vetted through the National Renewable

[1] https://evo-world.org/en/products-services-mainmenu-en/protocols/ipmvp

Energy Laboratory Uniform Methods Project Chapter 17: Residential Behavioral Protocol.[2]

1.5 Report Organization

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

- Chapter 2 provides General Methodology;
- Chapter 3 provides results for the Natural Gas Equipment Rebates Program;
- Chapter 4 provides results for the High Efficiency Homes Program;
- Chapter 5 provides results for the Commercial Solutions Program;
- Chapter 6 provides results for the Home Energy Reports Program;
- Chapter 7 provides results for the Low Income Savings Home Program;
- Chapter 8 provides results for the Low Flow Showerhead and Faucet Aerator Program;
- Appendix A provides the site-level custom reports for the Commercial Solutions Program.

[2] https://www.energy.gov/sites/prod/files/2015/02/f19/UMPChapter17-residential-behavior.pdf

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

A first step to detailing the evaluation methodologies, the Evaluators provide a glossary of terms to follow:

- *Ex Ante* – Savings estimates provided by program administrators prior to review from a third-party-evaluator (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 an energy savings or demand savings outcome (gross savings) for a single unit of an installed energy efficiency measure. This estimate (a) has been developed from data sources and analytical methods that are widely accepted for the measure and purpose and (b) 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 program participant who *would have* implemented the program measure or practice in the absence of the program. Free riders can be total, partial, or deferred.
- *Spillover* – Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program that exceed the program-related gross savings of the participants. There can be participant and/or non-participant spillover rates depending on the rate at which participants (and non-participants) adopt energy efficiency measures

or take other types of efficiency actions on their own (i.e., without an incentive being offered).

- *Net Savings* – The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of free drivers, free riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand. (e.g., if Free ridership for low-flow showerheads = 50%, net savings = 15 Therms x (100% - 50%) = 7.5 Therms)
- *Net-to-Gross-Ratio (NTGR) =* (1 – Free ridership % + Spillover %), also defined as Net Savings / Gross Savings
- *Ex Ante Net Savings* = Ex Ante Gross Savings x Ex Ante Free Ridership Rate
- *Ex Post Net Savings* = Ex Post Gross Savings x Ex Post Free Ridership Rate
- *Net Realization Rate* = Ex Post Net Savings / Ex Ante Net Savings
- *Effective Useful Life (EUL)* – An estimate of the median number of years that the efficiency measures installed under a program are still in place and operable.
- *Gross Lifetime Therms* = Ex Post Gross Savings x EUL

2.2 Overview of Methodology

The proposed methodology for the evaluation of the 2020 CenterPoint DSM Portfolio is intended to provide:

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

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. By leveraging experience and lessons learned from prior evaluations, the 2020 evaluation is streamlined to focus on areas in needed of research and improvement.

2.3 Sampling

Sampling is necessary to evaluate savings for the CenterPoint DSM portfolio insomuch as verification of a census of program participants is typically cost-prohibitive. Samples are drawn in order to ensure 90% confidence at the +/- 10% precision level. Programs are evaluated on one of three bases:

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

2.4 Census of Participants

A census of participant data was used for programs where such review is feasible. For example, the Home Energy Reports program's savings estimates are based on a regression model that incorporates billing data for a census of program recipients. Programs that received analysis of a census of participants include:

- Home Energy Reports;
- Commercial & Industrial Solutions – Custom Component

2.5 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 100 participants, the finite population correction would result in a final required sample size of 41. The Evaluators applied finite population correction factors in instances of low participation in determining samples required for surveying or onsite verification. Programs subject to Simple Random Sampling include:

- Heating System Rebates – Residential;
- Water Heating Rebates – Residential;
- Low Flow Showerhead & Faucet Aerator Program

2.6 Free Ridership

In determining ex post net savings for the CenterPoint DSM 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 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)."

Given this definition, participants are defined as free riders through a binary scoring mechanism, in being either 0% or 100% free riders.

2.6.1 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

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

2.6.2 Custom Free Ridership

For custom projects from the Commercial 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%.

3. Natural Gas Equipment Rebates Program

The Residential Natural Gas Equipment Rebates Program provides incentives to residential customers for high efficiency space and water heating equipment. Eligible measures for this program include:

Residential:

- $300 for Gas furnaces with 90%-94.9% AFUE;
- $500 for Gas furnaces with 95% or higher AFUE;
- $2,000 for placement of electric heating to gas furnaces with 90%-94.9% AFUE;
- $2,000 for placement electric heating to gas furnaces with 95% or higher AFUE;
- $60 for ENERGY STAR qualified smart thermostats;
- $60 for ENERGY STAR qualified smart thermostats intended to be self-installed;
- $200 per 100,000 input BTU for larger storage tank water heaters with 88% or greater thermal efficiency;
- $500 for tankless water heaters with an EF of 0.80 or greater.
- $900 for replacement of electric water heater with natural gas tankless water heaters with an EF of 0.80 or greater;
- Up to $300 for cooking ranges; and
- Up to $450 for gas clothes dryers.

Non-residential:

- $300 for Gas furnaces with 90%-94.9% AFUE;
- $500 for Gas furnaces with 95% or higher AFUE;
- $2,000 for replacement of electric heating to gas furnaces with 90%-94.9% AFUE;
- $2,000 for replacement electric heating to gas furnaces with 95% or higher FUE; and
- $200 per 100,000 input BTU for larger storage tank water heaters with 88% or greater thermal efficiency;
- $500 for tankless water heaters with an EF of .80 or greater.
- $900 for replacement of electric water heater with natural gas tankless water heaters with an EF of .80 or greater.

- $60 for smart thermostat listed on ENERGY STAR website for new natural gas or replacement from electric to gas.

The program is targeted at the residential and commercial market sectors and offers incentives for both retrofit and new construction applications. The marketing efforts for the space and water heating equipment were largely directed at plumbing and HVAC contractors; their involvement is seen as crucial, as they are generally a primary source of information for end-use customers when deciding upon a replacement system.

3.1 Program Overview

The Natural Gas Equipment Rebates Program is part of a reorganization of the CenterPoint portfolio to consolidate smaller programs. This program combines the following former programs:

- Space Heating
- Water Heating
- Clothes Dryers
- Cooking Ranges
- Multi-unit Market Transformation

3.1.1 Participation Summary

3.1.1.1 Residential Space Heating Participant Summary

The 2020 Natural Gas Equipment Rebates Program had a total of 469 processed rebates for residential space heating. The rebates comprised of:

- 284 single family furnace replacement rebates;
- 117 furnace fuel switch rebates;
- 17 new construction furnace rebates;
- 6 multifamily furnace rebates; and
- 35 smart thermostats rebates.

Of the 290 furnace replacements included:

- 283 furnaces exceeding 95% AFUE; and
- 7 furnaces between 90-94.99% AFUE.

3.1.1.2 Residential Self-Installed Smart Thermostat Participant Summary

As an additional aspect of the Natural Gas Equipment Rebate Program for 2020, there were a total of 128 stand-alone smart thermostats that were rebated to participants. All the smart thermostat rebates that the program processed were for single-family projects that received $60 as an incentive for self-installation.

3.1.1.3 Residential Water Heating Participant Summary

The 2020 Natural Gas Equipment Rebates Program had a total of 90 processed rebates for residential water heating. The rebates comprised of:

- 41 single family water heater replacement rebates;
- 16 water heater fuel switch rebates;
- 29 new construction water heater rebates; and
- 4 multifamily water heater rebates

All of the 41 residential water heater replacements were tankless water heaters.

There were 16 residential water heater fuel switch rebates and 41 single family (residential) water heater retrofit rebates that were awarded through the Water Heater Fuel Switch and Water Heater Rebate project types, respectively.

3.1.1.4 Appliance Participant Summary

Appliance participation comprised:

- 20 cooking ranges; and
- 13 clothes dryers.

3.1.1.5 Commercial Participation Summary

There were 76 commercial furnaces rebate in 2020:

- 72 furnaces with 95% or greater AFUE; and
- 4 with AFUE of 90-94.99%.

65.8% of commercial rebates were for retrofit projects. 34.2% were for new construction projects.

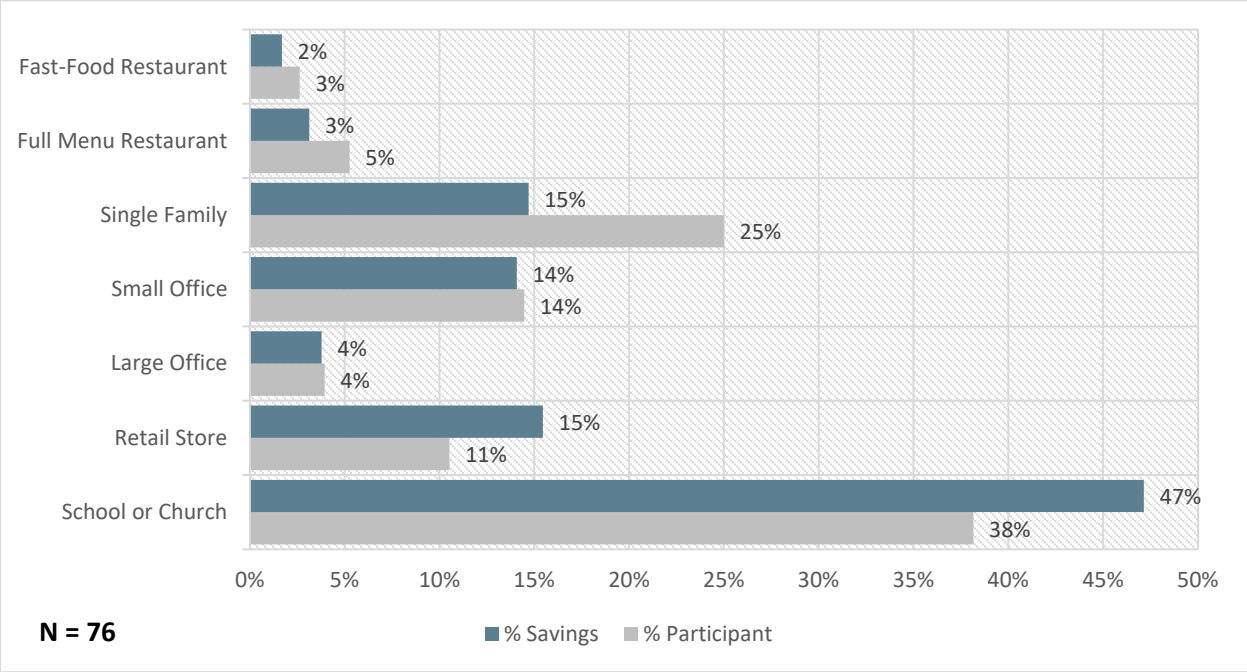

Figure 3-1 summarizes the participation levels by facility type.

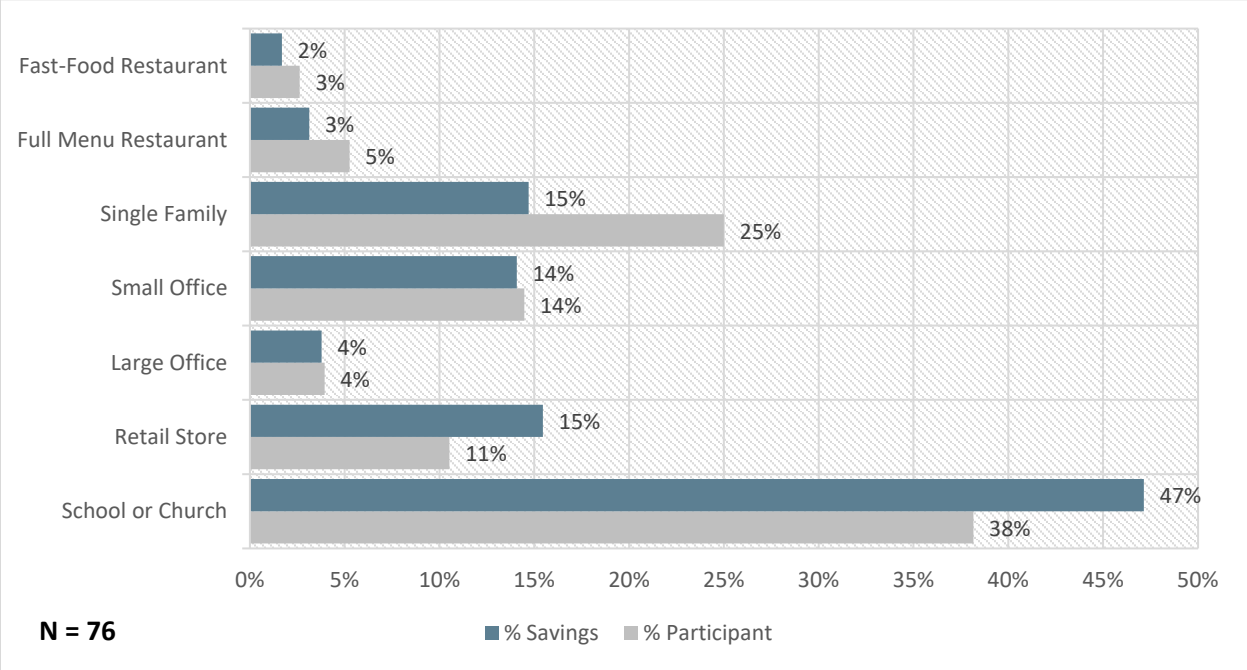

Figure 3-1 Heating System Rebates Commercial Participation by Facility Type

The bulk of participation and savings was driven by schools, small business facilities, and retail stores.

There were six commercial water heaters rebated in 2020:

- (1) commercial water heater; and
- (5) tankless water heaters.

3.2 Impact Evaluation

3.2.1 Space Heating Energy Savings Calculations

Savings for residential furnaces are calculated as follows:

$$therm_{ex\ post\ savings} = therm_{basline\ heating\ system} - therm_{new\ heating\ system}$$

First the energy use of the new heating system was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{new\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAP_H}{30}\right) \times 1.05$$

Where:

Site Area = square footage of the project site

$CAPH = (\frac{Btu}{hr})$ *= verified heating capacity verified by the Evaluators with AHRI number*

$AFUEnew\ heating\ system$ *= verified by the Evaluators with AHRI number*

Source to site ratio, electric to gas = 3.14

Next the energy use of the removed water heater was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{old\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAP_H}{30}\right) \times 1.05$$

Where:

$\left(\frac{\frac{\text{therms}}{\text{site area}}}{\text{yr}}\right)$ *= 0.233 (Evaluators' estimation, assuming unknown build age)*

$CAPH = (\frac{Btu}{hr})$ *= rated heating capacity = new furnace heating capacity, see above*

AFUEbase *= 80%*

Source to site ratio, electric to gas = 1.05

3.2.1.1 Impact of Early Replacement

The method for calculating the impact of early replacement for residential furnaces applies a degradation factor to the performance a 78 AFUE unit. This is calculated as:

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

Where:

$Base\ AFUE$ = efficiency of the existing equipment when new, 78% AFUE.
M = maintenance factor, 0.01.
age = the age of the existing equipment, in years.

Based on the degradation equation and the average age of replaced functional systems of 18.98 years this leads to an Early Retirement AFUE of:

$$AFUE_{base\_early} = .78 \times (1 - .01)^{18.98} = 0.6445$$

The Evaluators applied this baseline to residential retrofits as well as to master-metered multifamily units.

3.2.1.2 Net-to-Gross Ratio

The net-to-gross rates for the Heating Equipment Rebates residential component are as follows:

- Residential Retrofit: 84.62%
- Residential Retrofit – Multifamily: 85.0%
- Residential New Construction (builder production homes): 92.3%
- Residential New Construction (custom homes): 48.7%
- Residential Fuel Switch: 85.0%
- Smart Thermostats: 100%

Multifamily NTGR is based on the NTGR for the commercial component.

3.2.2 Smart Thermostat Energy Savings Calculations

Energy savings values for smart thermostats are calculated as follows:

$$therms_{ex\ post\ savings} = gas\ heating_{default} \times home\ square\ footage$$

Where:

$gas\ heating_{default}$ = 0.033 therms per square feet

$home\ square\ footage$ = verified home square footage, or default square footage of 1,484 SF

3.2.3 Water Heating Energy Savings Calculations

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.

$$therm_{ex\ post\ savings} = therm_{basline\ water\ heater} - therm_{new\ water\ heater}$$

First the energy use of the new water heater was found.

$therm_{new\ water\ heater}$=

$$\times Cp \times V \times \left(T_{SetPoint} - T_{Supply}\right) \times \frac{1}{EF_{Post}} \times \left(\frac{1}{100{,}000}\right) \times 1.05$$

Where,

ρ = Water density = 8.33 lb./gal

Cp = Specific heat of water = 1 BTU/lb.·°F

V = Calculated estimated annual hot water use (gal) = 21,521 (gal)

$TSetPoint$ = Water heater set point (default value = 120°F)

Tsupply = Calculated average supply water temperature = 63.2°F

$EFpost$ = verified Energy Factor of new water heater

BTU to Therms conversion factor = 100,000 $\mathrm{BTU/therm}$

Source to site ratio, gas to gas = 1.05

Energy use of the baseline water heater is calculated with the equation below.

$therm_{baseline\ water\ heater}$ =

$$\rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times \frac{1}{EF_{pre\ electric}} \times (\frac{1}{100{,}000}) \times 3.14$$

Where,

ρ = Water density = 8.33 lb./gal

C_p = Specific heat of water = 1 BTU/lb.·°F

V = Calculated estimated annual hot water use (gal) = 21,521 (gal)

$T_{SetPoint}$ = Water heater set point (default value = 120°F)

$T_{S\text{upply}}$ = Calculated average supply water temperature = 63.2°F

EF_{post} = verified Energy Factor of baseline water heater

Volume of water heater = verified water heater's volume, for tankless water heaters the assumed baseline volume is 50 gal

Source to Site ratio, gas to gas = 1.05

Source to Site ratio, electricity to gas = 3.14

Baseline energy factors are summarized in Table 3-1.

Table 3-1 Residential Water Heating Baseline Uniform Energy Factors

Draw Pattern	Equivalent Gallons	Baseline UEF
Very Small	20	0.3056
Low	30	0.5412
Medium	40	0.5803
High	50	0.6270

3.2.3.1 Net-to-Gross Ratio

The Evaluators used 2020 survey results in developing the Net-to-Gross Ratios for water heaters.

- Residential Retrofit: 100%
- Residential New Construction (builder production homes): 91.7%
- Residential New Construction (custom homes): 64.4%
- Residential Fuel Switch: 85.0%
- Multifamily: 85.0%

Multifamily NTGR is based on the NTGR for the commercial component.

3.2.4 Cooking Range Energy Savings Calculations

The energy savings of a gas range is found by subtraction the energy use of the new range from the energy use from the old range.

$$therm_{ex\ post\ savings} = therm_{basline\ range} - therm_{new\ range}$$

First the energy use of the baseline range was found.

$$therm_{baseline\ electric\ range} = 716\ \left(\frac{kWh}{yr}\right) \times 3{,}413\ \left(\frac{Btu}{kWh}\right) \times \left(\frac{1}{100{,}000\ \frac{Btu}{therm}}\right) \times 3.14$$

$$\text{therm}_{\text{baseline gas range}} = 3{,}986{,}950\ \text{BTU} \times \left(\frac{1}{100{,}000\ \frac{\text{BTU}}{\text{therm}}}\right) \times 1.05$$

Next the energy use of the newly installed range was found. It is the assumed that the installed range uses that same amount of energy as the baseline gas range

$$\text{therm}_{\text{ex post gas range}} = \text{therm}_{\text{baseline gas range}}$$

Where,

Annual kWh usage of electric range = 716 kWh/yr.

Annual BTU usage of gas range = 3,986,950 BTU

kWh to BTU conversion factor = 3413 $\mathrm{BTU/kWh}$

BTU to Therms conversion factor = 100,000 $\mathrm{BTU/Therms}$

Site-to-Source ratio, electricity to gas = 3.14

Site-to-Source ratio, gas to gas = 1.05

3.2.4.1 Net-to-Gross Ratio

Due to the low participation in the program, the Evaluators used the net-to-gross ratio (NTGR) from Oklahoma Natural Gas's PY2018 evaluation (80%).

3.2.5 Clothes Dryers Energy Savings Calculations

The energy savings of a gas clothes dryer is found by subtraction the energy use of the new dryer from the energy use from the old dryer.

$$therm_{ex\ post\ savings} = therm_{basline\ dryer} - therm_{new\ dryer}$$

First the energy use of the baseline dryer was found.

$$therm_{baseline\ electric\ range} = 967\ \left(\frac{kWh}{yr}\right) \times 3{,}413\ \left(\frac{Btu}{kWh}\right) \times \left(\frac{1}{100{,}000\ \frac{Btu}{therm}}\right) \times 3.14$$

$$\mathrm{therm_{baseline\ gas\ range}} = 3{,}723{,}583\ \mathrm{BTU} \times \left(\frac{1}{100{,}000\ \frac{\mathrm{BTU}}{\mathrm{therm}}}\right) \times 1.05$$

Next the energy use of the newly installed dryer was found. It is the assumed that the installed dryer uses that same amount of energy as the baseline gas dryer

$$\mathrm{therm_{ex\ post\ gas\ range}} = \mathrm{therm_{baseline\ gas\ range}}$$

Where,

Annual kWh usage of electric dryer = 967 kWh/yr.

Annual BTU usage of gas dryer = 3,723,583 BTU

kWh to BTU conversion factor = 3413 $\mathrm{BTU/kWh}$

BTU to Therms conversion factor = 100,000 BTU/Therm

Site-to-Source ratio, electricity to gas = 3.14

Site-to-Source ratio, gas to gas = 1.05

3.2.5.1 Net-to-Gross Ratio

Due to the low participation in the program, the Evaluators used the net-to-gross ratio (NTGR) from Oklahoma Natural Gas's PY2018 evaluation (80%).

3.2.1 Space Heating Energy Savings Calculations

The Evaluators applied AR TRM V8.1 deemed savings parameters in assessing savings of the commercial component.

Savings for commercial furnaces are calculated as follows:

$$therm_{ex\ post\ savings} = therm_{basline\ heating\ system} - therm_{new\ heating\ system}$$

First the energy use of the new heating system was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{new\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAP_H}{30}\right) \times 1.05$$

Where,

Site Area = square footage of the project site

$\mathrm{CAPH} = (\frac{\mathrm{BTU}}{\mathrm{hr}})$ = verified heating capacity verified by the Evaluators with AHRI number

$\mathrm{AFUE}_{\mathrm{new\ heating\ system}}$ = verified by the Evaluators with AHRI number

Source to site ratio, electric to gas = 3.14

Next the energy use of the removed water heater was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{old\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAPH}{30}\right) \times 1.05$$

Where,

$\left(\frac{\mathrm{therms}}{\frac{\mathrm{site\ area}}{\mathrm{yr}}}\right)$ = 0.233 (Evaluators' estimation, assuming unknown build age)

$\mathrm{CAPH} = (\frac{\mathrm{BTU}}{\mathrm{hr}})$ = rated heating capacity = new furnace heating capacity, see above

$\mathrm{AFUEbase}$ = 80%

Source to site ratio, electric to gas = 1.05

3.2.1.1 Impact of Early Replacement

The early retirement procedure described in Section 3.2.1.1 was applied to commercial projects in master-metered multifamily housing.

3.2.1.2 Net-to-Gross Ratio

The Evaluators applied the Oklahoma Natural Gas Space Heating free ridership estimate of 26.85% to the commercial segment. The resulting aggregate NTGR for this group was 73.15%.

3.2.2 Water Heating Energy Savings Calculations

Commercial water heater savings calculations incorporate more facility-specific information than the residential methodology. Therms savings for commercial water heaters are calculated as:

$$Therms\ Savings = \frac{\rho * C_P * V * \left(T_{SetPoint} - T_{Supply}\right) * \left(\frac{1}{EF_{pre}} - \frac{1}{EF_{post}}\right) * Days/Year}{100{,}000\ BTU/Therm}$$

Where,

ρ = Water density = 8.33 lb./gal

C_p = Specific heat of water = 1 BTU/lb.°F

V = Calculated estimated annual hot water use

$T_{SetPoint}$ = Water heater set point

$T_{S\mathrm{upply}}$ = Calculated average supply water temperature

EF= verified Energy Factor of baseline water heater

Days/Year = Days per year of operation

The required facility-specific inputs are volume and days/year. Volume can be calculated based on square footage of the facility or from units served.

Table 3-2 presents the volume and days of usage values for a facility by square footage. Table 3-3 presents the volume and days of usage values by unit produced or person served.

Table 3-2 Hot Water Requirements by Facility Size

Building Type	Daily Demand (Gallons / Unit / Day)	Unit	Units / 1,000 Sq. Feet	Applicable Days / Year	Gallons / 1,000 Sq. Feet / 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.
Motel	20	Unit (Room)	5	365	100.0
Hotel	14	Unit (Room)	2.2	365	30.8
Other	1	Employee	.7	250	.7

Table 3-3 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

3.2.2.1 Net-to-Gross Ratio

The Evaluators applied the Oklahoma Natural Gas Water Heating free ridership estimate of 23.78% to the commercial segment. The resulting aggregate NTGR for this group was 76.22

3.2.3 Verified Savings

Gross savings are summarized in Table 3-4.

Table 3-4 Verified Gross Therms Savings

Group	Measure Category	Expected Therms Savings	Verified Therms Savings	Realization Rate	EUL	Lifetime Therms Savings
Space Heating	Single-Family Retrofit	66,796	69,904	104.7%	12.27	857,529
	NC - Builder	717	792	110.5%	19.98	15,821
	NC – Owner/Custom	777	844	108.6%	20	16,888
	Multifamily	889	942	106.0%	20	18,844
	Fuel Switch	30,073	31,523	104.8%	16.99	535,576
	Smart Thermostats	3,135	3,216	102.6%	11	35,380
	Self-Install Smart Thermostat	8,086	8,086	100.0%	11	88,947
Water Heating	Single-Family Retrofit	2,419	1,879	77.7%	20	37,587
	NC - Builder	865	705	81.5%	18.33	12,925
	NC – Owner/Custom	804	611	76.0%	12.87	7,865
	Multifamily	632	605	95.7%	20	12098
	Fuel Switch	3,084	3,049	98.9%	19.64	59,891
Appliances	Cooking Range	697	697	100.0%	15.01	10,461
	Clothes Dryer	581	742	127.7%	15.99	11,867
Commercial	Furnace	11,804	10,488	88.9%	20	209,749
	Smart Thermostat	1,339	1,353	101.0%	11	14,883
	Water Heater	4,397	3,038	69.1%	19.35	58,794
	Overall:	**137,095**	**138,473**	**101.0%**	**14.4**	**2,005,105**

Net savings are summarized in Table 3-5.

Table 3-5 Verified Net Therms Savings

	Measure Category	NTGR		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
		Ex Ante	Ex Post	Ex Ante	Ex Post		
Space Heating	Single-Family Retrofit	87.7%	84.9%	58,580	59,383	101.4%	837,481
	NC - Builder	64.4%	92.2%	462	730	158.0%	14,603
	NC - Owner	91.0%	48.7%	707	411	58.1%	8,224
	Multifamily Retrofit	89.6%	85.0%	797	800	100.4%	16,008
	Fuel Switch	70.1%	85.0%	21,081	26,779	127.0%	535,576
	Smart Thermostats	81.2%	88.9%	2,528	2,860	113.1%	34,573
	Self-Install Smart Thermostat	80.0%	88.9%	6,469	7,189	111.1%	79,080
Water Heating	Single-Family Retrofit	71.4%	85.0%	1,727	1,597	92.5%	31,930
	NC - Owner	91.7%	91.6%	793	646	81.5%	12,925
	NC - Builder	64.4%	64.3%	518	393	75.9%	7,865
	Multifamily	85.0%	85.0%	537	514	95.7%	10,278
	Fuel Switch	71.4%	84.9%	2,202	2,590	117.6%	50,878
Appliances	Cooking Range	80.0%	80.1%	558	558	100.0%	8,369
	Clothes Dryer	80.0%	79.9%	465	593	127.5%	9,494
Commercial	Furnace	89.6%	70.3%	10,576	7,376	69.7%	147,516
	Smart Thermostat	89.6%	70.4%	1,200	952	79.3%	10,467
	Water Heater	84.4%	84.4%	3,711	2,563	69.1%	49,596
	Overall:	**80.6%**	**83.7%**	**112,648**	**115,933**	**102.9%**	**1,864,863**

4. High Efficiency Homes Program

The High Efficiency Homes Program provides incentives to new construction home builders. Eligible measures for this program include:

- $1,000 for gas furnaces (primary source) with 95% or higher AFUE;
- natural gas water heating; and
- at least one additional natural gas burner tip.

4.1 Program Overview

High Efficiency Homes Program is designed to encourage new home builders to choose energy efficient natural gas water heating and space heating equipment. The program is marketed to consumers, builders, and developers through local publication, bill inserts, various media avenues, and direct contact.

4.2 Participation Summary

In 2020, program participation consisted of 57 total furnaces – 56 furnaces were rated at 95% AFUE or greater and one furnace was rated at 90–94.9% AFUE. Additionally, there were four smart thermostats that were rebated.

There were no rebates for water heaters or natural gas burner tips.

4.3 Impact Evaluation

4.3.1 Space Heating Energy Savings Calculations

Savings for residential furnaces are calculated as follows:

$$therm_{ex\ post\ savings} = therm_{basline\ heating\ system} - therm_{new\ heating\ system}$$

First the energy use of the new heating system was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{new\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAP_H}{30}\right) \times 1.05$$

Where,

Site Area = square footage of the project site

$\mathrm{CAPH} = (\frac{\mathrm{BTU}}{\mathrm{hr}})$ = verified heating capacity verified by the Evaluators with AHRI number

AFUEnew heating system = verified by the Evaluators with AHRI number

Source to site ratio, electric to gas = 3.14

Next the energy use of the removed heater was found.

$$therm_{new\ heating\ system} = Heat\ load \times \left(\frac{1}{AFUE_{old\ heating\ system}}\right)$$

$$Heat\ load = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times site\ area = \left(\frac{\frac{therms}{site\ area}}{yr}\right) \times \left(\frac{CAP_H}{30}\right) \times 1.05$$

Where,

$\left(\frac{\frac{\text{therms}}{\text{site area}}}{\text{yr}}\right)$= 0.233 (Evaluators' estimation, assuming unknown build age)

$\text{CAPH} = (\frac{\text{BTU}}{\text{hr}})$ = rated heating capacity = new furnace heating capacity, see above

AFUEbase = 80%

Source to site ratio, electric to gas = 1.05

4.3.2 Net-to-Gross Ratio

The net-to-gross rates for the High Efficiency Homes Program was 87.2%. %

4.4 Verified Savings

Gross Therms are summarized in Table 4-1.

Table 4-1 Gross Therms Savings

Measure	Expected Therms Savings	Verified Therms Savings	Gross Realizations Rate	Lifetime Therms Savings
Total Gross Savings	10,096	10,195	104.1%	188,729

Net savings are summarized in Table 4-2.

Table 4-2 Net Therms Savings

Measure	NTGR		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Total Net Savings	87.0%	87.2%	8,780	8,748	102.8%	161,951

5. Commercial Solutions Program

The Commercial 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 on behalf of CenterPoint. 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 water heating or comfort heating;

(2) Prescriptive incentives for boiler and food service measures; and

(3) $0.95 per Therms for custom projects.

5.1 Commercial Solutions Program Overview

The Commercial Solutions Program is designed to provide no-cost direct installation of water saving and comfort heating measures, energy audits, and incentives for custom projects. The Commercial Solutions Program participants fall into one of four categories:

- Direct install;
- Prescriptive
- Custom audit recipients; and
- Closed custom projects.

In 2020, custom projects accounted for 36.3% of program savings and direct install accounted for 62.8%. These participants are detailed in the subsections to follow.

5.1.1 Direct Install Participation Summary

In 2020, 18 distinct premises participated in the direct install component of Commercial Solutions Program. Automotive facilities accounted for the majority (53.8%) of the program savings. Figure 5-1 summarizes the participation by facility type, quantified in percent of participation as well as percent of total savings by facility type.

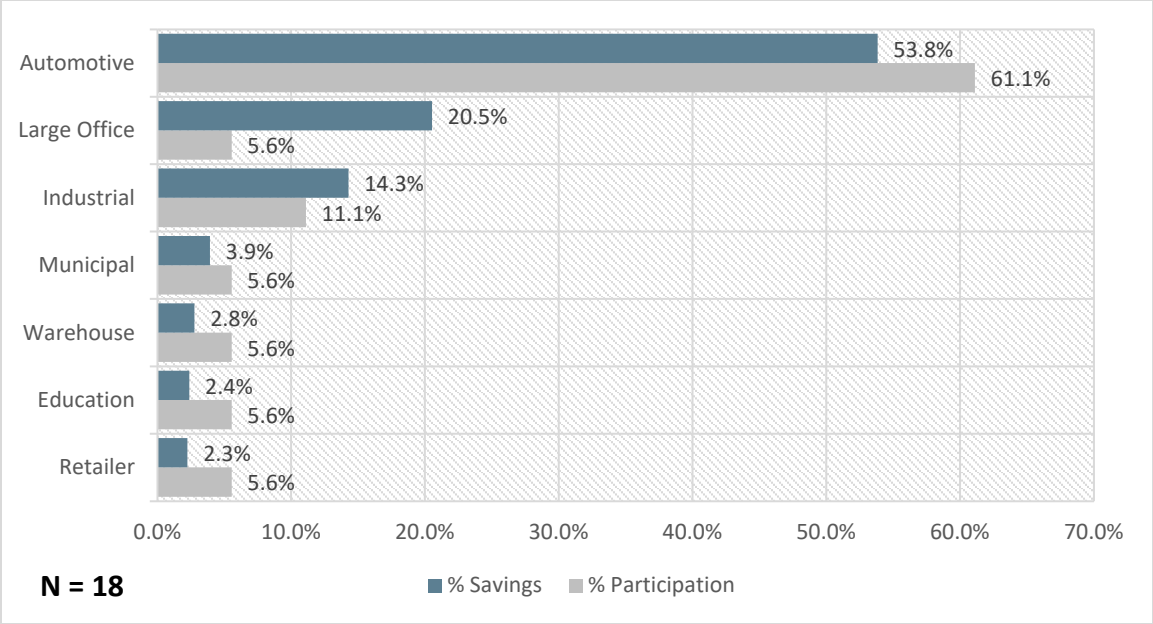

Figure 5-1 Commercial Solutions Direct Install Participant Summary by Facility Type

The number of measures is consistent with the number of rebates issued through the program. In 2020, there were 105 rebates issued through the Direct Install category. Overhead door weather stripping (WS) accounted for the majority (90.4%) of the program savings.

Figure 5-2 summarizes the participation by measure type, quantified in percent of measure type as well as percent of total savings.

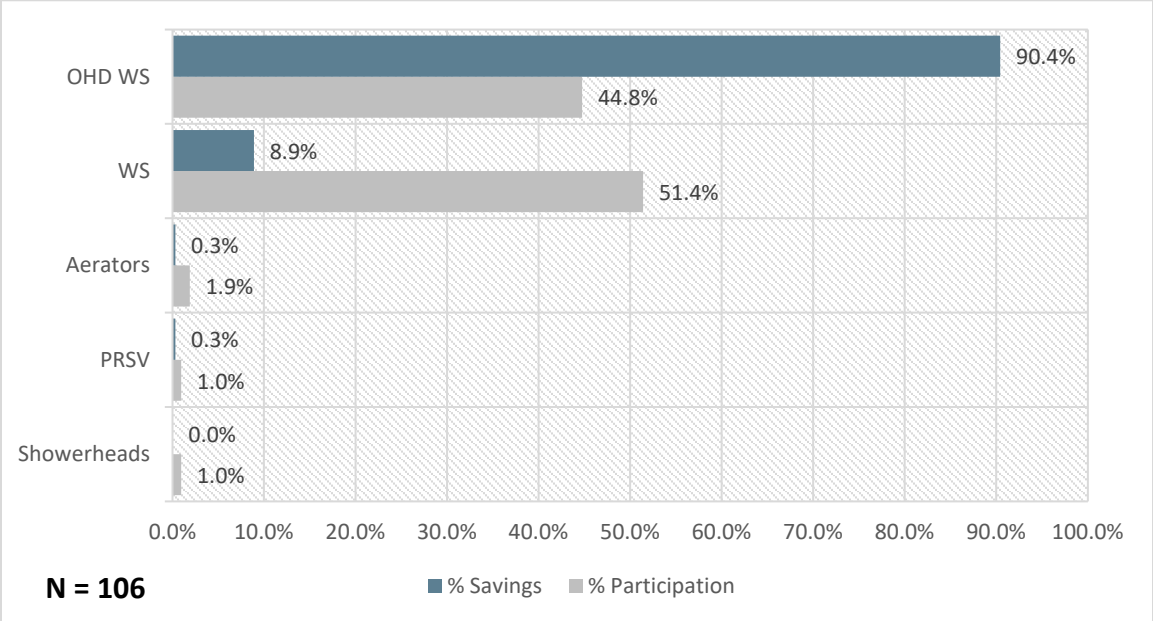

Figure 5-2 Commercial Solutions Direct Install Participant Summary by Measure Type

5.1.2 Prescriptive Participation Summary

5.1.2.1 Boilers

In 2020, the Commercial Boiler Program had one participant receive a rebate for one boiler. The participant is a large multi-use event center.

5.1.2.2 Food Service

In 2020, food service rebates were provided for three facilities totaling 14 units. There were six fryers, two combination ovens, and six convection ovens that were rebated in 2020. Two out of the three facilities were restaurants while the remaining facility was a public school. Figure 5-3 summarizes food service participation by measure category.

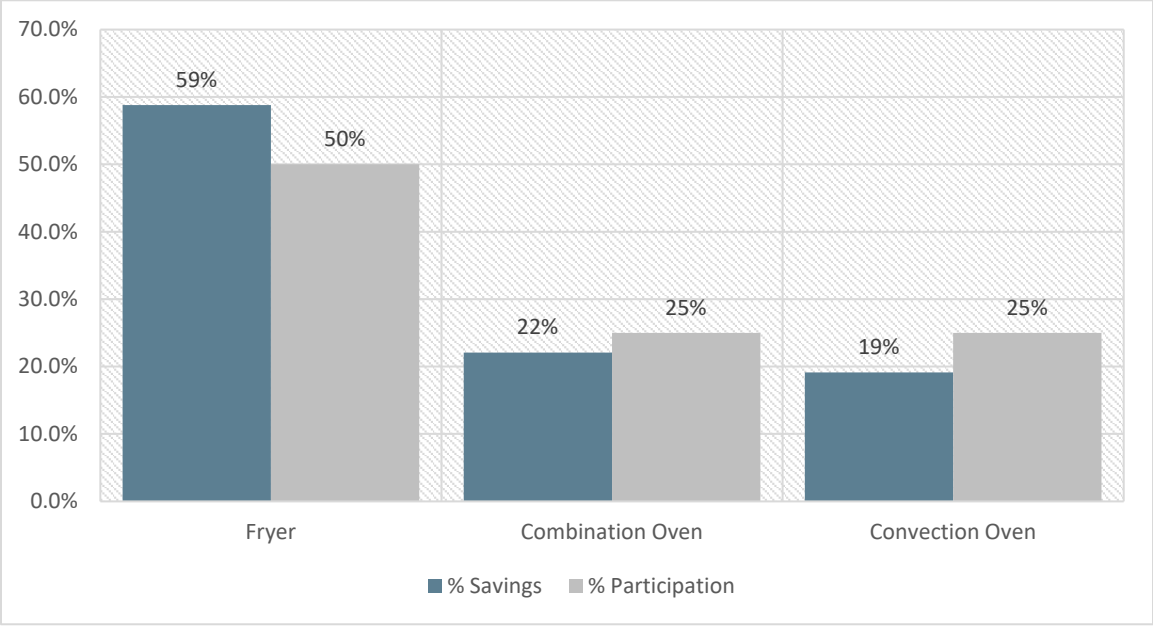

Figure 5-3 Food Service Participation by Measure Category

5.1.3 Closed Custom and Project Participation Summary

In 2020, C&I Solutions completed 14 custom projects in seven distinct facilities. Table 5-1 summarizes the completed projects for the 2020 C&I Solutions program.

Table 5-1 Custom Project Participation Summary

Facility Type	Project ID	Measure
Manufacturing	PRJ-2092613	Insulation
		Waste Heat Recovery
Manufacturing	PRJ-1745524	HVAC Controls
Dry Cleaning	PRJ-1879528	Insulation
		Steam Leak Repair
Manufacturing	PRJ-2590802	Insulation
Healthcare	PRJ-2295197	Burner Retrofit w/ Linkless Controls
Manufacturing	PRJ-2475265	Variable Frequency Drive
		Insulation
Manufacturing	PRJ-2475265	Insulation
		Waste Heat Recovery

5.2 Commercial Solutions Custom Impact Evaluation

The impact evaluation of the Commercial Solutions Program included the following:

- *Custom Project M&V*. The Evaluators conducted project-specific M&V on a census of the 14 projects completed through the Commercial Solutions program (accounting for 100% of program custom savings). Each project included an M&V plan and project-specific report. The reports are provided in Appendix A.

5.3 Commercial Solutions Direct Install Impact Evaluation

5.3.1 Energy Savings Calculations

The TRM Version 8.1 includes commercial faucet aerators, pre-rinse spray valves, low-flow showerheads, and weather stripping. The evaluation of the Commercial Solutions program incorporated these deemed values. They are detailed in the subsections to follow.

5.3.1.1 Faucet Aerators

Deemed savings calculations for direct install faucet aerators were based upon:

- Rated flow of installed aerators;
- Usage by facility type; and
- Water temperature setting by facility type.

Savings are calculated as follows:

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

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

The inputs for this equation are defined in Table 5-2.

Table 5-2 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	
	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 Therms/100,000 BTU	1/100,00
Eff_G	Efficiency of Gas Water Heater	0.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Prison	0.04
	Hospital, Nursing Home	0.03
	Dormitory	0.04
	Multifamily	0.03
	Lodging	0.02
	Commercial	0.08
	School	0.05

5.3.1.2 Direct Install Pre-Rinse Spray Valves

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:

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

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

Table 5-3 presents the definition of these parameters.

Table 5-3 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	
	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 Therms/100,000 BTU	1/100,000
Eff_G	Efficiency of Gas Water Heater	0.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Fast Food Restaurant	0.05
	Casual Dining Restaurant	0.04
	Institutional	0.03
	Higher Education	0.04
	School / K-12	0.05

Three PRSVs were installed through the Commercial Solutions Program in 2020. Savings for PRSVs were calculated using AR TRM V8.1 values.

5.3.1.3 Low Flow Showerheads

Low flow showerheads were added to the AR TRM V8.1. Deemed savings calculations for these showerheads were based upon:

- Rated flow of installed showerheads;
- Usage by facility type; and
- Water temperature setting by facility type.

Savings are calculated as follows:

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

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

In this formula, ΔV is calculated as follows:

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

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 5-4.

Table 5-4 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 Therms/100,000 BTU	1/100,00
E_T	Efficiency of Gas Water Heater	0.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Hospital, Nursing Home	0.03
	Lodging	0.02
	Commercial	0.08
	24 Hour Fitness Center	0.08
	School	0.05

Table 5-5 Daily Hot Water Reduction

Installed Flow Rate	Weather Zone	Hospital / Nursing	Lodging	Commercial 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

5.3.1.4 Weather Stripping

Deemed savings calculations for weather stripping were based upon:

- Air infiltration;
- Cooling and heating equivalent full-load hours; and
- Change in temperature between interior and exterior spaces.

Savings are calculated as follows:

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

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

The inputs for this equation are defined in Table 5-6.

Table 5-6 DI Weather Stripping 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
$EFLH_H$	Average heating equivalent full-load hours	Table 5-7

Table 5-7 $EFLH_H$ 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 SqFt)	811	1,014	1,054	1,036
Small Office (≤30k SqFt)	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 Table 5-8.

Table 5-8 Deemed Annual Therms 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

5.3.2 Boilers

Baseline efficiency for boilers is detailed in Table 5-9.

Table 5-9 Commercial Boiler Minimum Efficiency Levels

Project Type	Size Category	Subcategory	Minimum Efficiency
Replace-on-Burnout	< 300,000 BTUh	Hot Water	82% AFUE
		Steam	80% AFUE
	> 300,000 BTUh and < 2,500,000 BTUh	Hot Water	80% Et
		Steam	79% Et
	> 2,500,000 BTUh	Hot Water	82% Ec
		Steam	79% Et
Early Retirement	< 300,000 BTUh	Hot Water	80% AFUE
		Steam	75% AFUE
	> 300,000 BTUh and < 2,500,000 BTUh	Hot Water	75% Et
		Steam	75% Et
	> 2,500,000 BTUh	Hot Water	80% Ec
		Steam	80% Et

Savings for commercial boilers are calculated as:

$$Therms\ Savings = \frac{BTU\ Capacity * EFLH_H * \left(\frac{1}{Effic_{pre}} - \frac{1}{Effic_{post}}\right)}{100{,}000\ Therms/BTU}$$

The Evaluators recreated the deemed savings calculations for the boiler rebated through the program in 2020.

5.3.3 Food Service

The Evaluators applied deemed savings algorithms from Section 3.8.4 – 3.8.6 of AR TRM V8.1 in calculating savings for measures included in the Commercial Food Service Program.

The Evaluators conducted a review of the key parameters contributing to savings for equipment rebated in the Commercial Food Service Program. From this, a table was developed allowing CenterPoint to update energy savings calculations using the characteristics of the equipment purchased. In the subsections to follow, the deemed savings tables will present:

- Baseline specifications from the AR TRM V8.1;
- Efficient specifications from the AR TRM V8.1; and
- Average verified specifications from the Evaluators' review of units rebated in the program.

5.3.3.1 Fryer Savings Calculations

Savings for high efficiency fryers were calculated using similar algorithms as detailed for convection ovens. Table 5-10 summarizes the inputs used in the savings algorithm.

Table 5-10 Calculation Inputs for Fryers

Parameter	Baseline Model	Efficient Model
Preheat Energy (BTU/Day)	16,000	15,500
Idle Rate (BTU/h)	14,000	9,000
Cooking Eff. (%)	35%	50%
Capacity (lbs./hr.)	60	65
Lbs. of food Cooked/Day	150	150
Efood (BTU/lb./)	570	570
Hours/Day	12	12

5.3.3.1 Convection Ovens

Savings for convection ovens were calculated using the following series of equations:

$$\Delta Btu\ =\ Btu_{base} - Btu_{eff}$$

$$\Delta Therms = \frac{\Delta Btu}{100{,}000}$$

$$Btu_{(base\ or\ eff)} = Btu_{cooking} + Btu_{idle} + Btu_{preheat}$$

$$Btu_{cooking} = \left(LB \times \frac{E_{food}}{CookEff}\right) \times Days$$

$$Btu_{idle} = IdleEnergy \times \left(Daily\ Hrs - \frac{LB}{Capacity} - \frac{Preheat\ Time}{60}\right) \times Days$$

$$Btu_{preheat} = nP \times Preheat\ Energy \times Days$$

Savings for high efficiency fryers were calculated using similar algorithms as detailed for convection ovens. Table 5-11 summarizes the inputs used in the savings algorithm.

Table 5-11 Calculation Inputs for Convection Ovens

Parameter	Baseline Model	Efficient Model
Preheat Energy (BTU/Day)	16,000	15,500
Idle Rate (BTU/h)	14,000	9,000
Cooking Eff. (%)	35%	50%
Capacity (lbs./hr.)	60	65
Lbs. of food Cooked/Day	100	100
Efood (BTU/lb./)	250	250
Hours/Day	12	12

5.3.3.2 Combination Ovens

Savings for combination ovens were calculated using the following series of equations:

$$\Delta Btu = Btu_{base} - Btu_{eff}$$

$$\Delta Therms = \frac{\Delta Btu}{100{,}000}$$

$$Btu_{(base\ or\ eff)} = Btu_{oven} + Btu_{steam} + Btu_{preheat}$$

$$Btu_{(oven\ or\ steam)} = Btu_{cooking} + Btu_{tidle}$$

$$Btu_{cooking} = \left(\frac{LB_{\ (oven\ or\ steam)} \times E_{food}}{CookEff}\right) \times Days$$

$$LB_{\ oven} = LB \times (1 - \%Steam)$$

$$LB_{\ steam} = LB \times \%Steam$$

$$Btu_{idle} = (1 - \%Steam) \times IdleEnergy \times \left(Daily\ Hrs - \frac{LB}{Capacity} - \frac{nP \times Preheat\ Time}{60}\right) \times Days$$

$$Btu_{preheat} = nP \times Preheat\ Energy \times Days$$

Table 5-12 summarizes the deemed inputs for these equations as specified in AR TRM V8.1.

Table 5-12 Calculation Inputs for Conveyor Ovens

Parameter	Baseline Model	Efficient Model
Preheat Energy (BTU/Day)	35,000	18,000
Idle Rate (BTU/h)	70,000	57,000
Cooking Efficiency (%)	20%	42%
Production Capacity (pizzas/hr.)	150	220
Number of Pizzas cooked/day	250	250
Efood (BTU/lb./)	190	190
Hours/Day	12	12

5.4 Net-to-Gross Ratios (NTGR)

The Evaluators applied the Oklahoma Natural Gas NTGR of 98.4% for Direct Install Projects.

The Evaluators applied NTGR of 100% for custom and prescriptive projects.

5.5 Verified Savings

Table 5-13 presents the gross savings results of the evaluation of the 2019 Commercial Solutions Program. Total Gross Savings summarizes the savings calculations performed by TRM protocols and custom analyses.

Table 5-13 Commercial Solutions Verified Therms Savings

Component	Measure	Expected Therms Savings	Verified Therms Savings	EUL	Lifetime Therms Savings
Direct Install	Faucet Aerators	830	791	10	7,906
	Low Flow Showerheads	44	46	10	506
	Pre-Rinse Spray Valves	817	833	5	8,332
	Weather Stripping	256,118	256,118	11	2,652,765
Prescriptive	Boilers	2,925	2,925	20	58,500
	Food Service	7,188	7,188	12	86,250
Custom	Various	152,884	152,884	16.1	2,465,917
Total Gross Savings		**420,806**	**420,785**	**12.55**	**5,280,176**

Net savings for the Commercial Solutions program were calculated using free ridership rates based on participant surveys for the direct install and custom components. The resulting net savings are presented in Table 5-14.

Table 5-14 Commercial Solutions Net Savings Summary

Component	NTGR		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Direct Install	98.4%	98.4%	252,266	252,246	100.0%	2,612,115
Prescriptive	100.0%	100.0%	10,113	10,113	100.0%	144,750
Custom	100.0%	100.0%	152,884	152,884	100.0%	2,465,917
Overall:	**98.7%**	**98.7%**	**415,263**	**415,243**	**100.0%**	**5,222,782**

Table 5-15 summarizes the net non-energy benefits from the 2020 Commercial Solutions Program.

Table 5-15 Commercial Solutions Net Non-Energy Benefits Summary

Non-Energy Benefit	Annual Savings	Lifetime Savings
Water Savings (Gallons)	389,317	3,904,271

6. Home Energy Reports

The Home Energy Reports Program is an educational program run by Oracle, a third-party implementer for CenterPoint. The program provides educational materials to a sample of CenterPoint's residential customers, in which their usage is compared against similar households. The program is designed to encourage behavioral change and program participation on the part of the recipients of the Home Energy Report.

6.1 Participation Summary

The Home Energy Reports Program began in October 2011. The program is designed to generate quantifiable behavioral savings that cannot be feasibly attained through standard DSM efforts. The program differs from standard energy conservation marketing efforts in that it provides unique reports to each customer, comparing their gas bills against those of similar-sized homes in their neighborhood. The comparison against their neighbors is intended to have a jarring effect; when informed that their usage is above average, the program theory would assert that they are then driven to engage in conservation behaviors.

Over time, the population of recipients faces attrition. This occurs mostly due to members of the recipient group moving to a new residence. Table 6-1 summarizes the participation counts present for the 2020 program year.

Table 6-1 Home Energy Reports Recipient Attrition

Program Year	Wave 1	Wave 2	Wave 3	Wave 4
2020	15,708	7,251	6,958	11,427

6.1.1 Savings Calculation Methodologies

The post-program regression (PPR) model combines both cross-sectional and time series data in a panel dataset. This model uses only the post-program data, with lagged energy use for the same calendar month of the pre-program period acting as a control for any small systematic differences between the participant and control customers. In particular, energy use in calendar month *t* of the post-program period is framed as a function of both the participant variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between participants and controls will be reflected in differences in their past energy use, which is highly correlated with their current energy use. The version we estimate includes monthly fixed effects and interacts these monthly fixed effects with the pre-program energy use variable. These interaction terms allow pre-program usage to have a different effect on post-program usage in each calendar month.

The model specification is as follows:

$$Usage_{it} = \alpha_0 + \beta * treatment_i$$
$$+\alpha_1 * PreUsage_i$$
$$+\alpha_2 * PreUsageSummer_i$$
$$+\alpha_3 * PreUsageWinter_i$$
$$+\gamma * mm_t$$
$$+\delta_1 * mm_t * PreUsage_i$$
$$+\delta_2 * mm_t * PreUsageSummer_i$$
$$+\delta_3 * mm_t * PreUsageWinter_i$$
$$+\varepsilon_{it}$$

Where

- *i* denotes the *i*th customer
- *t* denotes the first, second, third, etc. month of the post-treatment period
- $Usage_{it}$ is the average daily use for reading *t* for household *i* during the post-treatment period
- $PreUsage_i$ is the average daily usage across household *i's* available pre-treatment billing reads.
- mm_t is a vector of month-year dummies

And parameter definitions are:

- α_0 is an intercept term
- $\alpha_1, \alpha_2, \alpha_3$ are effects of control variables $PreUsage_i$, $PreUsageSummer_i$, and $PreUsageWinter_i$ on $Usage_{it}$ in the reference month.
- $\delta_1, \delta_2, \delta_3$ are the effect of the control variables $PreUsage_i$, $PreUsageSummer_i$, and $PreUsageWinter_i$ in each month-year (mm_t) of the post period.
- ε_{it} is an error term.

In this specification, savings are calculated by:

- Savings = ∑ (Treatment_Coeff * Number of recipients in month i * Number of days in month i)

Where,

- Treatment_Coeff = Coefficient for treatment parameter (daily use is the dependent variable, a negative value for treatment reflects the difference in Therms/day used by the recipient group after report delivery)
- Number of recipients in month i = Total recipients in the Wave, after accounting for attrition, for each month
- Number of days in month i = For month i, the number of days in the month

6.1.2 Home Energy Report Net Savings

The HER program uses a randomized control trial, comparing recipients to non-recipients. As a result, the savings estimates from the model are net savings estimates, and no further deduction of free ridership is taken.

6.2 Model Output Results

Table 6-2 shows the pre-period interval for each wave, based on one year of billing data before the program start date. For each wave, the same interval was found for both recipient and controls groups, which allows for a proper comparison of pre-usage.

Table 6-2 Pre-period Interval

Wave	Start Year/Month	End Year/Month
1	2010-07	2011-09
2	2013-06	2014-08
3	2015-11	2017-01
4	2018-07	2019-09

6.2.1 Wave 1

Table 6-3 provides the model coefficients for the regression of customer billing data in the analysis of Wave 1.

Table 6-3 Regression Coefficients & Model Details – Wave 1

Variable Description	Regression Coefficient	Standard Error	T-Stat	PR > |T|
Intercept	0.83	0.02	33.57	<0.00001
Treatment	-0.04	0.01	-6.95	<0.00001
February	0.81	0.04	19.14	<0.00001
March	-0.43	0.04	-12.32	<0.00001
April	0.40	0.01	31.92	<0.00001
May	-0.01	0.04	-0.23	0.82
June	-0.47	0.04	-13.13	<0.00001
July	-0.69	0.03	-19.79	<0.00001
August	-0.80	0.04	-22.73	<0.00001
September	-0.73	0.04	-20.52	<0.00001
October	-0.66	0.04	-18.82	<0.00001
November	-0.68	0.04	-19.33	<0.00001
December	-0.76	0.04	-21.30	<0.00001
Pre-usage	-0.63	0.04	-17.79	<0.00001
Pre-summer	-0.51	0.04	-14.29	<0.00001
Pre-winter	-0.22	0.04	-6.36	<0.00001
Pre-usage: February	-0.46	0.07	-6.84	<0.00001
Pre-usage: March	-0.01	0.06	-0.21	0.83
Pre-usage: April	-0.25	0.06	-4.20	0.00
Pre-usage: May	-0.40	0.06	-6.63	<0.00001
Pre-usage: June	-0.76	0.06	-12.20	<0.00001
Pre-usage: July	-0.74	0.06	-12.09	<0.00001
Pre-usage: August	-0.72	0.06	-11.66	<0.00001
Pre-usage: September	-0.58	0.06	-9.49	<0.00001
Pre-usage: October	-0.13	0.06	-2.16	0.03
Pre-usage: November	-0.01	0.06	-0.12	0.90
Pre-usage: December	-0.05	0.06	-0.89	0.38
Pre-summer: February	0.32	0.05	5.81	<0.00001
Pre-summer: March	0.16	0.05	3.16	0.00
Pre-summer: April	0.68	0.05	13.47	<0.00001
Pre-summer: May	0.99	0.05	19.63	<0.00001

Pre-summer: June	1.15	0.05	22.37	<0.00001
Pre-summer: July	0.91	0.05	17.99	<0.00001
Pre-summer: August	0.93	0.05	18.16	<0.00001
Pre-summer: September	0.96	0.05	18.77	<0.00001
Pre-summer: October	0.55	0.05	10.81	<0.00001
Pre-summer: November	0.18	0.05	3.58	0.00
Pre-summer: December	0.14	0.05	2.77	0.01
Pre-winter: February	0.17	0.02	8.29	<0.00001
Pre-winter: March	-0.27	0.02	-14.66	<0.00001
Pre-winter: April	-0.34	0.02	-18.70	<0.00001
Pre-winter: May	-0.46	0.02	-25.34	<0.00001
Pre-winter: June	-0.41	0.02	-21.65	<0.00001
Pre-winter: July	-0.42	0.02	-22.92	<0.00001
Pre-winter: August	-0.43	0.02	-23.15	<0.00001
Pre-winter: September	-0.44	0.02	-24.01	<0.00001
Pre-winter: October	-0.45	0.02	-24.19	<0.00001
Pre-winter: November	-0.25	0.02	-13.62	<0.00001
Pre-winter: December	0.03	0.02	1.62	0.10
Adjusted R-Square: 0.716				

The resulting annual savings are:

- Annual Savings =

  $\sum$ (0.03662 * Number of customers in month i * Number of days in month i) =

  204,264 Therms

- 95% Confidence Interval: +/- 57,588 (28.2%)

6.2.2 Wave 2

Table 6-4 provides the model coefficients for the regression of customer billing data in the analysis of Wave 2.

Table 6-4 Regression Coefficients & Model Details – Wave 2

Variable Description	Regression Coefficient	Standard Error	T-Stat	PR > |T|
Intercept	0.62	0.02	28.03	<0.00001
Treatment	-0.04	0.00	-7.59	<0.00001
February	0.27	0.04	7.02	<0.00001
March	-0.21	0.03	-6.11	<0.00001
April	0.50	0.01	37.51	<0.00001
May	0.05	0.03	1.37	0.17
June	-0.22	0.03	-6.89	<0.00001
July	-0.46	0.03	-14.66	<0.00001
August	-0.62	0.03	-19.51	<0.00001
September	-0.58	0.03	-18.15	<0.00001
October	-0.51	0.03	-15.98	<0.00001
November	-0.52	0.03	-16.19	<0.00001
December	-0.57	0.03	-17.79	<0.00001
Pre-usage	-0.55	0.03	-17.24	<0.00001
Pre-summer	-0.44	0.03	-13.66	<0.00001
Pre-winter	-0.20	0.03	-6.36	<0.00001
Pre-usage: February	-0.21	0.06	-3.50	0.00
Pre-usage: March	-0.13	0.06	-2.22	0.03
Pre-usage: April	0.03	0.06	0.55	0.58
Pre-usage: May	0.00	0.06	0.00	1.00
Pre-usage: June	-0.18	0.06	-3.08	0.00
Pre-usage: July	-0.27	0.06	-4.80	<0.00001
Pre-usage: August	-0.24	0.06	-4.17	0.00
Pre-usage: September	-0.16	0.06	-2.92	0.00
Pre-usage: October	0.14	0.06	2.39	0.02
Pre-usage: November	0.10	0.06	1.72	0.08
Pre-usage: December	0.08	0.06	1.51	0.13
Pre-summer: February	0.09	0.05	1.75	0.08
Pre-summer: March	0.33	0.05	6.38	<0.00001
Pre-summer: April	0.47	0.05	9.27	<0.00001
Pre-summer: May	0.85	0.05	16.81	<0.00001

Pre-summer: June	0.93	0.05	18.08	<0.00001
Pre-summer: July	0.73	0.05	14.40	<0.00001
Pre-summer: August	0.74	0.05	14.54	<0.00001
Pre-summer: September	0.75	0.05	14.65	<0.00001
Pre-summer: October	0.53	0.05	10.38	<0.00001
Pre-summer: November	0.22	0.05	4.26	0.00
Pre-summer: December	0.00	0.05	0.06	0.95
Pre-winter: February	0.09	0.02	4.39	0.00
Pre-winter: March	-0.24	0.02	-12.35	<0.00001
Pre-winter: April	-0.40	0.02	-20.73	<0.00001
Pre-winter: May	-0.53	0.02	-27.43	<0.00001
Pre-winter: June	-0.51	0.02	-26.07	<0.00001
Pre-winter: July	-0.49	0.02	-25.24	<0.00001
Pre-winter: August	-0.50	0.02	-25.72	<0.00001
Pre-winter: September	-0.50	0.02	-25.80	<0.00001
Pre-winter: October	-0.48	0.02	-24.55	<0.00001
Pre-winter: November	-0.26	0.02	-13.43	<0.00001
Pre-winter: December	-0.01	0.02	-0.33	0.74
Adjusted R-Square: 0.714				

The resulting annual savings are:

- Annual Savings =

  $\sum$ (0.03576 * Number of customers in month i * Number of days in month i) =

  91,159 Therms
- 95% Confidence Interval: +/- 23,527 (25.8%)

6.2.3 Wave 3

Table 6-5 provides the model coefficients for the regression of customer billing data in the analysis of Wave 3.

Table 6-5 Regression Coefficients & Model Details – Wave 3

Variable Description	Regression Coefficient	Standard Error	T-Stat	PR > |T|
Intercept	0.59	0.02	37.07	<0.00001
Treatment	-0.02	0.00	-4.80	<0.00001
February	0.23	0.03	8.51	<0.00001
March	-0.16	0.03	-5.46	<0.00001
April	0.71	0.01	65.34	<0.00001
May	0.08	0.02	3.53	0.00
June	-0.32	0.02	-14.15	<0.00001
July	-0.43	0.02	-18.93	<0.00001
August	-0.70	0.02	-31.11	<0.00001
September	-0.63	0.02	-27.62	<0.00001
October	-0.54	0.02	-23.91	<0.00001
November	-0.56	0.02	-24.74	<0.00001
December	-0.69	0.02	-30.22	<0.00001
Pre-usage	-0.56	0.02	-24.63	<0.00001
Pre-summer	-0.40	0.02	-17.56	<0.00001
Pre-winter	-0.14	0.02	-6.11	<0.00001
Pre-usage: February	-0.13	0.04	-3.08	0.00
Pre-usage: March	0.34	0.04	8.67	<0.00001
Pre-usage: April	0.25	0.04	6.41	<0.00001
Pre-usage: May	0.35	0.04	8.99	<0.00001
Pre-usage: June	0.01	0.04	0.33	0.74
Pre-usage: July	-0.18	0.04	-4.59	<0.00001
Pre-usage: August	-0.18	0.04	-4.53	<0.00001
Pre-usage: September	0.14	0.04	3.53	0.00
Pre-usage: October	0.13	0.04	3.33	0.00
Pre-usage: November	0.14	0.04	3.50	0.00
Pre-usage: December	-0.06	0.04	-1.60	0.11
Pre-summer: February	0.05	0.05	0.93	0.35
Pre-summer: March	0.12	0.04	2.70	0.01
Pre-summer: April	0.49	0.04	11.33	<0.00001
Pre-summer: May	0.92	0.04	21.17	<0.00001

Pre-summer: June	0.86	0.04	19.50	<0.00001
Pre-summer: July	0.78	0.04	17.80	<0.00001
Pre-summer: August	0.81	0.04	18.25	<0.00001
Pre-summer: September	0.75	0.04	17.13	<0.00001
Pre-summer: October	0.57	0.04	12.96	<0.00001
Pre-summer: November	0.08	0.04	1.91	0.06
Pre-summer: December	0.19	0.04	4.35	0.00
Pre-winter: February	0.08	0.02	4.58	<0.00001
Pre-winter: March	-0.49	0.02	-31.04	<0.00001
Pre-winter: April	-0.64	0.02	-40.41	<0.00001
Pre-winter: May	-0.84	0.02	-53.59	<0.00001
Pre-winter: June	-0.76	0.02	-47.21	<0.00001
Pre-winter: July	-0.70	0.02	-44.62	<0.00001
Pre-winter: August	-0.70	0.02	-44.34	<0.00001
Pre-winter: September	-0.77	0.02	-48.74	<0.00001
Pre-winter: October	-0.63	0.02	-39.30	<0.00001
Pre-winter: November	-0.36	0.02	-22.87	<0.00001
Pre-winter: December	0.03	0.02	1.62	0.10
Adjusted R-Square: 0.740				

The resulting annual savings are:

- Annual Savings =

  $\sum$ (0.02062 * Number of customers in month i * Number of days in month i) =

  49,761 Therms

- 95% Confidence Interval: +/- 20,334 (40.9%)

6.2.4 Wave 4

Table 6-6 provides the model coefficients for the regression of customer billing data in the analysis of Wave 4.

Table 6-6 Regression Coefficients & Model Details – Wave 4

Variable Description	Regression Coefficient	Standard Error	T-Stat	PR > |T|
Intercept	0.26	0.01	24.13	<0.00001
Treatment	-0.02	0.00	-7.51	<0.00001
February	0.54	0.03	21.18	<0.00001
March	-0.11	0.02	-4.84	<0.00001
April	0.58	0.01	62.77	<0.00001
May	0.09	0.02	5.37	<0.00001
June	-0.11	0.02	-7.14	<0.00001
July	-0.19	0.02	-12.04	<0.00001
August	-0.25	0.02	-15.81	<0.00001
September	-0.23	0.02	-14.33	<0.00001
October	-0.20	0.02	-12.60	<0.00001
November	-0.20	0.02	-12.89	<0.00001
December	-0.23	0.02	-14.53	<0.00001
Pre-usage	-0.30	0.02	-19.09	<0.00001
Pre-summer	-0.21	0.02	-13.38	<0.00001
Pre-winter	-0.02	0.02	-1.49	0.14
Pre-usage: February	0.57	0.04	14.19	<0.00001
Pre-usage: March	0.74	0.04	19.97	<0.00001
Pre-usage: April	0.40	0.04	10.80	<0.00001
Pre-usage: May	0.00	0.04	-0.11	0.91
Pre-usage: June	-0.37	0.04	-9.71	<0.00001
Pre-usage: July	-0.46	0.04	-12.30	<0.00001
Pre-usage: August	-0.47	0.04	-12.46	<0.00001
Pre-usage: September	-0.34	0.04	-8.90	<0.00001
Pre-usage: October	-0.29	0.04	-7.63	<0.00001
Pre-usage: November	0.01	0.04	0.28	0.78
Pre-usage: December	0.13	0.04	3.31	0.00
Pre-summer: February	-0.25	0.04	-6.80	<0.00001
Pre-summer: March	0.08	0.03	2.34	0.02
Pre-summer: April	0.58	0.03	17.23	<0.00001
Pre-summer: May	1.00	0.03	29.69	<0.00001

Pre-summer: June	1.03	0.03	29.71	<0.00001
Pre-summer: July	0.83	0.03	24.38	<0.00001
Pre-summer: August	0.82	0.03	24.02	<0.00001
Pre-summer: September	0.88	0.03	25.61	<0.00001
Pre-summer: October	0.78	0.03	22.48	<0.00001
Pre-summer: November	0.22	0.03	6.40	<0.00001
Pre-summer: December	-0.08	0.03	-2.37	0.02
Pre-winter: February	-0.20	0.01	-13.47	<0.00001
Pre-winter: March	-0.67	0.01	-49.16	<0.00001
Pre-winter: April	-0.71	0.01	-52.14	<0.00001
Pre-winter: May	-0.74	0.01	-54.03	<0.00001
Pre-winter: June	-0.64	0.01	-45.76	<0.00001
Pre-winter: July	-0.60	0.01	-43.59	<0.00001
Pre-winter: August	-0.59	0.01	-42.76	<0.00001
Pre-winter: September	-0.63	0.01	-44.83	<0.00001
Pre-winter: October	-0.47	0.01	-33.19	<0.00001
Pre-winter: November	-0.34	0.01	-24.36	<0.00001
Pre-winter: December	-0.07	0.01	-5.20	<0.00001
Adjusted R-Square: 0.815				

The resulting annual savings are:

- Annual Savings =

  $\sum$ (0.02099 * Number of customers in month i * Number of days in month i) =

  78,807 Therms

- 95% Confidence Interval: +/- 20,577 (26.1%)

6.3 Group Comparison

The difference in consumption between the recipient and control groups is observable when presented graphically. Figure 6-1 presents the monthly differences in consumption between the two groups. Reports were first delivered in October of 2011, and at that point, the magnitude of difference in consumption increases. Further, the difference in use between the recipient and control group increases every year thereafter.

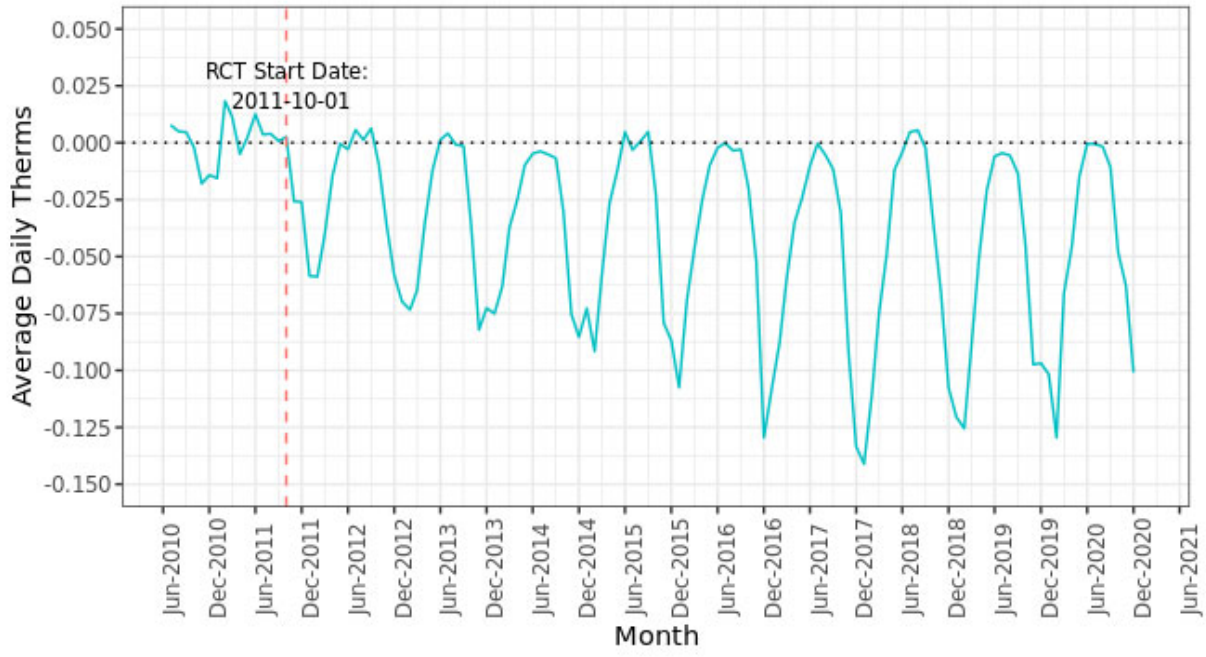

Figure 6-1 Daily Consumption between Recipient & Control Group – Wave 1

Similar representations for Wave 2, Wave 3, and Wave 4 are presented in Figure 6-2, Figure 6-3, and Figure 6-4, respectively. The impacts of the reports for Wave 3 and Wave 4 are somewhat lower than Wave 1 and 2. Wave 1 and Wave 2 show a pattern of increased difference in usage between participant and control groups over time, where this pattern is slowly starting to become recognizable in both Wave 3 and Wave 4.

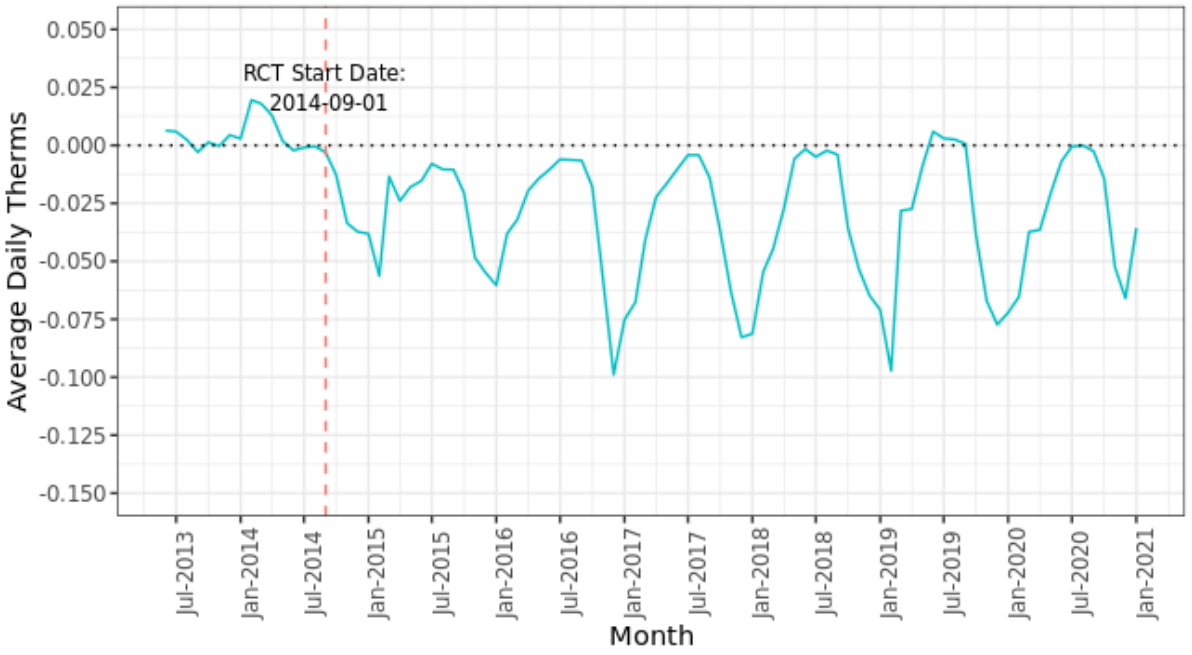

Figure 6-2 Daily Consumption between Recipient & Control Group – Wave 2

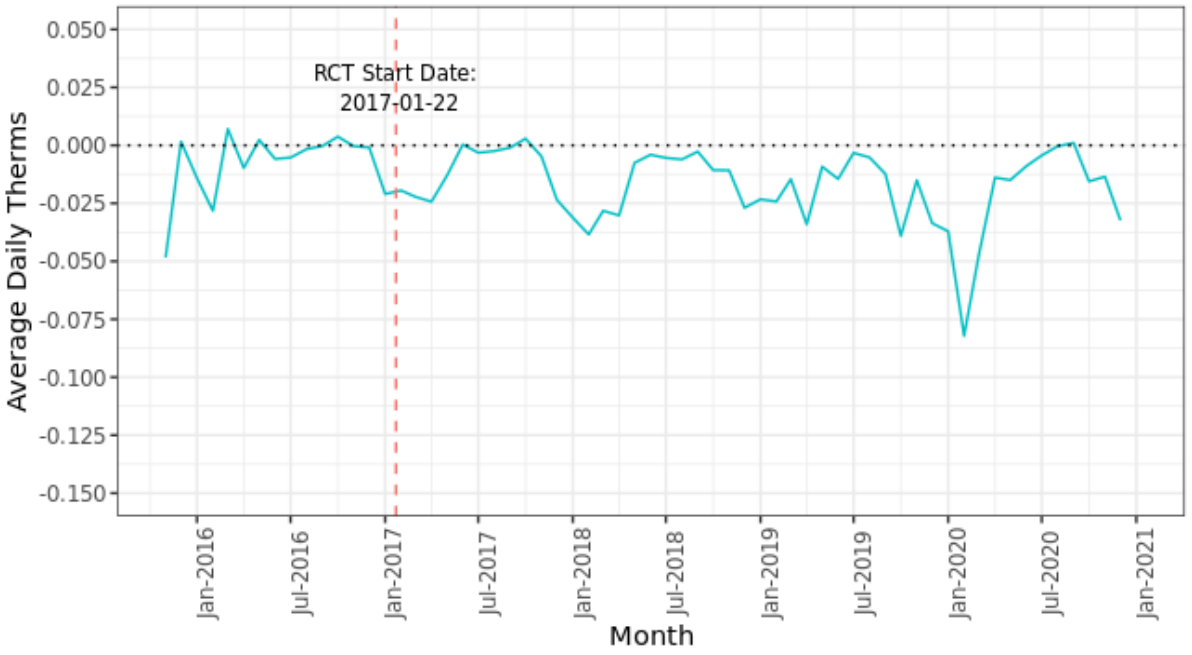

Figure 6-3 Daily Consumption between Recipient & Control Group – Wave 3

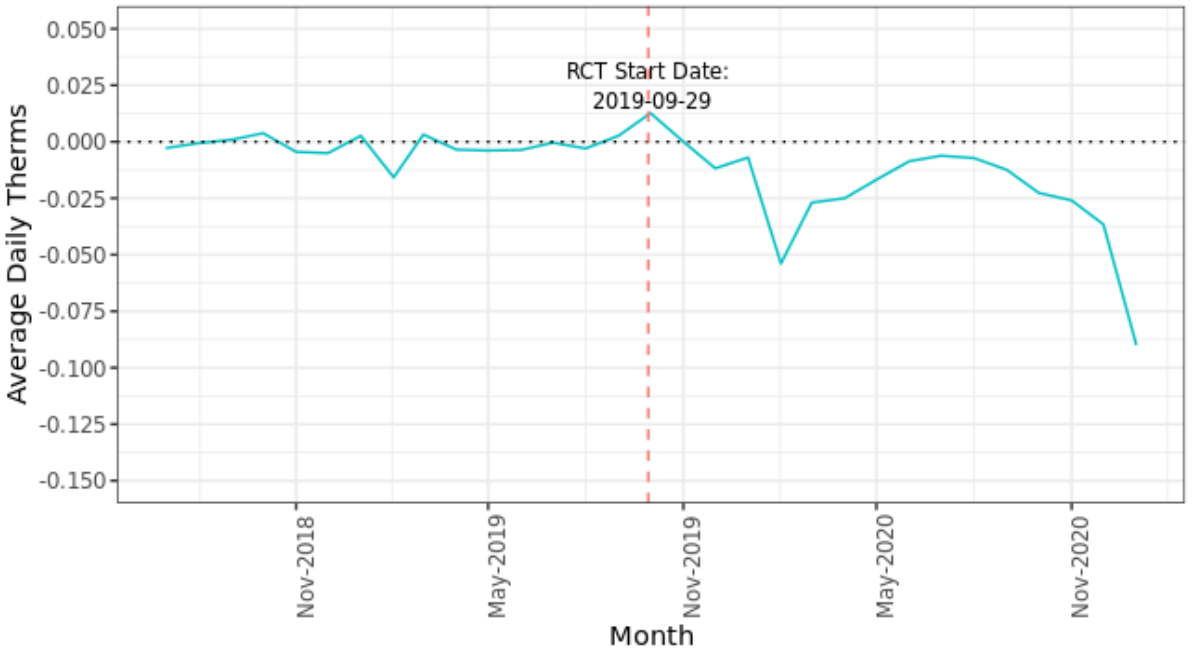

Figure 6-4 Daily Consumption between Recipient & Control Group – Wave 4

6.4 Per-Customer Performance

The annual savings per recipient for each wave is shown in Figure 6-5. Wave 1 had the highest savings at 13.38 therms per recipient. The savings for Wave 2 were 13.06 therms. The savings for Wave 3 were 7.53 therms. Finally, the Wave 4 savings were 7.67 therms. Of all the PY2020 waves, Wave 3 had the lowest savings.

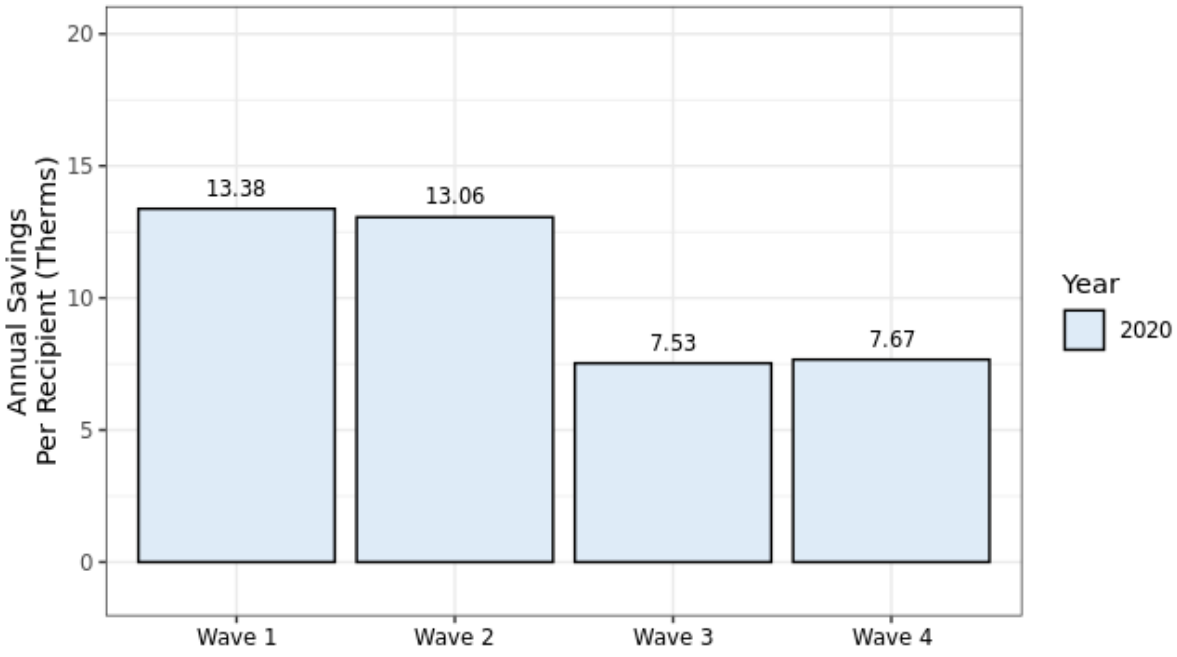

Figure 6-5 Savings per Recipient

Table 6-7 shows the savings per recipient for each wave at the both the lower and upper boundaries of the 95% confidence interval. Additionally, the annual pre-period usage per recipient and the percent of annual usage is provided below. The savings for each wave were calculated in the 1.43 – 1.77% range, consistent with expected general program performance and program performances in previous years.

Table 6-7 Pre-Period Usage per Recipient and Percent of Annual

Wave	Annual Savings per Recipient	Annual Savings (Lower 95% CI)	Annual Savings (Upper 95% CI)	Annual Pre-Period Usage per Recipient	Percent Weight of Total Participants	Percent of Annual Therms
1	13.38	9.61	17.15	756.61	39.02%	1.77%
2	13.06	9.69	16.43	718.36	17.83%	1.82%
3	7.53	4.45	10.61	579.75	16.88%	1.30%
4	7.67	5.66	9.67	535.47	26.27%	1.43%
All	**10.83**	**7.72**	**13.95**	**645.66**	-	**1.68%**

6.5 Verified Savings

the Home Energy Reports Program has 423,991 annual therms savings in 2020, shown in Table 6-8.

Table 6-8 HER Program Savings

Ex-ante Therms	Ex-post Therms	Realization Rate	95% Confidence Therms	Precision
423,991	423,991	102.5%	40,383	9.5%

The overall program realization rate for PY2020 is 102.5%.

Additionally, the overall program savings are shown on a per-wave basis in Table 6-9 where the lower and upper bounds at the 95% confidence interval are calculated.

Table 6-9 HER Program Savings at 95% Confidence

Wave	Weighted Number of Participants	Ex-post Therms	Ex-post Therms (Lower 95% CI)	Ex-post Therms (Upper 95% CI)
1	15,270.4	204,264	150,565	268,795
2	6,979.8	91,159	69,082	117,144
3	6,605.7	49,761	29,908	71,241
4	10,280.2	78,807	59,875	102,190
All	**39,136.1**	**423,991**	**309,430**	**559,370**

Table 6-10 summarizes the annual gross and net savings by wave.

Table 6-10 Therms Savings Summary by Wave

Wave	Number of Total Participants	Annual Therms Usage	Ex-post Savings	Savings as a Percent of Annual
1	15,708	11,553,793	204,264	1.77%
2	7,251	5,014,023	91,159	1.82%
3	6,958	3,829,678	49,761	1.30%
4	11,427	5,504,790	78,807	1.43%
All	**41,344**	**25,902,284**	**423,991**	**1.68%**

When aggregating across all waves, the Evaluators found that the overall 95% confidence interval was ± 9.5% of program savings. In addition, across all waves, the overall program savings were 1.68% of annual usage.

7. Low-Income Saving Homes Program

The Low-Income Saving Homes Program (LISHP) provides weatherization services to hard-to-reach customers. The program is administered in partnership with Public Service Company of Oklahoma (PSO).

Direct install measures include:

- Water heater pipe insulation, and
- Water heater jackets.

Weatherization measures include:

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

The program is implemented by Titan ES in partnership with PSO.

7.1 Program Background

The LISHP is intended to be primarily vendor-driven program, with the marketing targeted at contractors in the CenterPoint Energy service territory.

7.2 Participation Summary

The LISHP had 59 participants in PY2020, and a total of 526 energy efficiency improvements were installed overall.

Figure 7-1 summarizes the share of program savings contributed by each measure. Most of the program savings were generated by duct sealing, ceiling insulation, and air infiltration.

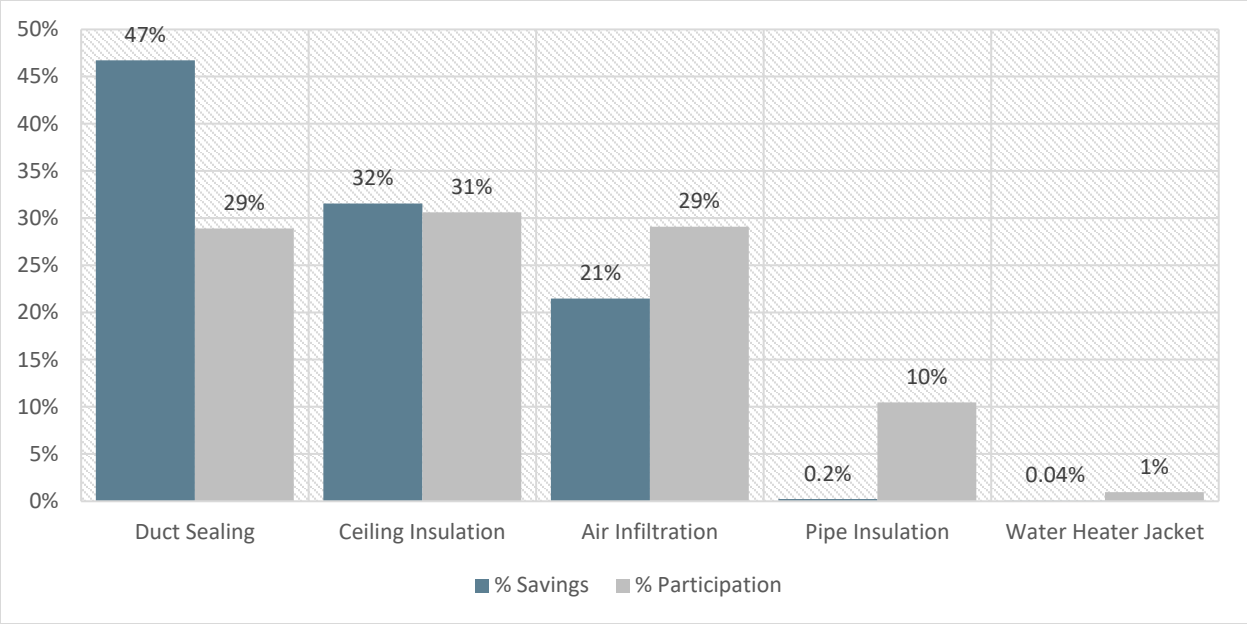

Figure 7-1 Program Summary by Savings Share and Participation

In addition, incentives were provided for 211 Health & Safety assessment measures at 164 homes.

7.2.1 Participation Timing

Figure 7-2 summarizes the premises by month as determined by the date of rebate delivery as well as the cumulative savings from the program.

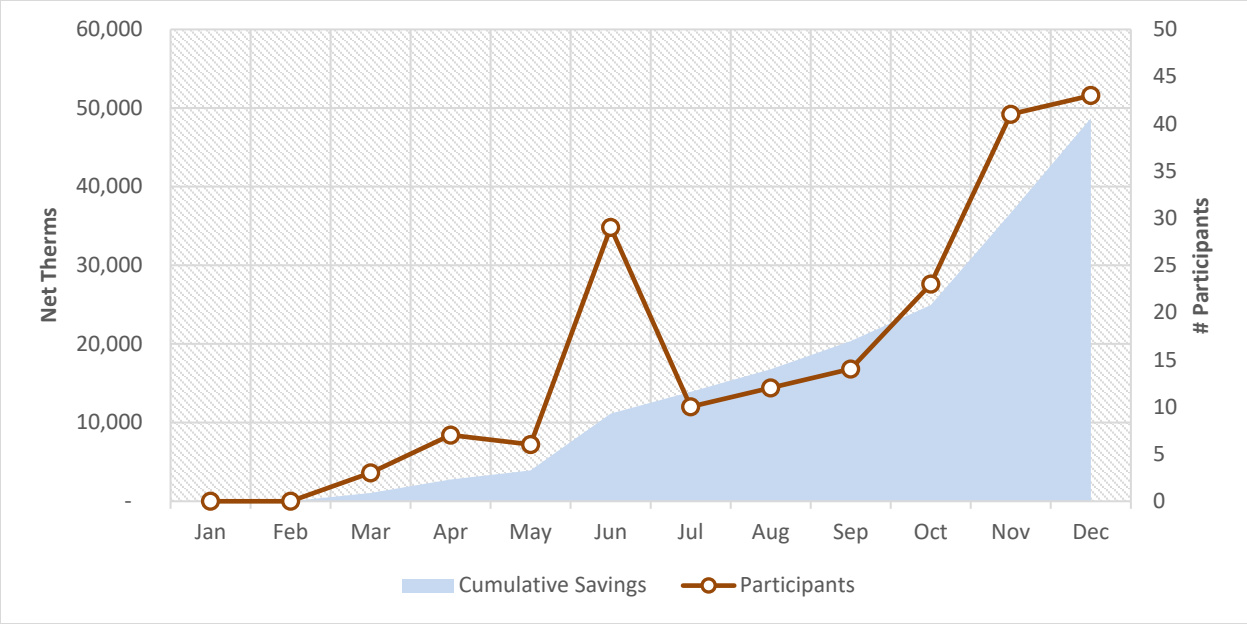

Figure 7-2 LISHP Cumulative Savings and Participants by Month

7.2.2 Quality Assurance

Staff at CLEAResult conducts post inspections at a minimum of 10% of the projects completed by each trade ally. Post inspections are conducted by a quality assurance specialist. The post-inspection procedure includes designations of major violations and minor violations for each measure.

- Major violations require immediate resolution which may include charging the contractor back for the coupon amount.
- Minor violations may be resolved without coupon chargeback.

The definition of major and minor violations by measure are summarized in Table 7-1.

Table 7-1 QA Violation Definitions by Measure

Measure	*Definitions*
Direct install	Major violation examples: ■ Verified devices installed does not match claimed devices installed. ■ Device installed on an appliance of non-eligible fuel type ■ Installation of direct install equipment results in damage or inoperability of existing equipment Minor violation examples: ■ None
Insulation	Major violation examples: ■ Stated existing R-value: error > 1 step difference in R-value range chart on the coupon. ■ Stated finished R-value: error of > 10% in R-value ■ Stated square footage: error of >10% in square feet Minor violation examples: ■ Improper installation of new insulation (such as varying depths) ■ Bag count card not properly displayed ■ Depth markers not properly displayed
Duct sealing/air sealing	Major violation examples: ■ Starting vs. finished air leakage rate: verification reveals discrepancy > 20% ■ Minimum Ventilation Requirement (MVR): failure to identify correct MVR or take proper action in the event of the MVR not being met ■ Duct sealing or air sealing materials: use of improper materials ■ Combustion Safety Test (CST): not performing the CST or failing to take proper action on the results. Minor violation examples: ■ None

7.3 LISHP Impact Evaluation

The evaluation effort of the LISHP included:

- *Desk review of residential calculations*. The Evaluators utilized TRM V8.1 values in assessing savings from measures included in the program.
- *Field verification.* Due to COVID-19, the Evaluators were unable to conduct in-person site visits to determine field verification rates. Instead, the Evaluators used a three-year average of field verification rates from PY17 through PY19 from the SHP and applied those values to LISHP.

7.3.1 Tracking Data Review

The impact evaluation began with a review of program tracking data. The tracking data included a separate row for each measure installed. Every premise in the program had a unique rebate identifier, and thus one premise would have multiple rows to reflect the different measures completed. Table 7-2 summarizes ex ante savings by measure for the LISHP.

Table 7-2 LISHP Ex Ante Summary

Measure	Ex Ante Therm
Duct Sealing	22,729
Ceiling Insulation	15,333
Air Infiltration	10,457
Pipe Insulation	111
Water Heater Jacket	20
Total	**48,649**

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. Further, the tracking data was found to include detailed parameters for all measures, such as baseline R-value for ceiling insulation.

7.3.2 Field Verification Procedures

Due to COVID-19, the Evaluators were unable to perform in-person site visits to determine field verification rates (FVRs) for projects in PY2020. As a result, the Evaluators have reviewed the site visits from PY2017, PY2018, and PY2019 (72 total sites) completed as part of evaluation of the CenterPoint Arkansas Saving Homes Program and applied the average of the three years to result in measure-level FVRs. These results are summarized in Table 7-3.

Table 7-3 Three Year Average Applied to PY2020

Measure	*SHP PY2017 FVR*	SHP PY2018 FVR	SHP PY2019 FVR	SHP PY2020 FVR
Duct Sealing	100.0%	N/A	N/A	100.0%
Ceiling Insulation	95.0%	101.1%	97.6%	97.9% / 100.0%
Air Infiltration	100.0%	100.0%	100.0%	100.0%
Pipe Insulation	95.9%	100.3%	102.5%	99.6% / 100.0%
Water Heater Jacket	100.0%	100.0%	100.0%	100.0%

7.3.3 Net Savings Estimates

The NTGR for the LISHP is 100% due to the program's emphasis on targeting hard-to-reach customers.

7.3.3.1 Direct Install Measures Free Ridership Methodology

Due to the low volume of direct install measures (which accounted for 0.26% of verified savings) the Evaluators did not develop a separate NTGR. DI measures received the 100.0% NTGR developed for the weatherization measures.

7.3.4 Verified Savings

Table 7-4 presents the gross savings results of the evaluation of the PY2020 Low-Income Saving Homes Program. Total gross savings summarizes the savings calculations performed by TRM protocols for program measures.

Table 7-4 LISHP Verified Savings Summary

Measure	Ex Ante Therms	Ex Post Therms	Gross Realization	EUL	Lifetime Therms
Duct Sealing	22,747	22,729	99.9%	18	409,120
Ceiling Insulation	15,358	15,333	99.8%	20	306,650
Air Infiltration	10,457	10,457	100.0%	11	115,026
Pipe Insulation	111	111	100.0%	11	1,161
Water Heater Jacket	20	20	100.0%	13	257
Total	**48,693**	**48,649**	**99.9%**	**17.1**	**832,215**

Table 7-5 LI SHP 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			
6.25%	0.00%	48,693	48,649	106.6%	17.1	832,215

8. Low Flow Showerhead & Faucet Aerator Program

The Low Flow Showerhead & Faucet Aerator Program provides no-cost mailer kits to CenterPoint residential customers. These kits may contain:

- Up to three 1.5 gallons per minute (GPM) low flow showerheads, available in chrome and ivory finish; and
- Up to three faucet aerators, with options including 1.5 GPM kitchen aerators (with a shutoff valve) and 1.0 GPM bathroom aerators (without a shutoff valve).

8.1 Program Background

The Low Flow Showerhead & Faucet Aerator is designed to provide no-cost kits containing low flow showerheads and faucet aerators to CenterPoint residential customers. These kits are then self-installed. The program has been markedly popular among CenterPoint customers.

8.2 Low Flow Showerhead & Faucet Aerator Program Participation Summary

In 2020, CenterPoint distributed 936 kits to their residential customers. Table 8-1 presents a summary of the composition of the kits installed. The table is organized showing first the number of customers by showerhead, then how many aerators were ordered by customers that ordered that specified number of showerheads.

Table 8-1 Low Flow Kit Composition

Showerheads		*Bathroom Aerators*		*Kitchen Aerators*	
Quantity	*% Selected*	*Quantity*	*% Selected*	*Quantity*	*% Selected*
0	20.51%	0	71.35%	0	56.25%
		1	18.23%	1	35.94%
		2	8.85%	2	5.73%
		3	1.56%	3	2.08%
1	38.14%	0	69.19%	0	57.14%
		1	25.77%	1	39.78%
		2	4.76%	2	2.80%
		3	0.28%	3	0.28%
2	34.36%	0	52.63%	0	39.91%
		1	17.98%	1	53.07%
		2	25.44%	2	6.14%
		3	3.95%	3	0.88%
3	16.99%	0	36.48%	0	34.59%
		1	21.38%	1	46.54%
		2	35.85%	2	12.58%
		3	6.29%	3	6.29%

8.3 Low Flow Showerhead & Faucet Aerator Program Impact Evaluation

8.3.1 Energy Savings Calculations

Savings from low flow showerheads are calculated by the following process:

- First, the Evaluators total the per-unit savings as determined by AR TRM V8.1 algorithms which incorporate weather-zone specific ground water temperatures, and an assumed mixed water temperature of 104.3 deg. F for the water heater.
- Further, these values are scaled down by the verified In-Service Rate. This is the percent of distributed equipment installed. This is determined separately for each item in the kit (showerheads, kitchen aerators, and bathroom aerators).
- The Evaluators then parse out the savings based on the percent of electric vs. gas water heating as determined through the participant surveys. This serves to provide a weighted average value of energy savings based upon the electric and natural gas savings algorithms for each measure as indicated in AR TRM V8.1.

8.3.2 Unit Energy Savings

8.3.2.1 Faucet Aerators

Savings from faucet aerators are based upon AR TRM V8.1 values. Savings for faucet aerators are calculated as follows:

$$Energy\ Savings\ = \frac{\rho \times C_P \times V \times \left(T_{Mixed} - T_{Supply}\right) \times \left(\frac{1}{RE}\right)}{Conversion\ Factor}$$

Where,

ρ = Water density, 8.33 lbs./gal.

C_P = Specific heat of water, 1 BTU/lb·°F

V = DHW gallons saved / yr. / faucet

$V =$ gallons of hot water saved per year per faucet
$= 533$
$\times (2.2$
$- gpm)$ where GPM is the flow rate of the new aerator. This formula is a linear extrapolation of values in.

$T_{SetPoint}$ = Mixed water temperature (default value 102.6°F)

T_{Supply} = Average supply water temperature

RE = Recovery efficiency of water heater, excluding standby losses (.98 electric / 0.79 Gas).

$Conversion\ Factor$ = 3,412 BTU/kWh for electric water heating or 100,000 BTU/Therms for gas water heating.

Table 8-2 Faucet Aerator Volume of Use

Parameter	Value
Faucet use gallons/person/day (baseline)	9.7
Faucet use gallons/person/day (1.5 GPM)	8.2
Faucet use gallons/person/day (1.0 GPM)	7.2
Occupants per home	2.53
Faucets per home	3.86
Gal./yr./faucet (Baseline)	2,321
Gal./yr./faucet (1.5 GPM)	1,962
Gal./yr./faucet (1.0 GPM)	1,722
Mixed Water Temperature	105.3°F
DHW gallons saved/yr./faucet for 1.5 GPM (V)	359
DHW gallons saved/yr./faucet for 1.0 GPM (V)	599

8.3.2.2 Low Flow Showerheads

Savings for low flow showerheads are detailed in Section 2.3.5 of the TRM Version 8.1. They are calculated in the same manner as faucet aerators, differing only in the volume of use estimates.

Table 8-3 Showerhead Volume of Use

Parameter	Value
Average Shower Duration (minutes)	8.3
Gallons/shower @ 2.5 GPM (baseline	20.7
Gallons/shower @ 2.0 GPM	16.5
Gallons/shower @ 1.5 GPM	12.4
Showers/person/day (baseline)	.69
Showers/person/day(post)	.72
Occupants per home	2.53
Showers/home/day (baseline)	1.62
Showers/home/day(post)	1.93
Showerheads per home	1.62
Showers per showerhead per day (baseline)	1.16
Showers per showerhead per day (post)	1.19
Gal./yr./showerhead @ 2.5 GPM (baseline)	8,142
Gal./yr./showerhead @ 1.5 GPM	5,089
Mixed Water Temperature	107.1 °F
1.5 GPM showerhead DHW gallons saved/yr. (V)	3,053

In addition, to account for the customers with electric water heating, the Evaluators incorporated the AR TRM V8.1

8.3.3 In-Service Rates

The Evaluators applied in-service rates developed in 2016 CenterPoint Arkansas participant surveying. They are:

- Showerhead: 65.8%
- Kitchen aerator 66.2%
- Bathroom aerator: 57.6%

8.4 Net-to-Gross

The evaluators used CenterPoint Arkansas free ridership of 96.3% with spillover of 0.639 Therms per kit.

8.5 Verified Savings

Table 8-4 summarizes the total gross savings for the Low Flow Showerhead & Faucet Aerator Program.

Table 8-4 Low Flow Showerhead & Faucet Aerator Program Verified Gross Savings

Measure Category	Annual Therms Savings		EUL	Lifetime Therms Savings		Gross Realization Rate
	Ex Ante	Ex Post		Ex Ante	Ex Post	
Aerators	3,308	2,760	10	33,081	27,601	85.5%
Showerheads	25,834	22,088	10	258,337	220,878	83.4%
Total Gross Savings	**29,142**	**24,848**		**291,417**	**248,479**	**85.3%**

Table 8-5 Low Flow Showerhead & Faucet Aerator Program Verified Net Savings

Measure Category	Net-to-Gross Ratio		Annual Therms Savings		EUL	Lifetime Therms Savings	
	Ex Ante	Ex Post	Ex Ante	Ex Post		Ex Ante	Ex Post
Kit Savings	100%	50.3%	12,767	12,506	10	127,669	125,059
Total Net Savings			**12,767**	**12,506**	**10**	**127,669**	**125,059**

Table 8-6 summarizes the net non-energy benefits from the 2020 Low Flow Showerhead & Faucet Aerator Program.

Table 8-6 Low Flow Showerhead & Faucet Aerator Program Net Non-Energy Benefits Summary

Non-Energy Benefit	Annual	EUL
Water Savings (Gallons)	3,824,311	10

9. Appendix A: Site Reports

This appendix contains the individual site reports for Commercial Solutions Program.

Program	C&I Solutions
Project ID	CNPOK-2020-001
Facility SIC Code	2000-3999 Manufacturing
Measures	Pipe Insulation Compressor Heat Recovery

Project Background

The participant is a manufacturing facility that received incentives from CenterPoint Energy for:

- ECM #1 – Pipe Insulation
- ECM #2 – Compressor Heat Recovery

The energy conservation measures implemented at this facility is insulation of the hot water system and waste heat recovery from multiple air compressors to provide comfort heating to the production area. The existing equipment affected are the Ingersoll Rand R110i in building #1, Kaeser ESD 250 in building #2, Ingersoll Rand SSR-EP200 in building #3, and Ingersoll Rand R75i compressor in building #4.

The new equipment is ductwork retrofitted to each compressor which carries heat from compressor exhaust to adjacent production areas for comfort heating in winter months. In summer months, a damper in the ductwork diverts the hot air to outdoors.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2012 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Supply water temperature is 66.10°F based on the AR TRM 8.1
- Annual operating hours for the site are 8,760 hours
- Combustion efficiency is 85.0% (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 in
- Insulation material type: 850°F Min. Fiber Pipe and Tank, Type IIIB, C1393-14 and 850°F MF BLANKET, TYPE IV, C553-13
- Process temperature is 135°F -185°F
- The average annual ambient air temperature 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:

Equation 1. Pipe Insulation Installation Annual Energy Savings

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

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	4'' Pipe Return	Pipe	1	5	4
2	4'' Supply Pipe	Pipe	1	3	4
3	2'' HX Pipe	Pipe	1	7	2
4	2'' HX Pipe	Pipe	1	5	2
5	5'' Return Valve	Valve	1	6	
6	4'' Supply Valve	Valve	1	4	
7	4'' Pipe Return	Valve	1	4	

Compressor Heat Recovery

The following equations were used to determine the annual therm savings associated with this project. The heating hours were calculated using TMY3 data from Lawton, OK.

Equation 2 CFM equation

$$Air\ Flow\ (CFM) = Air\ Flow\ \left(\frac{Feet}{Minute}\right) x\ Area_{Register}(Ft^2)$$

The annual energy savings were calculated using the equation below.

Equation 3 Compressor Heat Recovery Annual Savings Equation

$$Annual\ Energy\ Savings\left(\frac{CCF}{yr}\right) = \frac{1.08\left(\frac{BTU\ min}{°F\ ft^3\ hr}\right) \times CFM \times \left(T_{SA}(°F) - T_{RA}(°F)\right) \times Heating\ Hours\left(\frac{hrs}{yr}\right)}{100{,}000\left(\frac{BTU}{CCF}\right) \times Efficiency(\%)}$$

Where:

1.08 = 0.24(BTU/(lb. °F)) × 0.075(lb./ft^3) × 60(min/hr.)

T_{CA} = *Average Temperature of compressor cooling air entering production facility*

T_{RA} = *Production facility set point temperature (75 °F)*

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

Efficiency = Assumed efficiency = 80%

Measure Life

Estimated Useful Life by Measure

Measure	EUL
Compressor Heat Recovery	13 years
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	4'' Pipe Return	Pipe	165	219	25	100
2	4'' Supply Pipe	Pipe	185	282	32	77
3	2'' HX Pipe	Pipe	160	113	15	71
4	2'' HX Pipe	Pipe	135	74	10	33
5	5'' Return Valve	Valve	165	268	28	88
6	4'' Supply Valve	Valve	185	282	29	90
7	4'' Pope Return	Valve	165	219	23	70
					Total:	**529**

Compressor Heat Recovery

Compressor Heat Recovery Annual Energy Savings

Entry #	Description	Fan CFM	Average Room Temperature (°F)	Average Duct Temperature (°F)	Compressor Operating Hours	Balance Point	Heating Hours	Savings
1	Compressor Building #1	6899	75	122	6240	55	2202	11,613
2	Compressor Building #2	9551	75	117	6240	55	2202	14,629
3	Compressor Building #3	6731	75	115	6240	55	2202	9,774
4	Compressor Building #4	8778	75	88	6240	55	2202	4,011
							Total:	**40,027**

Overall, project savings are as follows:

Overall Project Savings

Measure	*Expected Annual therms Savings*	*Realized Annual therms Savings*	*Realization Rate*	*Lifetime therms Savings*
Compressor Heat Recovery	32,938	40,027	122.3%	520,351
Pipe Insulation	529	529	100.0%	10,580
Total	**33,467**	**40,556**	**121.2%**	**530,931**

Program	C&I Solutions
Project ID	CNPOK-2020-003
Facility SIC Code	2000-3999 Manufacturing
Measures	HVAC Controls – Schedule Optimization

Project Background

The participant is a manufacturing facility that received incentives from CenterPoint Energy for:

- ECM #1 – HVAC Controls – Schedule Optimization

The energy conservation measures implemented at this facility is the upgrade to the facilities HVAC units to allow for a set schedule to be used on the facilities 47 heaters. The initial heaters would supply heat to the facility any time the ambient air temperature dropped below 60°F year round, regardless of if the facility were occupied or not. The newly implemented HVAC controls allowed for the facilities heaters to supply heat to the facility when it was occupied and the ambient air temperature was below 65°F, the heaters would then supply heat to the facility when it was unoccupied whenever the ambient air temperature fell below 45°F.

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.

HVAC Controls – Schedule Optimization

Annual therms savings was calculated using the following equations:

Unoccupied Supply Air Temperature

$$T_{SA,H,Unocc}(°F) = T_{SA,H}(°F) - T_{Setback}(°F)$$

Mixed Air Temperature

$$\text{mixed air temperature} = \begin{cases} \text{when occupied, } T_{MA.H,Occ} = \frac{(V_{SA} - V_{OA}) \times T_{RA,H} + V_{OA} \times T_{OA}}{V_{SA}} \\ \text{when unoccupied, } T_{MA.H,Unocc} = T_{RA,H} \end{cases}$$

Occupied BTUs

$$BTU = 1.08\left(\frac{\text{BTU Min}}{Ft^3\ °F\ Hr}\right) \times V_{SA} \times Load_{H,Occ} \times \left(T_{SA,H}(°F) - T_{MA,H,Occ}(°F)\right)$$

Unoccupied BTUs

$$BTU = 1.08\left(\frac{\text{BTU Min}}{Ft^3\ °F\ Hr}\right) \times V_{SA} \times Load_{H,Unocc} \times \left(T_{SA,H,Unocc}(°F) - T_{MA,H,Unocc}(°F)\right)$$

Therms Savings

$$\text{Natural Gas Savings (Therms)} = \frac{BTU_{\text{ Existing}} - BTU_{Proposed}}{100{,}000\left(\frac{BTU}{Therm}\right) \times Efficiency_{Heating}(\%)}$$

Where:

$T_{SA,H}$ = Supply Air Temperature

$T_{setback}$ = Setback temperature

V_{SA} = Supply Air Flow Rate (CFM)

V_{OA} = Outdoor Air Flow Rate

$T_{RA,H}$ = Return Air Temperature

T_{OA} = Outside Air Temperature

T_{RA} = Return Air Temperature

$Load_{H,Occ}$ = Occupied Heating Load

$Load_{H,Unocc}$ = Unoccupied Heating Load

$TMA_{,H,Occ}$ = Mixed Air Temperature

Measure Life

Estimated Useful Life by Measure

Measure	*EUL*
HVAC Controls	15 years

Overall, project savings are as follows:

Overall Project Savings

Measure	*Expected Annual therms Savings*	*Realized Annual therms Savings*	*Realization Rate*	*Lifetime therms Savings*
HVAC Controls	8,946	8,152	91%	122,278
Total	**8,946**	**8,152**	**91%**	**122,278**

Program	C&I Solutions
Project ID	CNPOK-2020-006
Facility SIC Code	2000-3999 Manufacturing
Measures	Pipe Insulation

Project Background

The participant is a manufacturing facility that received incentives from CenterPoint Energy for:

- ECM #1 – Pipe Insulation

The steam system serves the facility's asphalt production process. Pipe insulation measure saved energy by reducing the heat loss from the piping and joints/values, thus reducing the gas consumption.

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 8,760 hours
- Combustion efficiency is 87% (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 in and 2 in
- Insulation material type: 850F Min Fiber Pipe and Tank, Type IIIB, C1393-14; 850F MF BLANKET, Type IV, C553-13
- Process temperatures: 373 °F for pipe and 350 °F for tank shell

- The average annual ambient air temperature is 75°F for pipe and 61.86 °F for tank shell

The 3E Plus software was used to calculate heat loss (BTU/hr./ft) for bare piping (pre-retrofit) and piping with 1 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:

Equation 4. Pipe Insulation Installation Annual Energy Savings

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

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency = 80.5%

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) /Surface Area (ft^2)	Diameter (in)
1	Storage Tanks 3" x 84' 373F	Pipe	1	84	3
2	Storage Tanks 3" 12 Fittings 373F	Pipe	12	3.35	3
3	Valve Station 3" x 21' 373F	Pipe	1	21	3
4	Valve Station 3" 8 Fittings 373F	Pipe	8	3.35	3
5	1" x 4' 373F	Pipe	1	4	1
6	1" 4 Fittings 373F	Pipe	4	2.25	1
7	Main Kiln 8' x 40' x 37'	Valve	1	1030.44	8

Measure Life

Estimated Useful Life 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	Storage Tanks 3" x 84' 373F	Pipe	373	865.9	73.44	6,703
2	Storage Tanks 3" 12 Fittings 373F	Pipe	373	865.9	70.3	3,220
3	Valve Station 3" x 21' 373F	Pipe	373	865.9	73.44	1,676
4	Valve Station 3" 8 Fittings 373F	Pipe	373	865.9	70.3	2,147
5	1" x 4' 373F	Pipe	373	349.3	55.89	118
6	1" 4 Fittings 373F	Pipe	373	349.3	53.61	268
7	Main Kiln 8' x 40' x 37'	Valve	350	881.8	50.58	18,189
					Total:	**32,321**

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	32,215	32,321	100.3%	646,417
TOTAL	**32,215**	**32,321**	**100.3%**	**646,417**

Program	C&I Solutions
Project ID	CNPOK-2020-007
Facility SIC Code	3582 – Drycleaning
Measures	Steam Leak Repairs Pipe Insulation

Project Background

The participant is a Drycleaners that received incentives from CenterPoint Energy for:

- ECM #1 - Steam leak repairs
- ECM #2 – Pipe Insulation

The existing equipment affected was the steam boiler/generator system which provides steam to processes/comfort heating. Steam leaks have occurred across the given system and the leaks range from valves to fittings. Savings will come from repairing the failed steam traps throughout the site's pipework, as well as properly insulating sections of pipe throughout the facility's pipework.

M&V Methodology

The M&V effort for this project follows the guidelines of the 2012 International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement.

Measurement and verification activities are based on the following assumptions:

- Supply water temperature is 67.9°F
- Annual operating hours for the site are 6,136 hours
- Combustion efficiency is 80.0% (for both pre-retrofit and post-retrofit condition)

Steam Leak Repairs

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

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

Equation 5. Equating Steam Plume Length to Flow Rate

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

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

Equation 6. Calculation for Heat Loss

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

Where:

Leak Rate = calculated value using Equation 5.
Steam Enthalpy = saturated steam region based on system steam pressure
MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (34.2 BTU/lb.)

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

Steam Leak #	Description	Quantity of Leaks	Plume Length (ft)	Steam Pressure (psig)	Leak Rate (lbs./hr.)	Boiler Efficiency
1	Leak 1	1	2.0	56	17.42	80.0%
2	Leak 2	1	2.0	56	17.42	80.0%

Energy Savings

The annual energy savings from repairing a steam leak is calculated with the following equation:

Equation 7. Steam Leak Repair Annual Energy Savings

$$Annual\ Energy\ Savings\ (therms) = \frac{Heat\ Loss\ \left(\frac{Btu}{hr}\right) x\ Annual\ Operating\ Hours\left(\frac{hrs}{yr}\right)}{Boiler\ Efficiency(\%)\ x\ 100{,}000\ \frac{Btu}{therm}}$$

Where:

Annual Operating Hours = number of hours facility operates annually = 6,136 hours

Boiler Efficiency = 80.0%

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

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: 2.0 in
- Insulation material type: 850°F Min. Fiber Pipe and Tank, Type IIIB, C1393-14
- Process temperature is 302.65°F
- The average annual ambient air temperature 75°F

The 3E Plus software was used to calculate heat loss (BTU/hr./ft) for bare piping (pre-retrofit) and piping with 2-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:

Equation 8. Pipe Insulation Installation Annual Energy Savings

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

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" 19 ft pipe	Pipe	1	19	1.0
2	2" 38 ft pipe	Pipe	1	38	2.0

Water Savings

In addition to energy savings, water savings were calculated for each of the ECMs. These savings are considered as Non-Energy Benefits (NEBs).

Annual Energy Savings Unit Conversion (therms/year to BTU/year)

$$Annual\ Energy\ Savings\ \left(\frac{Btu}{yr}\right) = Annual\ Energy\ Savings\ \left(\frac{therm}{yr}\right) \times 100{,}000\ \frac{Btu}{therm}$$

Calculation for Pounds of Steam Produced per Year

$$Steam_{Trap}\ \left(\frac{lb}{yr}\right) = \left(\frac{Annual\ Energy\ Savings\ (Btu)}{Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - FW\ Enthalpy\ \left(\frac{Btu}{lb}\right)}\right) \times Eff_{Boiler}\ (\%)$$

$$Steam_{Leak}\ \left(\frac{lb}{yr}\right) = \left(\frac{Annual\ Energy\ Savings\ (Btu)}{Steam\ Enthalpy\ \left(\frac{Btu}{lb}\right) - MW\ Enthalpy\ \left(\frac{Btu}{lb}\right)}\right) \times Eff_{Boiler}\ (\%)$$

Annual Water Savings Calculation

$$Annual\ Water\ Savings\ \left(\frac{gal}{yr}\right) = \frac{Steam\ \left(\frac{lb}{yr}\right)}{8.33\ \left(\frac{lb}{gal}\right)}$$

Measure Life

Estimated Useful Life by Measure

Measure	EUL
Steam Leak Repairs	10 years
Pipe Insulation	20 years

Calculated Savings:

Steam Leak Repairs

Steam Leak Repairs Savings

Steam Leak #	Description	Quantity of Leaks	Plume Length (ft)	Steam Enthalpy (BTU/lb.)	System Enthalpy (BTU/lb.)	Therms Savings
1	Leak 1	1	2.0	1,181.3	1,145.32	1,530
2	Leak 2	1	2.0	1,181.3	1,145.32	1,530
					Total:	**3,061**

Pipe Insulation

Pipe Insulation Annual Energy Savings

Entry #	Description	Pipe or Valve	Temperature (°F)	Pre Heat Loss	Post Heat Loss	Therms Savings
1	1” 19 ft pipe	Pipe	302.65	237.61	28.19	305
2	2” 38 ft pipe	Pipe	302.65	408.25	39.60	1,074
					Total:	**1,380**

Overall, project savings are as follows:

Overall Project Savings

Measure	*Expected Annual therms Savings*	*Realized Annual therms Savings*	*Realization Rate*	*Lifetime therms Savings*	*Annual Water Gallons Savings*	*Lifetime Water Gallons Savings*
Steam Leak Repair	3,061	3,061	100.0%	30,610	25,664	256,640
Pipe Insulation	1,380	1,380	100.0%	27,600	N/A	N/A
TOTAL	**4,441**	**4,441**	**100.0%**	**58,210**	**25,664**	**256,640**

Program	C&I Solutions
Project ID	CNPOK-2020-008
Facility SIC Code	8062 General Medical and Surgical Hospitals
Measures	Commercial Boiler

Project Background

The participant is a Healthcare Center that received incentives from CenterPoint Energy for:

- ECM #1 – Commercial Boiler

The commercial boiler functions a part of the steam system to serve the healthcare center's typical systems, including space heat, sanitization, and laundry.

M&V Methodology

Savings for the commercial boiler replacement measure was calculated using Oklahoma stipulated deemed values. The deemed values were formulated using methodologies from the Oklahoma C&I Natural Gas Guidebook V1.

Energy Savings

The annual energy savings from commercial boiler is calculated with the following equation:

Commercial Boiler Energy Savings

$$Annual\ Energy\ Savings\ (therms) = \frac{Capacity\ \left(\frac{Btu}{hr}\right) x\ EFLH_H(hr)\ x\ (\frac{1}{\eta_{pre}} - \frac{1}{\eta_{post}})}{100{,}000\ \frac{Btu}{therm}}$$

Where:

Capacity: Rated equipment heating capacity BTU/hr.

$EFLH_H$: Equivalent full-load hours for heating

η_{pre} : 80% Energy Efficiency of the baseline boiler

η_{post}: Nameplate Efficiency of the new boiler

100,000 BTU/therm: thermal conversion factor (BTU/yr. to therm/yr.)

Measure Life

Estimated Useful Life by Measure

Measure	*EUL*
Commercial Boiler	20 years

Calculated Savings:

Commercial Boiler

Commercial Boiler Savings

Unit	Heating Capacity (BTU/hr.)	η_{pre}	η_{post}	Expected Annual Therm Savings	Calculated Annual Therm Savings	Lifetime Savings	Realization Rate
1	10,461,000	80%	83.2%	739	739	14,785	100%
1	10,461,000	80%	83.3%	11,917	11,917	238,336	100%
			Total:	**12,656**	**12,656**	**253,121**	**100%**

Overall, project savings are as follows:

Overall Project Savings

Measure	*Expected Annual therms Savings*	*Realized Annual therms Savings*	*Realization Rate*	*Lifetime therms Savings*
Commercial Boiler	12,656	12,656	100.0%	253,121
TOTAL	**12,656**	**12,656**	**100.0%**	**253,121**

Program	C&I Solutions
Project ID	CNPOK-2020-009
Facility SIC Code	2000-3999 Manufacturing
Measures	Pipe Insulation Exhaust Control VFD

Project Background

The participant is a construction material production facility that received incentives from CenterPoint Energy for:

- ECM #1 – Pipe Insulation
- ECM #2 – Exhaust Control VFD

The steam system serves the facility's asphalt production process. Pipe insulation measure saved energy by reducing the heat loss from the piping and joints/values, thus reducing the gas consumption. Exhaust Control VFD saved energy by reducing CFM flow rates, thus reducing heat loss through the dust control system and saved gas consumption.

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 8,760 hours
- Combustion efficiency is 82% (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: 2 in

- Insulation material type: 850F MF BLANKET, Type IV, C553-13 and 850F Min.Fiber Pipe and Tank, Type IIIB, C1393-14
- Process temperature is 330°F
- The average annual ambient air temperature is 62°F
- The wind speed is 7.22 mph

The 3E Plus software was used to calculate heat loss (BTU/hr./ft) for bare piping (pre-retrofit) and piping with 2 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

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

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency = 82%

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) /Surface Area (ft^2)	Diameter (in)
1	Rotary Kiln	Cylindrical Tank	1	326.73	8
2	(6) 3" 3 way valve	Valve or Fitting	1	20.1	3
3	(3) 3" 90 elbow	Valve or Fitting	1	10.05	3
4	(1) 11"x15" large valve 4" pipe	Valve or Fitting	1	3.47	4
5	(3) 3" 2 way valve	Valve or Fitting	1	10.05	3
6	(13) 3" flange	Valve or Fitting	1	43.55	3
7	(2) 3"x24" pipe	Pipe	1	4	3
8	(1) 3" sweep ell 24" long	Pipe	1	2	3
9	(1) 10"x12" large valve 2" pipe	Valve or Fitting	1	3	2
10	(2) 3" flex line 22" long	Pipe	1	3.67	3
11	(1) 3" flex line 60" long	Pipe	1	5	3

Exhaust Control VFD

The following calculations were used to determine the annual therm savings associated with this measure.

Post CFM Calculation

$$\frac{Power_{Pre}}{Power_{Post}} = \left(\frac{CFM_{Pre}}{CFM_{Post}}\right)^{2.8}$$

Where:

$Power_{Pre}$ = Maximum power kW

$Power_{post}$ = Average power kW

CFM_{pre} = 15,000 CFM

2.8 = Affinity law exponent assumption, never 3 in practice

Exhaust Control VFD Annual Energy Savings

$$Annual\ Energy\ Savings\left(\frac{CCF}{yr}\right) = \frac{1.08\left(\frac{BTU\ min}{°F\ ft^3\ hr}\right) \times (CFM_{Pre} - CFM_{Post}) \times \left(T_{Stack}(°F) - T_{Ambient}(°F)\right) \times EFLH\left(\frac{hrs}{yr}\right)}{100{,}000\left(\frac{BTU}{CCF}\right) \times Efficiency(\%)}$$

Where:

1.08 = 0.24(BTU/(lb. °F)) × 0.075(lb./ft^3) × 60(min/hr.)

T_{Stack} = Stack temperature = 350°F

$T_{Ambient}$ = Average dry bulb temperature from TMY3 for McAlester, OK = 62°F

EFLH = Equivalent full load hours = 913 hrs./yr.

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

Efficiency = Assumed efficiency = 80%

Entry #	*Description*	*CFM_{pre}*	*CFM_{post}*	*$Power_{pre}$*	*$Power_{post}$*	*$Temp_{Stack}$ (°F)*	*$Temp_{Ambient}$ (°F)*	*EFLH (hrs.)*	*Efficiency (%)*
1	Blower - VFD	15,000	8,887	183.78	42.44	330	62	913	80%

Measure Life

Estimated Useful Life by Measure

Measure	*EUL*
Pipe Insulation	20 years
Exhaust Control VFD	15 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	Rotary Kiln	Cylindrical Tank	330	747.40	43.07	11,060
2	(6) 3" 3 way valve	Valve or Fitting	330	1326.00	60.70	2,785
3	(3) 3" 90 elbow	Valve or Fitting	330	1326.00	60.70	1,392
4	(1) 11"x15" large valve 4" pipe	Valve or Fitting	330	1582.00	72.48	574
5	(3) 3" 2 way valve	Valve or Fitting	330	1326.00	60.70	1,392
6	(13) 3" flange	Valve or Fitting	330	1326.00	60.70	6,034
7	(2) 3"x24" pipe	Pipe	330	1326.00	60.70	554
8	(1) 3" sweep ell 24" long	Pipe	330	1326.00	60.70	277
9	(1) 10"x12" large valve 2" pipe	Valve or Fitting	330	1019.00	46.30	320
10	(2) 3" flex line 22" long	Pipe	330	1326.00	60.70	508
11	(1) 3" flex line 60" long	Pipe	330	1326.00	60.70	693
					Total:	**25,589**

Exhaust Control VFD

Entry #	Description	CFM_{pre}	CFM_{post}	EFLH (hrs.)	Efficiency (%)	Therms Savings
1	Blower - VFD	15,000	8,887	913	80%	21,689
					Total:	21,689

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	25,588	25,589	100.0%	511,780
Exhaust Control VFD	21,689	21,689	1000%	325,335
TOTAL	**47,279**	**47,278**	**100.0%**	**837,115**

Program	C&I Solutions
Project ID	CNPOK-2020-010
Facility SIC Code	2000-3999 Manufacturing
Measures	Pipe Insulation Compressor Heat Recovery

Project Background

The participant is a manufacturing facility that received incentives from CenterPoint Energy for:

- ECM #1 – Pipe Insulation
- ECM #2 – Compressor Air Heat Recovery

The steam system serves the facility's asphalt production process. Pipe insulation measure saved energy by reducing the heat loss from the piping and joints/values, thus reducing the gas consumption. Compressor air heat recovery will save energy by reducing heat load on existing box heaters in the production area.

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 4,160 hours
- Combustion efficiency is 80.5% (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 in
- Insulation material type: Polystyrene, Type IV, C578-15b

- Process temperatures: 130°F and 160°F
- The average annual ambient air temperature is 75°F

The 3E Plus software was used to calculate heat loss (BTU/hr./ft) for bare piping (pre-retrofit) and piping with 1 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

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

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency = 80.5%

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) /Surface Area (ft^2)	Diameter (in)
1	Hot Water Supply side	Pipe	1	48	1.5
2	Hot Water Return side	Pipe	1	48	1.5

Compressor Air Heat Recovery

The following calculations were used to determine the annual therm savings associated with this measure.

Compressor Air Heat Recovery Annual Energy Savings

$$Annual\ Energy\ Savings\left(\frac{CCF}{yr}\right) = \frac{1.08\left(\frac{BTU\ min}{°F\ ft^3\ hr}\right) \times CFM \times \left(T_{CA}(°F) - T_{RA}(°F)\right) \times Heating\ Hours\left(\frac{hrs}{yr}\right)}{100{,}000\left(\frac{BTU}{CCF}\right) \times Efficiency(\%)}$$

Where:

1.08 = 0.24(BTU/(lb. °F)) × 0.075(lb./ft^3) × 60(min/hr.)

T_{CA} = Average Temperature of compressor cooling air entering production facility

T_{RA} = Production facility set point temperature (75 °F)

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

Efficiency = Assumed efficiency = 80%

Compressor Air Heat Recovery Parameters

Entry #	Description	CFM	$Temp_{CA}$ (°F)	$Temp_{RA}$ (°F)	Heating Hours (hrs.)	Efficiency (%)
1	Compressor Air Heat Recovery	5,298	120	75	2,230	80%

Measure Life

Estimated Useful Life by Measure

Measure	EUL
Pipe Insulation	20 years
Compressor Air Heat Recovery	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	Hot Water Supply side	Pipe	160	91.98	14.76	192
2	Hot Water Return side	Pipe	130	54.11	9.22	111
					Total:	**303**

Compressor Air Heat Recovery

Compressor Air Heat Recovery Annual Energy Savings

Entry #	Description	CFM	Heating Hours (hrs.)	Efficiency (%)	Therms Savings
1	Compressor Air Heat Recovery	5,298	2,230	80%	7,177
				Total:	7,177

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	303	303	100.0%	6058
Compressor Air Heat Recovery	7,177	7,177	100.0%	143,547
Total	**7,480**	**7,480**	**100.0%**	**149,605**