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May 1, 2020

Mr. Brandy Wreath
Public Utility Division
Oklahoma Corporation Commission
2101 N. Lincoln Blvd.
Oklahoma, City, OK 73105

Re: 2019 Demand Programs Annual Report

Dear Mr. Wreath:

Enclosed please find CenterPoint Energy Resources Corp. d/b/a CenterPoint Energy Oklahoma Gas' 2019 Demand Programs Annual Report, which is being provided to you pursuant to OAC § 165:45-23-7.

Please do not hesitate to contact me if you have any questions or if I can be of further assistance.

Sincerely,

/s/ Emon Mahony

Emon Mahony

Enclosure

cc: Mr. Geoffrey Rush
Ms. Kathy Champion

CenterPoint Oklahoma Demand Programs Annual Report 2019

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 2014-2016 in Order No. 616573 in Cause No. PUD 201300085. On October 26, 2016, the Commission approved an updated CIP portfolio for program years 2017-2019 in Order No. 657250 in Cause No. PUD 201600263.

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 the 2019 program year.

CenterPoint Oklahoma implemented and administered the following CIP programs in 2019:

- CenterPoint Energy Education Program (CEEP) - Program 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 providing individualized information and recommendations regarding energy usage through Home Energy Reports sent to approximately 30,385 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 efficient water heating and space heating solutions to residential and commercial customers. Inducements are offered to customers to encourage the purchase and installation of new high efficiency natural gas equipment and includes the following components:

- Water heater inducements from $50 to $250 for the purchase and installation of energy efficient natural gas water heaters. CenterPoint Oklahoma also provides a $900 inducement to customers who switch from electric resistance water heating to a more efficient natural gas water heating solution. 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. A $15 trade ally incentive is available for plumbers that install a high efficiency natural gas storage tank water heater.

- Furnace inducements range from $300 to $400 to residential and commercial customers that purchase and install energy efficient 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. CenterPoint Oklahoma also offers a $25 inducement for qualifying furnace tune-ups. HVAC contractors are eligible to receive a $50 trade ally incentive for every qualifying furnace replacement and a $5 trade ally incentive for each qualifying furnace tune-up.

- 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.

- Commercial Boiler 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.

- Commercial Food Service 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 $30 to $225 are also available for qualifying equipment.

- Multi-Unit Market Transformation Program – 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.

- Clothes Dryer Program – 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 Program – 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.

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

- Natural Gas Commercial 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 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 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.

In 2019, the CIP Portfolio produced net energy savings of 92,072 Mcf. The programs generated a net economic benefit of $231,6397 and helped 37,484 participants save money through a combination of prescriptive and custom rebates, direct-install measures, energy usage reports, and facility audits. Key insights from 2019 program delivery include:

- **Natural Gas Equipment program sees an increase in participation and savings –**To increase program participation, the Company focused on building and maintaining strong relationships with trade allies to upsell customers on high efficiency equipment. The efforts paid off as the Natural Gas Equipment program experienced a 19% increase in participation and a 9% increase in savings over the previous year.

- **Demand for fuel-switching rebates remains high –** In 2019, more than 280 participants utilized the Company's fuel-switching rebates available for natural gas space heating, water heating equipment, and multi-family programs. Also, 52 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 2019, inducements were provided for 76 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, along with an increase in the rebate from $750 to $1,000 in 2017, continue to influence builders to install efficient natural gas equipment in new homes.

- **Multi-Unit Market Transformation Program participation is lower than expected –** The multi-unit market continues to be inconsistent in the Company's service territory in 2019. Though there were more multi-family projects in 2019 as compared to 2018 (+19), the number of units fell far short of goal. The Company continues to work with multi-family developers to induce the use of natural gas in their developments.

- **Boiler projects low in the Company's service area –** There were no qualified boilers installed in the Company's service territory in 2019. Very few prescriptive space heating boiler opportunities have been available in CenterPoint's Oklahoma service territory over the years. Rooftop heating units tend to dominate commercial building heat design. This is one reason the Company decided to consolidate the boiler, food service, and Commercial and Industrial (C&I) programs for program year (PY) 2020-2022.

- **Natural Gas Commercial Solutions Program –** 2019 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, repair and replacement of

steam equipment, as well as equipment controls. This year, the program saw a higher amount of net benefits and TRC ratio. This was due to a large custom project that produced a significant amount of savings with a measure life of 20 years. The program delivered energy savings of 31,349 Mcf and was the company's most cost-effective offering.

- **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 2019, the program delivered net energy savings of 40,946 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

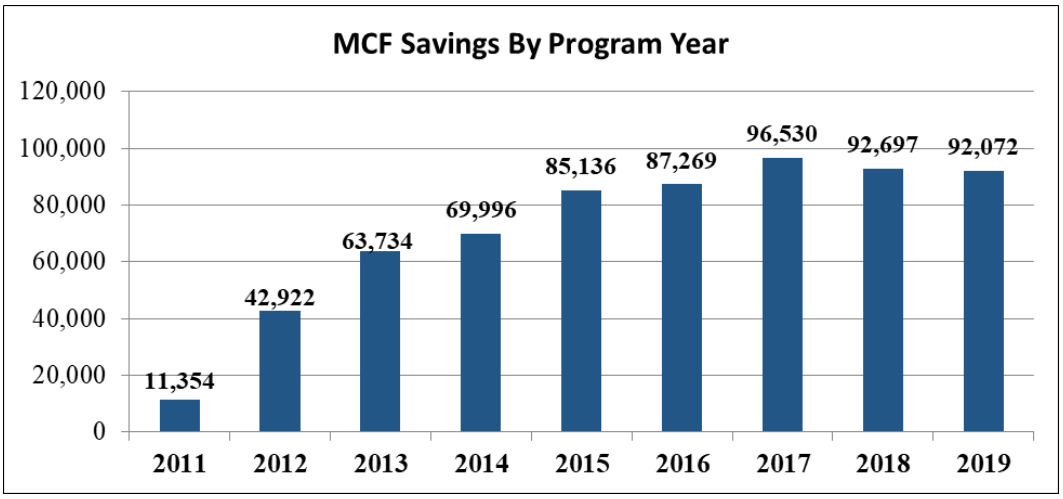
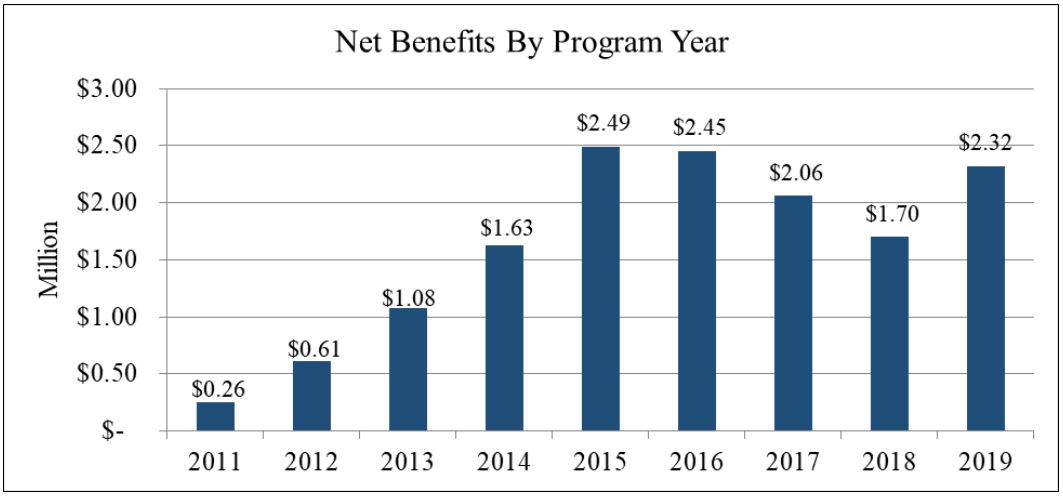


Figure 2: Net Benefits by Program Year



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 2019

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	✓			
Clothes Dryer	✓			
Cooking Range	✓			
Multi-Unit Market Transformation	✓			
Commercial Food Service Program		✓	✓	✓
Commercial Boiler Program		✓	✓	✓
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 program years 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 program years 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.

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

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

CenterPoint Oklahoma's 2019 CIP Portfolio included a total of 37,484 distinct participants. Participation counts for each program are listed in Table 2.

Table 2: Participation by Program

Program	Participants
Natural Gas Equipment Program	1223
Low Flow Showerhead/Aerator	1,495
Home Energy Report	30,385
High Efficiency Home	76
Clothes Dryer	13
Cooking Range	39
Multi-Unit Market Transformation	46
Commercial Food Service Program	11
Commercial Boiler Program	0
Natural Gas Commercial Solutions Program	4196
CenterPoint Energy Education Program	NA
Total	**37,484**

§ 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;

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 3 compares the projected savings to the gross and net savings achieved in 2019 for each program.

Table 3: Projected, Gross, and Net Energy Savings by Program

Program	2019 Projected Annual Savings (MCF)	2019 Annual Gross Savings Achieved (MCF)	2019 Annual Net Savings Achieved (MCF)
Natural Gas Equipment Program	19,509	18,330	15,136
Low Flow Showerhead/Aerator	9,534	2,431	2,435
Home Energy Report	27,900	41,342	40,946
High Efficiency Home	1,287	1,146	1,023
Clothes Dryer	345	129	104
Cooking Range	189	136	109
Multi-Unit Market Transformation	9,330	629	522
Commercial Food Service Program	4,664	581	448
Commercial Boiler Program	6,696	0	0
Natural Gas Commercial Solutions Program	24,821	31,349	31,349
CenterPoint Energy Education Program	NA	NA	NA
Total	**104,274**	**96,073**	**92,072**

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.[1] 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 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 2019, ADM Associates (ADM) conducted the Evaluation, Measurement, and Verification (EM&V) of CenterPoint Oklahoma's CIP Portfolio. ADM's review included a process evaluation

[1] http://www.apscservices.info/EEInfo/TRM v8.0.pdf.

and an impact evaluation to determine the verified and net savings attributable to the Company's 2019 program activities. The 2019 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 2019 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 2019 CIP Portfolio was $4.23 per Mcf. 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 4 and 5 provide details on the levelized cost at the program, customer sector, and portfolio levels.

Table 4: 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	7,938	$ 357,985	1.46	$ 6.82
Natural Gas Equipment - Residential	Electric to Gas Fuel Switch	3,592	$ 244,120	1.80	$ 5.50
Natural Gas Equipment - GS-1	Natural Gas	2,732	$ 123,247	1.41	$ 7.03
Natural Gas Equipment - GS-1	Electric to Gas Fuel Switch	874	$ 95,303	3.42	$ 2.90
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		**15,136**	**$ 820,655**	**1.58**	**$ 6.30**
Commercial Food Service - GS-1	Natural Gas	448	$ (32,445)	0.53	$ 15.16
Commercial Food Service - CS-1	Natural Gas	0	$ -	NA	NA
Commercial Food Service - Total		**448**	**$ (32,445)**	**0.53**	**$ 15.16**
Commercial Boiler - GS-1	Natural Gas	0	$ (59,846)	0.00	NA
Commercial Boiler - CS-1	Natural Gas	0	$ -	NA	NA
Commercial Boiler - Total		**0**	**$ (59,846)**	**0.00**	**NA**
Natural Gas Commercial Solutions - GS-1	Natural Gas	10,406	$ 1,334,550	20.56	$ 0.46
Natural Gas Commercial Solutions - CS-1	Natural Gas	20,942	$ 1,568,488	2.33	$ 4.02
Natural Gas Commercial Solutions - LCS-1	Natural Gas	0	$ -	NA	NA
Natural Gas Commercial Solutions - Total		**31,349**	**$ 2,903,038**	**3.32**	**$ 2.82**
Low Flow Showerhead/Aerator	**Natural Gas**	**2,435**	**$ 97,172**	**2.47**	**$ 3.11**
Residential Home Energy Reports	**Natural Gas**	**40,946**	**$ 38,178**	**1.19**	**$ 5.14**
High Efficiency Homes	**Natural Gas**	**1,023**	**$ 26,432**	**1.20**	**$ 8.27**
Clothes Dryer	**Electric to Gas Fuel Switch**	**104**	**$ 276**	**1.03**	**$ 8.52**
Cooking Range	**Electric to Gas Fuel Switch**	**109**	**$ 2,064**	**1.21**	**$ 7.20**
Multi-Unit Market Transformation	**Electric to Gas Fuel Switch**	**522**	**$ (10,999)**	**0.88**	**$ 11.29**
CenterPoint Energy Education Program - Res	Educational Program	0	$ (40,374)	0.00	NA
CenterPoint Energy Education Program - GS-1	Educational Program	0	$ (10,662)	0.00	NA
CenterPoint Energy Education Program - CS-1	Educational Program	0	$ (7,644)	0.00	NA
CenterPoint Energy Education Program - LCS	Educational Program	0	$ -	NA	NA
CenterPoint Energy Education Program	**Educational Program**	0	$ (58,680)	0.00	NA
Total Portfolio		**92,072**	**$ 3,725,846**	**2.10**	**$ 4.09**

Table 5: Levelized Cost by Customer Sector

Total Resource Cost Test and TRC Levelized Cost By Customer Sector	Net Energy Savings	Total Resource Cost Test (TRC)		
	Annual Net Energy Savings	Total Net Benefits	TRC	TRC Levelized Cost
Customer Sector	MCF	$	Ratio	($/MCF)
Residential	56,669	$ 714,854	1.44	$ 5.65
Commercial GS-1	14,461	$ 1,450,148	3.66	$ 2.60
Commercial CS-1	20,942	$ 1,560,844	2.31	$ 4.04
Commercial LCS	0	$ -	NA	NA
Total Portfolio	**92,072**	**$ 3,725,846**	**2.10**	**$ 4.09**

§ 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[2] to estimate the impact of reduced emissions attributable to the 92,072 in Mcf savings delivered through the 2019 CIP Portfolio. Overall, the Company's programs reduced carbon dioxide (CO_2) emissions by 5,052 metric tons. This is equivalent to:

Greenhouse gas emissions from:

- 1,091 passenger vehicles driven for one year; or
- 12,535,500 miles driven by an average passenger vehicle.

Carbon dioxide emissions from:

- Annual energy use of 583 homes;
- 5,566,398 pounds of coal burned; or
- 568,449 gallons of gasoline consumed.

Reduced Water Consumption

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 each

[2] https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator.

low-flow equipment type, an estimated annual reduction in gallons of water use was calculated. The results of those calculations are provided in Table 6.

Table 6: 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	1,189	410,234	395,055
Kitchen Aerator	948	225,300	216,964
Showerhead	2,564	5,150,753	4,960,175
Total	4,701	5,786,286	5,572,194

§ 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 7 displays the 2019 CIP Portfolio budget as a percentage of CenterPoint Oklahoma's 2019 revenue.

Table 7: Demand Portfolio Funding as a Percent of Total Annual Gas Revenue

2019 Portfolio Budget	2019 Revenue	Demand Portfolio Funding % Total Revenue
$2,832,492	87,446,465	3.24%

§ 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 8 displays the 2019 CIP Portfolio net energy savings as a percentage of CenterPoint Oklahoma's 2019 natural gas throughput.

Table 8: Demand Portfolio Savings as a Percent of Total 2019 Natural Gas Usage

2019 Net Energy Savings (MCF)	2019 Natural Gas Usage (MCF)	Energy Savings % Annual Gas Usage
92,072	16,452,439	0.56%

§ 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 9 provides the 2019 budgets for each program by cost category.

Table 9: 2019 Program Budgets by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$27,000	$714,575	$140,134	$148,000	$33,375	$1,063,084
Low Flow Showerhead and Faucet Aerator	$4,812	$26,184	$22,682	$55,148	$3,832	$112,658
Residential Home Energy Reports	$1,305	$0	$0	$182,100	$1,200	$184,605
High Efficiency Homes Program	$4,812	$57,750	$6,582	$20,392	$2,389	$91,925
Clothes Dryer	$1,604	$25,000	$7,666	$12,230	$1,285	$47,785
Cooking Range	$1,604	$18,750	$5,480	$10,230	$1,147	$37,211
Multi-Unit Market Transformation	$5,587	$495,800	$7,673	$20,936	$18,647	$548,642
Commercial Food Service	$10,425	$52,855	$25,875	$51,953	$4,853	$145,961
Commercial Boiler	$8,019	$56,500	$25,875	$50,501	$4,636	$145,531
Natural Gas Commercial Solutions	$4,812	$224,313	$0	$142,514	$12,721	$384,360
CenterPoint Energy Education Program	$0	$0	$70,730	$0	$0	$70,730
Total Program Costs	**$69,978**	**$1,671,727**	**$312,697**	**$694,006**	**$84,084**	**$2,832,492**

§ 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 10 provides the actual 2019 expenditures for each program by cost category.

Table 10: 2019 Program Spending by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$17,403	$748,730	$29,245	$98,220	$54,621	$948,218
Low Flow Showerhead and Faucet Aerator	$3,101	$12,320	$15,067	$41,428	$6,560	$78,476
Residential Home Energy Reports	$841	$0	$0	$182,771	$21,769	$205,380
High Efficiency Homes Program	$3,101	$78,650	$1,465	$13,144	$4,336	$100,696
Clothes Dryer	$1,034	$6,600	$931	$8,134	$783	$17,481
Cooking Range	$1,034	$11,700	$915	$6,895	$818	$21,362
Multi-Unit Market Transformation	$3,601	$82,350	$67	$13,745	$18,721	$118,485
Commercial Food Service	$5,169	$8,150	$12,382	$33,249	$2,881	$61,831
Commercial Boiler	$6,719	$0	$12,713	$36,118	$4,296	$59,846
Natural Gas Commercial Solutions	$3,101	$219,302	$0	$166,880	$52,693	$441,976
CenterPoint Energy Education Program	$0	$0	$58,680	$0	$0	$58,680
Total Program Costs	**$45,104**	**$1,167,802**	**$131,464**	**$600,583**	**$167,478**	**$2,112,430**

§ 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 $306,800 based on the results of its 2019 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 2019, the Company is eligible for an incentive because CenterPoint Oklahoma's CIP portfolio goal ratio was 88% and it achieved a cost/benefit ratio of 2.10.

Table 11 provides the calculation for the requested 2019 CIP Portfolio incentive.

Table 11 Incentive Calculation

Line No.	Incentive Calculation Input	
1	Projected Energy Savings (MCF)	104,274
2	Actual Portfolio Energy Savings (MCF)	92,072
3	Program Expenditure	$2,112,430
4	TRC Ratio	2.10
5	Portfolio Net Benefits	$2,316,397
6	Maximum Incentive, Percentage Net Benefits	15%
7	Goal Ratio (Line 2/Line 1)	88%
8	Maximum Eligible Incentive $ (Line 5 X Line 6 X Line 7)	$306,800
9	Incentive Cap Percentage Portfolio Expenditure	13%
10	Incentive Cap (Line 3 X Line 9)	$316,864
11	2019 Incentive	$306,800[3]

§ 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 12.

[3] Line 11 is based on the final, verified savings and TRC benefits. In the Company's March 15 PBRC filing, the Company requested an incentive of $300,972. The Company's PBRC request was based on an earlier savings estimate that has been subsequently updated.

Table 12: Metered Sales Volumes (CCF) per Customer Class

Customer Class	2017	2018	2019	Average Rate of Change Per Year
Residential	41,224,824	53,639,082	54,106,960	14.56%
Commercial GS-1	12,892,967	13,715,340	11,860,902	-4.09%
Commercial CS-1	19,799,411	17,254,304	19,685,831	-0.29%
TSO	19,799,411	50,120,091	51,583,016	61.41%

§ 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.

2017 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 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.

Participation in the Multi-Unit Market Transformation program was lower than projected in 2019, as the number of completed multi-family developments in the Company's service territory has curtailed. These projects often have a lengthy planning and construction cycle, making it difficult to predict the number of units that will be completed in a given year. CenterPoint Oklahoma

continues to engage with developers early in the planning process to influence the design of units that are equipped with efficiency space heating and water heating equipment.

In 2019, the Company continued its efforts to strengthen the Commercial Boiler Program by tracking and pursuing projects in its service territory and leveraging relationships with trade allies to influence the installation of highly efficient natural gas boiler equipment. The only projects identified in 2019 were process boilers loads that did not qualify for the prescriptive space heating boiler program.

The Company continued to promote its Dryer and Cooking Range Programs to customers and retailers. CenterPoint Oklahoma will continue efforts to influence appliance retailers to stock natural gas dryers eligible for the Company's Rebates.

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 2018) and the projects completed by these customers achieved 31,349 Mcf 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 13 provides the actual 2019 program expenditures by Demand Program and cost category.

Table 13: 2019 Program Spending by Category

Program	Admin.	Inducements	Education/ Advertising	Delivery	Evaluation	Total Program
Gas Equipment Program	$17,403	$748,730	$29,245	$98,220	$54,621	$948,218
Low Flow Showerhead and Faucet Aerator	$3,101	$12,320	$15,067	$41,428	$6,560	$78,476
Residential Home Energy Reports	$841	$0	$0	$182,771	$21,769	$205,380
High Efficiency Homes Program	$3,101	$78,650	$1,465	$13,144	$4,336	$100,696
Clothes Dryer	$1,034	$6,600	$931	$8,134	$783	$17,481
Cooking Range	$1,034	$11,700	$915	$6,895	$818	$21,362
Multi-Unit Market Transformation	$3,601	$82,350	$67	$13,745	$18,721	$118,485
Commercial Food Service	$5,169	$8,150	$12,382	$33,249	$2,881	$61,831
Commercial Boiler	$6,719	$0	$12,713	$36,118	$4,296	$59,846
Natural Gas Commercial Solutions	$3,101	$219,302	$0	$166,880	$52,693	$441,976
CenterPoint Energy Education Program	$0	$0	$58,680	$0	$0	$58,680
Total Program Costs	**$45,104**	**$1,167,802**	**$131,464**	**$600,583**	**$167,478**	**$2,112,430**

§ 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 2019 CIP Portfolio expenses were $2,112,430, which is 75% of the approved budget of $2,832,492.

Program	Comments
Natural Gas Equipment Program	The program reached 89% of the planned budget with expenses at $948,218. Strong participation in the Natural Gas Equipment Program resulted in inducement expenditure meeting expectations, but expenditures for marketing, delivery, and administration came in under budget.
Low Flow Showerhead/Aerator	The program expenses reached 70% of the planned budget. The program was heavily marketed but did not have the type of participation anticipated.
Clothes Dryer and Cooking Range	The Clothes Dryer and Cooking Range programs reached only 37% and 57%, respectively. The stocking of these appliances in local stores continues to be an issue. We are continuing to work with stores and are exploring new avenues to promote increased participation in these programs.
Multi-Unit Market Transformation	The most significant factor in total CIP Portfolio expenditures being less than expected was a $430,157 underspend in the Multi-Unit Market Transformation Program budget. The number of multi-family development projects completed in 2019 was again much lower than anticipated, and program expenditures reached just 22% of budget.
Commercial Food Service Program	Participation in the program continues to be low due to the rural areas the Company serves. There were a few chain restaurants that participated, however, the number of restaurants opening or replacing equipment continues to lag. This contributed to the program expenses only reaching 42%
Commercial Boiler Program	The program did not have participation in 2019 as boiler installation and replacement opportunities were very low. The market continues to choose alternative equipment like rooftop units or banks of tankless water heaters to replace boilers. Of the very few boilers that were being installed, none qualified for an inducement due to not meeting minimum efficiency standards.
CenterPoint Energy Education Program	The program reached 80% of the planned budget. Educating customers 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	$1,063,084	$948,218	89%
Low Flow Showerhead and Faucet Aerator	$112,658	$78,476	70%
Residential Home Energy Reports	$184,605	$205,380	111%
High Efficiency Homes Program	$91,925	$100,696	110%
Clothes Dryer	$47,785	$17,481	37%
Cooking Range	$37,211	$21,362	57%
Multi-Unit Market Transformation	$548,642	$118,485	22%
Commercial Food Service	$145,961	$61,831	42%
Commercial Boiler	$145,531	$59,846	41%
Natural Gas Commercial Solutions	$384,360	$441,976	115%
CenterPoint Energy Education Program	$70,730	$58,680	83%
Total Program Costs	**$2,832,492**	**$2,112,430**	**75%**

§ 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 2019 expenditures, participation, energy savings, overall program scale, as well as recent or proposed changes is provided below for each program:

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 continued to implement the CEEP in its 2019 CIP Portfolio and does not propose any major changes to the program at this time.

Program Expenditures

Customer Class	Admin	Inducements	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	-	-	$40,374	-	-	$40,374	1.91%
GS-1	-	-	$10,662	-	-	$10,662	0.50%
CS-1	-	-	$7,644	-	-	$7,644	0.36%
LCS	-	-	$0	-	-	$0	0.0%
Total	-	-	$58,680	-	-	$58,680	2.78%

Home Energy Reports Program

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	30,385	40,946	44.80%	40,946	44.47%

Program Expenditures							
Customer Class	**Admin**	**Inducement**	**Education/ Marketing**	**Delivery**	**EM&V**	**Total Program**	**% Total Portfolio**
Residential	$841	$0	$0	$182,771	$21,769	$205,380	9.72%

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, and smart thermostats.

Beginning in 2017, CenterPoint Oklahoma combined the previously administered Space Heating and Water Heating Programs into a single offering and made several program modifications (including the addition of rebates for smart thermostat rebates and large, condensing tank water heaters).

The Company does not propose any 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	1,001	14,287	14.93%	11,531	12.52%
GS-1	222	4,043	4.23%	3,606	3.92%
CS-1	0	0	0.00%	0	0.00%
Total	1,223	18,330	19.16%	15,136	16.44%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	14,222	611,869	23,899	80,266	44,637	$774,893	36.68%
GS-1	3,181	136,860	5,346	17,954	9,984	$173,325	8.21%
CS-1	0	0	0	0	0	$0	0.00%
Total	$17,403	$748,730	$29,245	$98,220	$54,621	$948,218	44.89%

Low Flow Showerhead and Faucet Aerator 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	1,495	2,431	2.54%	2,435	2.64%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$3,101	$12,320	$15,067	$41,428	$6,560	$78,476	3.71%

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	76	1,146	1.20%	1,023	1.11%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$3,101	$78,650	$1,465	$13,144	$4,336	$100,696	4.77%

Clothes Dryer Program

The CenterPoint Oklahoma Clothes Dryer Program is designed to promote efficient clothes drying solutions to residential consumers. Consumers are offered inducements for the purchase and installation of new natural gas clothes dryers.

The Company has no immediate changes planned for this program.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	13	129	0.14%	104	0.11%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$1,034	$6,600	$931	$8,134	$783	$17,481	0.83%

Cooking Range Program

The Cooking Range Program provides inducements to CenterPoint Oklahoma consumers for the installation of natural gas cooking ranges. The goal of the program is to assist consumers in lowering their overall energy use by switching from electric cooking ranges to more efficient natural gas models.

The Company has no immediate changes planned for this program.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
Residential	39	39	136	0.14%	109

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$1,034	$11,700	$915	$6,895	$818	$21,362	1.01%

Multi-Unit Market Transformation Program

The Multi-Unit Market Transformation Program is designed to promote efficient water heating and heating solutions to multi-family developers. Inducements are offered to developers for the purchase and installation of new, natural gas water and space heating systems at newly constructed multi-unit buildings and existing multi-unit buildings that convert from electric to natural gas equipment.

The Company does not propose any major changes in 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	46	629	0.66%	522	0.57%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
Residential	$3,601	$82,350	$67	$13,745	$18,721	$118,485	5.61%

Commercial Food Service Program

The Commercial Food Service Program provides inducements to food service operators to encourage the purchase and installation of new high-efficient natural gas food service equipment. In 2017, CenterPoint Oklahoma expanded the suite of equipment that is eligible for inducements and adjusted the inducement and trade ally incentives offered for several types of high-efficiency food service equipment.

CLEAResult will be administering the prescriptive Food Service Program in 2020.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
GS-1	11	581	0.61%	448	0.49%
CS-1	0	0	0.00%	0	0.00%
Total	11	581	0.61%	448	0.49%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
GS-1	$5,169	$8,150	$12,382	$33,249	$2,881	$61,831	2.93%
CS-1	$0	$0	$0	$0	$0	$0	0.00%
Total	$5,169	$8,150	$12,382	$33,249	$2,881	$61,831	2.93%

Commercial Boiler Program

The Commercial Boiler Program is designed to promote high efficiency space heating solutions to commercial customers. Inducements are offered for the purchase and installation of new high efficiency natural gas boiler equipment.

CLEAResult will be administering the prescriptive space heating boiler program in 2020.

Participation & Energy Savings

Customer Class	Participation	Gross Energy Savings (MCF)	% Portfolio Gross Savings	Net Energy Savings (MCF)	% Portfolio Net Savings
GS-1	0	0	0%	0	0%
CS-1	0	0	0%	0	0%
Total	0	0	0%	0	0%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
GS-1	$6,719	$0	$12,713	$36,118	$4,296	$59,846	2.83%
CS-1	$0	$0	$0	$0	$0	$0	0.00%
Total	$6,719	$0	$12,713	$36,118	$4,296	$59,846	2.83%

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	19	10,406	10.88%	10,406	11.30%
CS-1	7	20,942	21.89%	20,942	22.75%
LCS - TSO	5	0	0.00%	0	0.00%
Total	31	31,349	32.77%	31,349	34.05%

Program Expenditures

Customer Class	Admin	Inducement	Education/ Marketing	Delivery	EM&V	Total Program	% Total Portfolio
GS-1	$950	$67,180	$0	$51,121	$16,142	$135,393	6.41%
CS-1	$2,151	$152,122	$0	$115,759	$36,551	$306,583	14.51%
LCS-TSO	$0	$0	$0	$0	$0	$0	0.00%
Total	$3,101	$219,302	$0	$166,880	$52,693	$441,976	20.92%

§ 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 the 2019 program year.

§ 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, Commercial Boiler, Commercial Food Service, Low Flow Showerhead and Faucet Aerator, Space Heating Systems and Water Heating.

The contact information is:

Name of Program Implementer: Jose Laboy

Job Title: CIP Implementation Manager

Business Postal Address: 401 W. Capitol Ave., Suite 102, Little Rock, AR 72201

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: Joaquin Obieta

Job Title: Service Delivery Manager

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

Business Email Address: joaquin.obieta@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 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

In the third year of CenterPoint Oklahoma's 2017-2019 Triennial Plan, the Company's CIP Portfolio experienced a slight decline in natural gas energy savings but still delivered a comprehensive suite of programs to residential and commercial customers. Specifically, the 2019 net energy savings total of 92,072 Mcf represented a 0.67% decrease in savings when compared to 2018. This is due to a market that continues to be stagnant and rural. As CenterPoint Oklahoma strives to grow its programs, insights from 2019 helps 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 CIP Portfolio.

Appendix A – EM&V Report

Evaluation of 2019 DSM Portfolio

Submitted to:

CenterPoint Energy Oklahoma

April 2020

Final

ADM Associates, Inc.

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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 2019 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 2019 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 2019, the CenterPoint DSM portfolio contained the following programs:

- Natural Gas Equipment Rebates Program;
- Multi-Unit Market Transformation Program;
- High Efficiency Homes Program;
- Commercial Boiler Program;
- Commercial and Industrial Solutions Program;
- Commercial Food Service Program;
- Home Energy Reports Program;
- Low Flow Showerhead & Faucet Aerator Program;
- Cooking Range Program; and
- Clothes Dryer Program.

1.2 Evaluation Objectives

The goals of the 2019 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

Table 1-1 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	
Residential Equipment Rebates	143,343	142,876	2,325,771	2,318,194	99.7%
Commercial Equipment Rebate	36,586	37,585	724,225	744,000	102.7%
Multi-Unit Market Transformation	6,293	6,289	125,858	125,778	99.9%
High Efficiency Homes	11,473	11,460	229,462	229,202	99.9%
Commercial Boiler	0	0	0	0	N/A
Commercial Solutions	315,500	313,489	4,266,129	4,238,937	99.4%
Commercial Food Service	4,570	5,808	54,840	69,696	127.1%
Home Energy Reports	412,927	409,456	412,927	409,456	99.2%
Low Flow Showerhead & Faucet Aerator	24,311	24,311	243,107	243,107	100.0%
Cooking Range	1,360	1,360	20,399	20,399	100.0%
Clothes Dryer	839	1,294	13,423	20,703	154.2%
Total	**957,202**	**953,928**	**8,416,141**	**8,419,472**	**99.7%**

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		
Residential Equipment Rebates	125,927	115,306	2,002,516	1,833,619	81%	91.6%
Commercial Equipment Rebate	35,099	36,058	693,512	712,461	96%	102.7%
Multi-Unit Market Transformation	5,075	5,223	87,239	89,955	83%	102.9%
High Efficiency Homes	10,284	10,235	205,674	204,694	89%	99.5%
Commercial Boiler	0	0	0	0	N/A	N/A
Commercial Solutions	315,499	313,489	4,266,116	4,238,937	100%	99.4%
Commercial Food Service	3,528	4,484	42,334	53,805	77%	127.1%
Home Energy Reports	412,927	409,456	412,927	409,456	100%	99.2%
Low Flow Showerhead & Faucet Aerator	24,352	24,352	243,518	243,518	100%	100.0%
Cooking Range	1,088	1,088	16,319	16,319	80%	100.0%
Clothes Dryer	671	1,035	10,738	16,563	80%	154.2%
Total	**934,450**	**920,726**	**7,980,894**	**7,819,327**	**97%**	**98.5%**

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

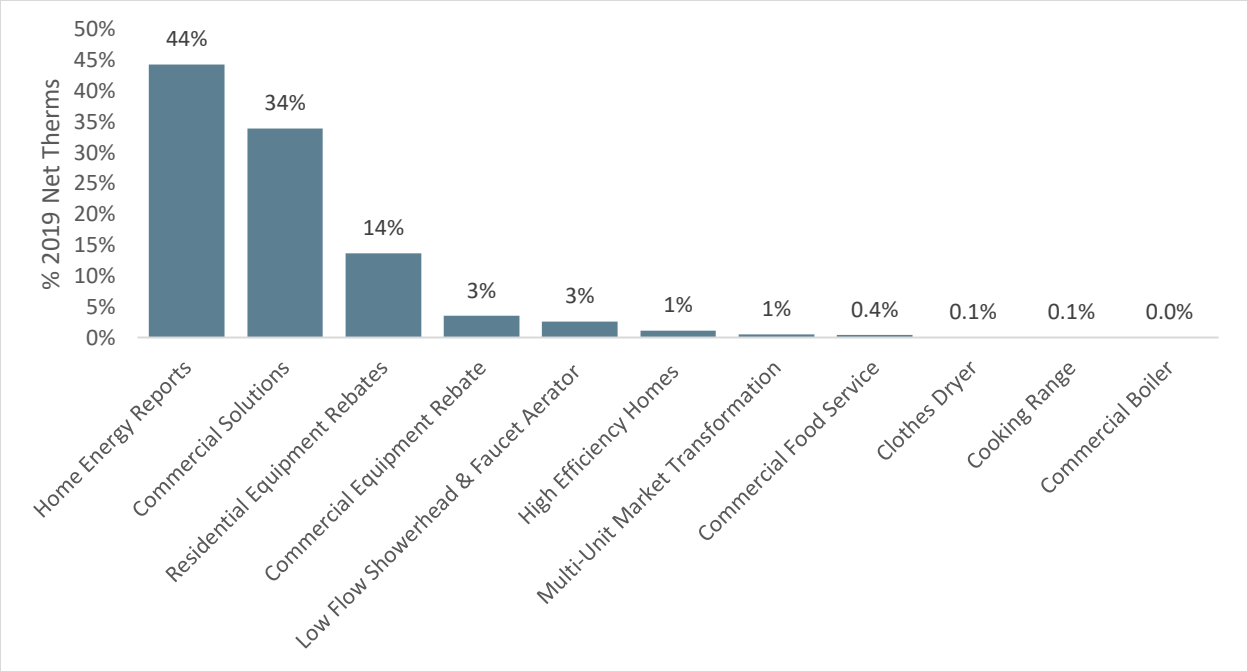

Figure 1-1 Contribution to Portfolio Net Savings by Program

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

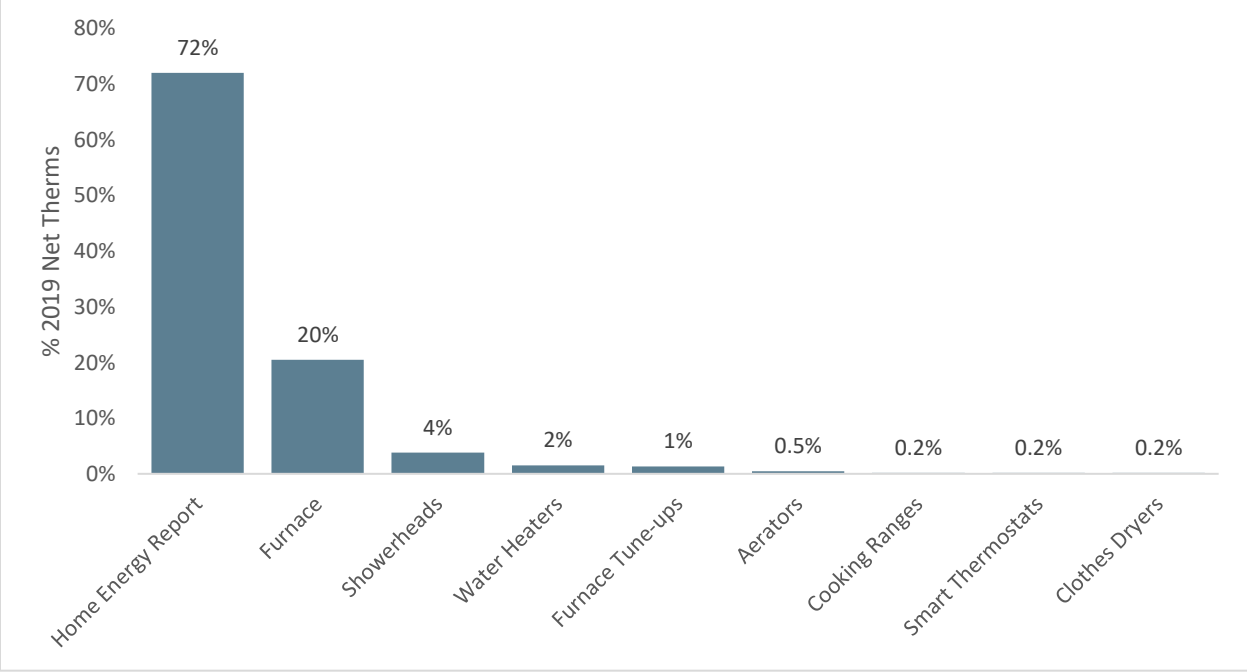

Figure 1-2 Residential Portfolio Savings Share by Measure

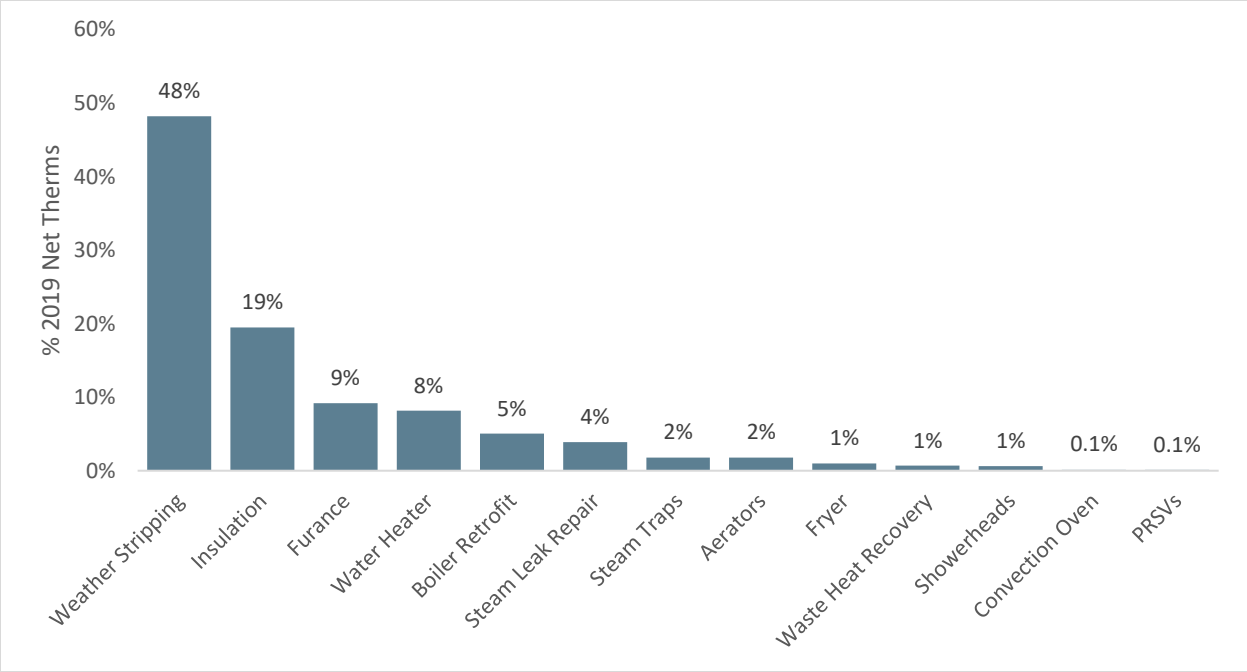

Figure 1-3 C&I Portfolio Savings Share by Measure

1.4 Summary of EM&V Effort

The CenterPoint portfolio is in a period of transition at the end of this three-year program cycle, and on this basis evaluation activities were limited. 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 Portfolio Recommendations

Considering the performance of the programs in CNP's 2017-2019 portfolio, the Evaluators have recommendations pertaining to portfolio reorganization. Some of these may be in progress by CNP.

1.5.1 Residential Programs

The residential portfolio is currently comprised of:

- Equipment Rebates;
- Home Energy Reports;
- Multifamily Market Transformation;
- High Efficiency Homes;
- Low Flow Showerhead & Faucet Aerator;
- Cooking Range; and
- Clothes Dryers.

Many of these programs target similar end-uses (HVAC, DHW) and could be administered in a more cost-efficient manner with reasonable aggregation. Portfolio organization can have one of multiple logical bases: end-use, target market, or replacement disposition (gas-to-gas versus fuel switch). They are presented in Table 1-3 through Table 1-5. In some instances, a current program is presented more than once as the recommended reorganization entails splitting part of a current program into more than one destination program.

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

Table 1-3 Residential Portfolio Reorganization – End-use Based

Current Program	*Recommended Reorganization*
Residential Equipment Rebates	Equipment Rebates
Multi-Unit Market Transformation	
High Efficiency Homes	
Home Energy Reports	Home Energy Reports
Low Flow Showerhead & Faucet Aerator	Low Flow Showerhead & Faucet Aerator
Cooking Range	Appliance Rebates
Clothes Dryer	

Table 1-4 Residential Portfolio Reorganization – Market-based

Current Program	*Recommended Reorganization*
Residential Equipment Rebates	Single-family Retrofit
Cooking Range	
Clothes Dryer	
Multi-Unit Market Transformation	Multifamily Efficiency
Cooking Range	
Clothes Dryer	
High Efficiency Homes	Residential New Construction
Multi-Unit Market Transformation	
Home Energy Reports	Home Energy Reports
Low Flow Showerhead & Faucet Aerator	Low Flow Showerhead & Faucet Aerator

Table 1-5 Residential Portfolio Reorganization – Replacement Disposition

Current Program	*Recommended Reorganization*
Residential Equipment Rebates	Residential Retrofit
Multi-Unit Market Transformation	Residential New Construction
High Efficiency Homes	
Residential Equipment Rebates	Residential Fuel Switch
Cooking Range	
Clothes Dryer	
Home Energy Reports	Home Energy Reports
Low Flow Showerhead & Faucet Aerator	Low Flow Showerhead & Faucet Aerator

Table 1-6 through Table 1-8 present proposed reorganization schemes for the non-residential portfolio. Commercial portfolios are typically organized by market segment (small versus large commercial), end-use (space heating, water heating, food service, etc.) or rebate type (prescriptive versus custom).

Table 1-6 Non-residential Portfolio Reorganization – Rebate-Type

Current Program	*Recommended Reorganization*
C&I Solutions	C&I Solutions
Commercial Food Service	Commercial Prescriptive Rebates
Commercial Boiler	
Commercial Equipment Rebates	

Table 1-7 Non-residential Portfolio Reorganization – Market-based

Current Program	*Recommended Reorganization*
C&I Solutions – Direct Install	Small Business Efficiency
Commercial Food Service	
Commercial Boiler	
Commercial Equipment Rebates	
C&I Solutions - Custom	Large Commercial & Industrial Efficiency
Commercial Boiler	
Commercial Food Service	

Table 1-8 Non-residential Portfolio Reorganization – Replacement Disposition

Current Program	*Recommended Reorganization*
C&I Solutions	C&I Solutions
Commercial Food Service	Commercial Prescriptive Rebates
Commercial Boiler	
Commercial Equipment Rebates	
Commercial Equipment Rebates	Commercial Fuel Switch

This portfolio reorganization would streamline operations and reduce administrative costs, while increasing flexibility across measure groups (for example, allowing unused funds from Commercial Boilers to be used on food service, furnace, of water heater projects).

1.6 Report Organization

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

- Chapter 2 provides General Methodology;
- Chapter 3 provides results for the Residential Natural Gas Equipment Rebates Program;
- Chapter 4 provides results for the Commercial Natural Gas Equipment Rebates Program;
- Chapter 5 provides results for the Multi-Unit Market Transformation Program;
- Chapter 6 provides results for the High Efficiency Homes Program;
- Chapter 7 provides results for the Commercial Boiler Program;

- Chapter 8 provides results for the Commercial Solutions Program;
- Chapter 9 provides results for the Commercial Food Service Program;
- Chapter 10 provides results for the Home Energy Reports Program;
- Chapter 11 provides results for the Low Flow Showerhead and Faucet Aerator Program;
- Chapter 12 provides results for the Cooking Range Program;
- Chapter 13 provides results for the Clothes Dryer Program; and
- Appendix A provides the site-level custom reports for the Commercial Solutions Program.

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* – Forecasted savings used for program and portfolio planning purposes (from the Latin for "beforehand")
- *Ex Post* – Savings estimates reported by an evaluator after the energy impact evaluation has been completed (From the Latin for "From something done afterward")
- *Deemed Savings* – An estimate of 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 2019 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 2019 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. As per evaluation requirements set forth by the Independent Evaluation Monitor (IEM), samples are drawn in order to ensure 90% confidence at the +/- 10% precision level. Programs are evaluated on one of three bases:

- Census of all participants
- Simple Random Sample

- Stratified Random Sample

2.4 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. Residential 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:

- $300 for Gas furnaces with 90%-94.9% AFUE;
- $400 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; and
- $50 for ENERGY STAR qualified smart thermostats.
- $50 for storage tank water heaters with rated at less than 75,000 BTU with an EF of 0.70 or greater;
- $200 per 100,000 input BTU for larger storage tank water heaters with 88% or greater thermal efficiency;
- $250 for tankless water heaters with an EF of 0.80 or greater.
- $900 for replacement of electric water heater with natural gas tank water heaters with rated at less than 75,000 BTU with an EF of 0.70 or greater;
- $900 for replacement of electric water heater with natural gas tankless water heaters with an EF of 0.80 or greater.

The program is targeted at the residential market sector and offers incentives for both retrofit and new construction applications. The space heating equipment utilizes an 80% baseline AFUE, while the water heating equipment utilizes the same baseline Energy Factors as determined through equipment capacity. 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 Residential Natural Gas Equipment Rebates Program is part of a reorganization of the CenterPoint portfolio to have programs assigned by market sector rather than technology. The residential components of the Space Heating and Water Heating Equipment Rebates Programs were separated out to form this program.

3.1.1 Participation Summary

3.1.1.1 Space Heating Participant Summary

The 2019 Residential Equipment Rebates Program had a total of 1,103 processed rebates for space heating. The rebates comprised of:

- 272 single family furnace replacement rebates;
- 205 furnace fuel switch rebates;
- 120 new construction furnace rebates;
- 173 multifamily furnace rebates;
- 14 smart thermostats rebates; and
- 254 furnace tune-ups rebates.

Of the 729 furnace replacements included:

- 564 furnaces exceeding 95% AFUE; and
- 165 furnaces between 90-94.99% AFUE.

There were 120 residential new construction space heating rebates in the Residential Equipment Rebate program. All rebates were rebated under the High Efficiency Heating System Rebate project type.

3.1.1.2 Water Heating Participant Summary

The 2019 Residential Equipment Rebates Program had a total of 106 processed rebates for water heating. The rebates comprised of:

- 70 single family water heater replacement rebates;
- 29 water heater fuel switch rebates;
- 36 new construction water heater rebates; and
- 1 multifamily water heater rebates

Of the 69 water heater replacements included:

- 7 storage tank water heaters; and
- 62 tankless water heaters.

There were 29 residential water heater fuel switch rebates and 70 single family (residential) water heater retrofit rebates that were awarded through the Water Heater Fuel Switch and Water Heater Rebate project types, respectively.

3.2 Residential Space Heating 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:

$\left(\frac{\text{therms}}{\text{site area}}{\text{yr}}\right)$ *= 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: 87.7%
- Residential Retrofit – Multifamily: 89.6%
- Residential New Construction (builder production homes): 91.0%
- Residential New Construction (custom homes): 64.4%
- Residential Fuel Switch: 70.1%
- New Construction – Multifamily: 89.6%
- Furnace Tune-up: 80.0%
- Smart Thermostats: 83.7%

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

3.2.2 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.

$$therm_{baseline\ water\ heater} = \rho \times C_p \times V \times (T_{SetPoint} - T_{Supply}) \times \frac{1}{EF_{pre\ electric}} \times \left(\frac{1}{100{,}000}\right) \times 3.14$$

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

3.2.2.1 Net-to-Gross Ratio

The Evaluators used 2018 survey results in developing the Net-to-Gross Ratios for the CenterPoint Water Heating Program.

- Residential Retrofit: 71.4%
- Residential New Construction (builder production homes): 91.7%
- Residential New Construction (custom homes): 64.4%
- Residential Fuel Switch: 71.4%
- Multifamily: 71.4%

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

3.2.3 Verified Savings

Table 3-2 summarizes the gross savings results for space heating measures. Table 3-3 summarizes the gross savings results for water heating measures.

Table 3-2 Heating System Rebates Verified Therms Savings

Measure Category	Expected Therms Savings	Verified Therms Savings	Realization Rate	EUL	Lifetime Therms Savings
Single-family Retrofit	62,860	63,426	100.00%	14.3	902,874
Single-family NC by Owner	1,570	1,675	100.00%	20	31,396
Single-family NC by Builder	504	588	100.00%	20	10,075
Multifamily	14,298	13,436	100.00%	14.3	268,722
Fuel Switch	44,870	45,024	99.90%	20	897,403
Furnace Tune-up	9,906	9,393	94.80%	20	28,178
Total Gross	**134,008**	**133,541**	**99.60%**	**16.4**	**2,138,648**

Table 3-3 Water Heating Verified Therms Savings

Measure Category	Expected Therms Savings	Verified Therms Savings	Realization Rate	EUL	Lifetime Therms Savings
Single-family Retrofit	2,021	2,021	100.00%	19.5	40,412
Single-family NC by Builder	1,683	1,683	100.00%	19.6	33,668
Single-family NC by Owner	301	301	100.00%	19.8	6,020
Multifamily New Construction	60	60	100.00%	20	1,208
Fuel switch	5,270	5,270	100.00%	18.1	98,238
Total Gross Savings	**9,335**	**9,335**	**100.00%**	**19.4**	**179,546**

Net savings are summarized in Table 3-4 through Table 3-6.

Table 3-4 Heating System Rebates Net Savings Summary

Measure Category	NTGR		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Single-family Retrofit	87.7%	87.7%	55,104	55,593	99.90%	791,371
Single-family NC by Owner	64.4%	64.4%	614	1,079	100.00%	20,219
Single-family NC by Builder	90.9%	90.9%	398	534	100.00%	9,168
Multifamily Retrofit	87.9%	89.6%	13,259	12,039	102.00%	226,627
Fuel Switch	87.7%	70.7%	40,745	31,562	80.50%	629,083
Furnace Tune-up	80.0%	80.0%	7,925	7,514	94.80%	22,542
Overall:	**87.0%**	**81.4%**	**118,045**	**108,321**	**93.20%**	**1,699,010**

Table 3-5 Water Heating Equipment Rebates Net Savings Summary

Measure Category	NTGR		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
	Ex Ante	Ex Post	Ex Ante	Ex Post		
Single-family Retrofit	85.0%	71.4%	1,718	1,443	84.30%	28,854
Single-family NC by Builder	91.7%	91.7%	1,544	1,544	100.00%	3,877
Single-family NC by Owner	51.3%	64.4%	154	194	125.50%	30,873
Multifamily New Construction	92.3%	71.9%	55	43	77.90%	862
Fuel Switch	83.7%	71.4%	4,411	3,763	85.30%	70,142
Overall:	**84.4%**	**74.8%**	**7,882**	**6,986**	88.70%	**134,609**

Table 3-6 Residential Equipment Rebates Savings Summary

Savings Type	Annual Therms Savings		Realization Rate	Lifetime Therms Savings
	Ex Ante	Ex Post		
Gross	143,343	142,876	100%	2,318,194
Net	125,927	115,306	93%	1,833,619

4. Commercial Equipment Rebates

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

- $300 for Gas furnaces with 90%-94.9% AFUE;
- $400 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
- $50 for storage tank water heaters with rated at less than 75,000 BTU with an EF of .70 or greater;
- $200 per 100,000 input BTU for larger storage tank water heaters with 88% or greater thermal efficiency;
- $250 for tankless water heaters with an EF of .80 or greater.
- $900 for replacement of electric water heater with natural gas tank water heaters with rated at less than 75,000 BTU with an EF of .70 or greater;
- $900 for replacement of electric water heater with natural gas tankless water heaters with an EF of .80 or greater.
- $50 for smart thermostat listed on ENERGY STAR website for new natural gas or replacement from electric to gas.

The program is targeted at the small commercial market sector and offers incentives for 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.

4.1 Program Overview

The Commercial Natural Gas Equipment Rebates Program is part of a reorganization of the CenterPoint portfolio to have programs assigned by market sector rather than technology.

4.2 Participation Summary

4.2.1 Space Heating Participation Summary

In 2019, Space Heating program channel had 190 rebates. Participation comprised of:

- 169 furnaces with 95% or greater AFUE; and
- 21 with AFUE of 90-94.99%.

87.0% of commercial rebates were for retrofit projects. 47.0% were for new construction projects.

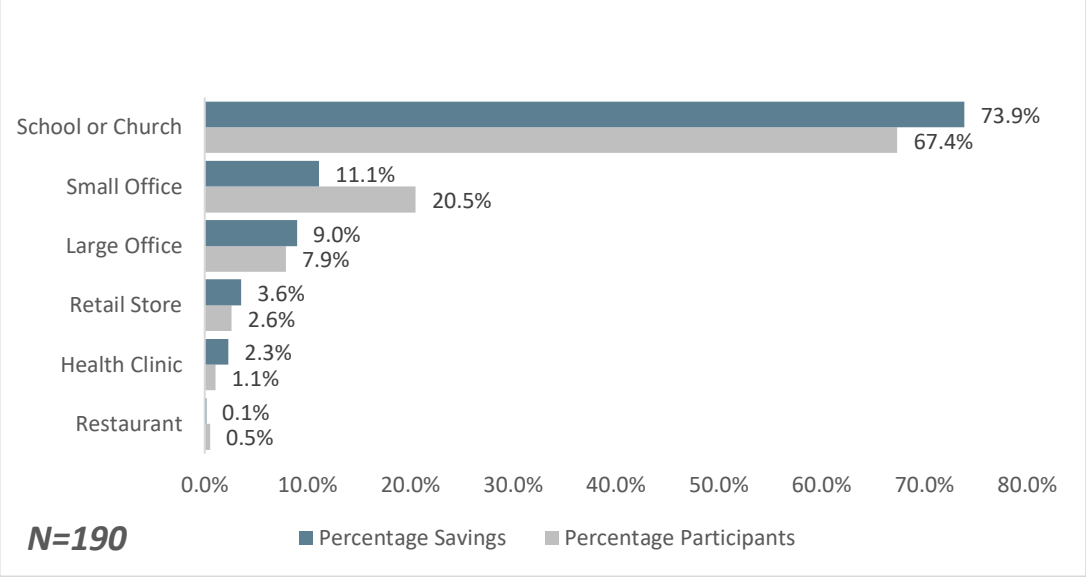

Figure 4-1 summarizes the participation levels by facility type.

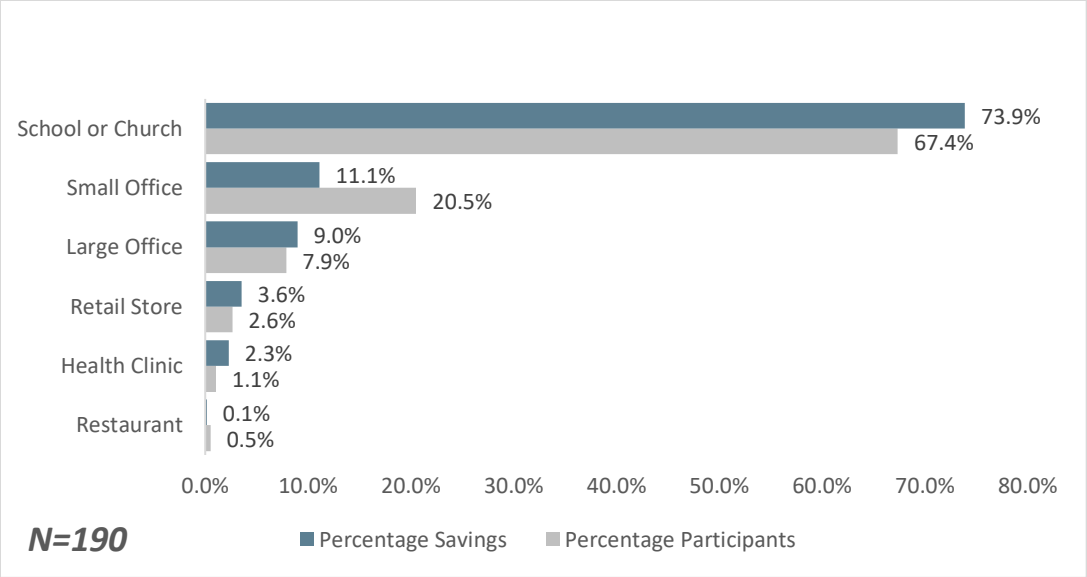

Figure 4-1 Heating System Rebates Commercial Participation by Facility Type

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

4.2.2 Water Heating Participation Summary

The 2019 Water Heating channel had eight rebates. Commercial participation comprised:

- (2) high efficiency storage tank water heater; and
- (6) tankless water heaters.

Participation was comprised of five retrofits, two new construction rebates, and one fuel switching rebate. 92% of savings from this channel came from two projects: a tankless water heater retrofit in a medical facility and a tankless fuel switching retrofit in a hotel.

4.3 Impact Evaluation

4.3.1 Space Heating Energy Savings Calculations

The Evaluators applied AR TRM V8.0 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

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

$\mathrm{AFUEnew\ heating\ system}$ = 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.

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

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

Where,

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

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

$\mathrm{AFUEbase}$ = 80%

Source to site ratio, electric to gas = 1.05

4.3.1.1 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.

4.3.1.2 Net-to-Gross Ratio

The Evaluators applied the Oklahoma Natural Gas Space Heating free ridership estimate of 89.6% to the commercial segment. In addition, the Evaluators found four single family residences under commercial meters. These projects were assigned the residential NTGR of 87.7%. The resulting aggregate NTGR for this group was 89.6% for gas-to-gas retrofits and 89.3% for electric-to-gas fuel switching.

4.3.2 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

$T_{S\text{upply}}$ = 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 4-1 presents the volume and days of usage values for a facility by square footage. Table 4-2 presents the volume and days of usage values by unit produced or person served.

Table 4-1 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 4-2 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

4.3.2.1 Net-to-Gross Ratio

The Evaluators applied the Oklahoma Natural Gas Water Heating free ridership estimate of 84.4% to the commercial segment.

4.4 Verified Savings

Gross Therms are summarized in Table 4-3 and Table 4-4.

Table 4-3 Space Heating Gross Therms Savings

Measure	*Measure Category*	*Expected Therms Savings*	*Verified Therms Savings*	EUL	*Lifetime Therms Savings*
Furnace	Retrofit	29,037	29,037	20	580,742
	Fuel Switch	8,955	8,955	20	179,092
Total		**34,151**	**35,150**	**20.0**	**702,996**

Table 4-4 Water Heating Gross Therms Savings

Measure	*Measure Category*	*Expected Therms Savings*	*Verified Therms Savings*	*EUL*	*Lifetime Therms Savings*
Water Heater	Retrofit	1,555	1,555	20	26,168
	Fuel Switch	879	879	20	14,836
Total Gross Savings		**2,435**	**2,435**	**20**	**41,004**

Overall gross and net savings are summarized in Table 4-5.

Table 4-5 Commercial Equipment Rebates Overall Savings Summary

Savings Type	*Annual Savings*		*Realization Rate*	*Lifetime Therms Savings*
	Ex Ante	*Ex Post*		
Gross	36,586	37,585	102.73%	744,000
Net	35,099	36,058	102.73%	712,461

5. Multi-Unit Market Transformation Program

Multi-Unit Market Transformation Program provides incentives to multi-unit (multi-family house) developers for the following measures:

- $2,000 for gas furnaces with 90%-94.9% AFUE;
- $2,000 for gas furnaces with 95% or higher AFUE;
- $900 for storage tank water heaters with an UEF of 0.70 or greater;
- $900 for tankless water heaters with an UEF of 0.80 or greater.

The Multi-Unit Market Transformation Program encourages multi-unit developers to purchase new natural gas water heating and space heating systems. Incentives are only awarded to participants for the purchase of new, natural gas DHW and space heating systems installed at newly constructed multi-unit buildings or exiting multi-unit buildings that converted from electric to natural gas equipment

5.1 Program Overview

Multi-Unit Market Transformation Program is promoted to multi-unit developers through trade organizations, marketing to developers with upcoming projects within CenterPoint's territory, and marketing to existing multi-unit owners. CenterPoint also work with dealers and wholesalers also help promote this program. The program is designed to drive Oklahoma multi-unit developers to purchase for efficient natural gas water and space heating equipment.

5.2 Participation Summary

5.2.1 Space Heating Participation Summary

Space Heating had 33 rebates. The program participation comprised of:

- 31 furnaces with 95% or greater AFUE; and
- 2 furnaces with 90-94.9% AFUE.

5.2.2 Water Heating Participation Summary

Water Heating had 13 rebates. The program participation comprised of:

- 13 tankless water heaters.

5.3 Impact Evaluation

5.3.1 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

$\mathrm{AFUEnew\ heating\ system}$ = 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,

$\left(\frac{\frac{\mathrm{therms}}{\mathrm{site\ area}}}{\mathrm{yr}}\right)$= 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

5.3.2 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

5.3.3 Net-to-Gross Ratio

Multifamily NTGR is based on the NTGR for the Commercial Equipment Rebates Program.

5.4 Verified Savings

Gross Therms are summarized in Table 5-1.

Table 5-1 Gross Therms Savings

Measure	*Expected Therms Savings*	*Verified Therms Savings*	*Gross Realization Rate*	*Lifetime Therms Savings*
Space Heating	4,029	4,025	99.9%	80,494
Water Heating	2,264	2,264	100.0%	45,284
Total Gross Savings	**6,293**	**6,289**	**99.9%**	**125,778**

Net savings are summarized in Table 5-2.

Table 5-2 Net Therms Savings

Measure	*Net Annual Savings*		*Net Realization Rate*	*Net Lifetime Therms Savings*
	Ex Ante	*Ex Post*		
Space Heating	3,454	3,606	104.%	72,122
Water Heating	1,621	1,617	99.9%	17,833
Total Net Savings	**5,075**	**5,223**	**102%**	**89,955**

6. 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 with 90% or higher AFUE;
- $1,000 for natural gas water heating; and
- $1,000 for additional natural gas burner tip.

6.1 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.

6.2 Participation Summary

In 2019, program participation consisted of 75 furnaces with 95% AFUE or greater. There were no rebates for water heaters or natural gas burner tips.

6.3 Impact Evaluation

6.3.1 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

$\mathrm{AFUEnew\ heating\ system}$ = 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)

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

AFUEbase = 80%

Source to site ratio, electric to gas = 1.05

6.3.2 Net-to-Gross Ratio

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

- Residential New Construction (builder production homes): 91.0%
- Residential New Construction (custom homes): 64.4%

6.4 Verified Savings

Gross Therms are summarized in Table 6-1.

Table 6-1 Gross Therms Savings

Measure	*Expected Therms Savings*	*Verified Therms Savings*	*Gross Realizations Rate*	*Lifetime Therms Savings*
Space Heating	11,473	11,460	99.9%	229,202
Total Gross Savings	**11,473**	**11,460**	**99.9%**	**229,202**

Net savings are summarized in Table 6-2.

Table 6-2 Net Therms Savings

Measure	*Net Annual Savings*		*Net Realization Rate*	*Net Lifetime Therms Savings*
	Ex Ante	*Ex Post*		
Space Heating	10,284	10,235	99.5%	204,694
Total Net Savings	**10,284**	**10,235**	**99.5%**	**204,694**

7. Commercial Boiler Program

The Commercial Boiler Program provides incentives for boilers and boiler controls used in HVAC applications. Eligible measures include:

- $1,400/MMBtuh input for boilers that are 83% - 91.9% efficient;
- $2,000/MMBtuh input for boilers that are 92% efficient or greater;
- $1,000/MMBtuh for Burner replacement – 6 step modulation or fully modulating;

The Commercial Boiler Program is targeted at large commercial facilities using boilers in HVAC applications.

7.1 Program Overview

7.1.1 Participation Summary

In 2019, the Commercial Boiler Program no participation and issued no rebates.

8. 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; and

(2) $0.95 per Therms for custom projects.

8.1 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 three categories:

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

In 2019, custom projects accounted for 37.8% of program savings and direct install accounted for 62.2%. These participants are detailed in the subsections to follow.

8.1.1 Direct Install Participation Summary

In 2019, 27 premises participated in the direct install component of Commercial Solutions Program. Of the 27 premises, six were schools and five were municipal buildings.

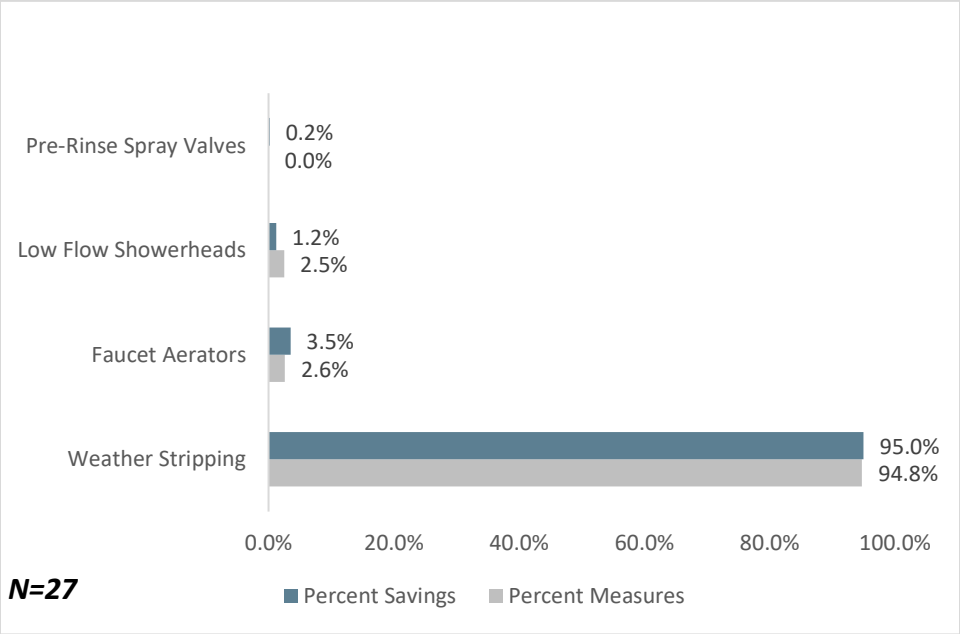

Figure 8-1 summarizes the participation by measure type, quantified in percent of measure type as well as percent of total savings.

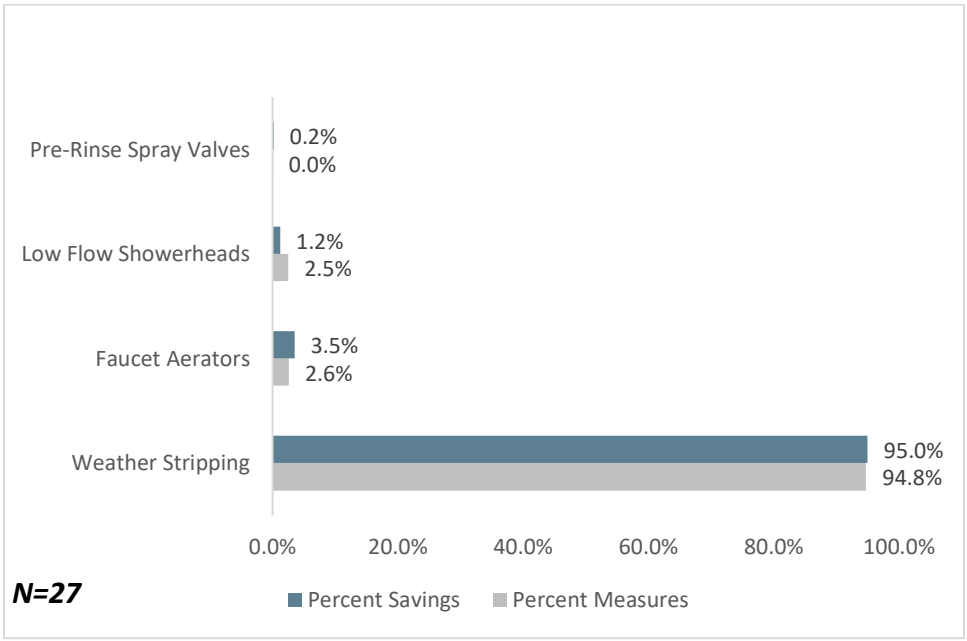

Figure 8-1 Commercial Solutions Direct Install Participant Summary

8.1.2 Closed Custom and Project Participation Summary

In 2019, C&I Solutions completed seven custom projects in three facilities. Table 8-1 summarizes the completed projects for the 2019 C&I Solutions program.

Table 8-1 Custom Project Participation Summary

Facility Type	Project ID	Measure
Industrial	PRJ-1745684	Steam Leak Repair
Industrial	PRJ-2195038	Boiler Retrofit
		Insulation
		Steam Leak Repair
		Steam Trap Replacements
		Waste Heat Recovery
Industrial	PRJ-2219444	Insulation

8.2 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 seven 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.

8.3 Commercial Solutions Direct Install Impact Evaluation

8.3.1 Energy Savings Calculations

The TRM Version 8.0 includes commercial faucet aerators and pre-rinse spray valves, and the evaluation of the Commercial Solutions program incorporated these deemed values. They are detailed in the subsections to follow.

8.3.1.1 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 8-2.

Table 8-2 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	.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Prison	.04
	Hospital, Nursing Home	.03
	Dormitory	.04
	Multifamily	.03
	Lodging	.02
	Commercial	.08
	School	.05

8.3.1.2 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 8-3 presents the definition of these parameters.

Table 8-3 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	.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Fast Food Restaurant	.05
	Casual Dining Restaurant	.04
	Institutional	.03
	Higher Education	.04
	School / K-12	.05

Three PRSVs were installed through the Commercial Solutions Program in 2019. Savings for PRSVs were calculated using AR TRM V8.0 values.

8.3.1.3 Low Flow Showerheads

Low flow showerheads were added to the AR TRM V8.0. 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 8-4.

Table 8-4 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	.8
P	Hourly Peak Demand as a percent of Daily Demand for the following applications	
	Hospital, Nursing Home	.03
	Lodging	.02
	Commercial	.08
	24 Hour Fitness Center	.08
	School	.05

Table 8-5 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

8.3.1.4 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 8-6.

Table 8-6 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 8-7

Table 8-7 $EFLH_H$ 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 8-8.

Table 8-8 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

8.4 Net-to-Gross Ratios (NTGR)

The Evaluators applied the Oklahoma Natural Gas NTGR of 96.4% for Direct Install Projects.

The Evaluators applied NTGR of 100% for Custom Projects.

8.5 Verified Savings

Table 8-9 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 8-9 Commercial Solutions Verified Therms Savings

Component	Measure	Expected Therms Savings	Verified Therms Savings	EUL	Lifetime Therms Savings
Direct Install	Faucet Aerators	7,231	6,889	10	68,892
	Low Flow Showerheads	2,396	2,401	10	24,005
	Pre-Rinse Spray Valves	405	422	5	2,112
	Weather Stripping	186,509	185,213	11	2,037,338
Custom	Various	118,959	118,564	17.8	2,106,590
Total Gross Savings		**315,500**	**313,489**	**13.5**	**4,238,937**

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 8-10.

Table 8-10 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	100.0%	100.0%	196,540	194,925	99.2%	2,132,347
Custom	100.0%	100.0%	118,959	118,564	99.7%	2,106,590
Overall:	**100.0%**	**100.0%**	**315,499**	**313,489**	**99.4%**	**4,238,937**

Table 8-11 summarizes the net non-energy benefits from the 2019 Commercial Solutions Program.

Table 8-11 Commercial Solutions Net Non-Energy Benefits Summary

Non-Energy Benefit	Annual Savings	Lifetime Savings
Water Savings (Gallons)	2,500,944	24,620,945

9. Commercial Food Service Program

The Commercial Food Service Program provides incentives for a range of food service measures. In 2019, eligible high efficiency measures include:

- Combination Ovens;
- Convection Ovens;
- Conveyor Ovens;
- Griddles;
- Steamers;
- Rotating Rack Ovens; and
- Fryers.

Incentives range from $300 to $2,400 for eligible equipment, with an additional $50 dealer/installer incentive.

9.1 Program Overview

The Commercial Food Service Program is primarily a vendor-driven program, with the marketing targeted at food service equipment distributors. These distributors are generally a primary point of contact and source of information in food service equipment purchases and are in a better position to influence the outcome of the transactions.

9.2 Participation Summary

In 2019, the Commercial Food Service Program had four facilities receiving rebates for five units. There were four fryers rebated and 1 convection oven. Four out of the five facilities were

restaurants, and the remaining facility was a public school.

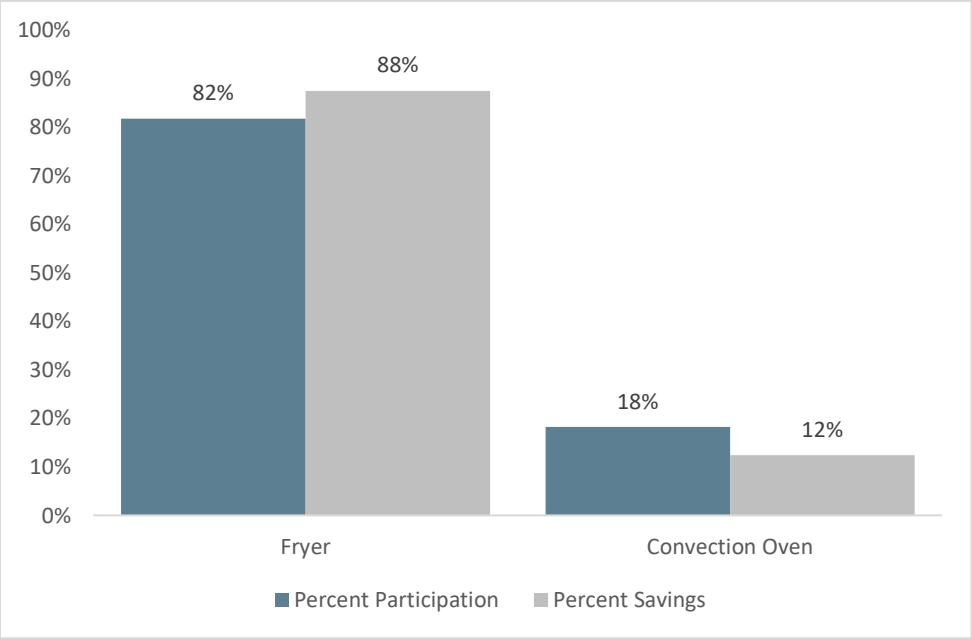

Figure 9-1 summarizes Commercial Food Service Program participation by measure category.

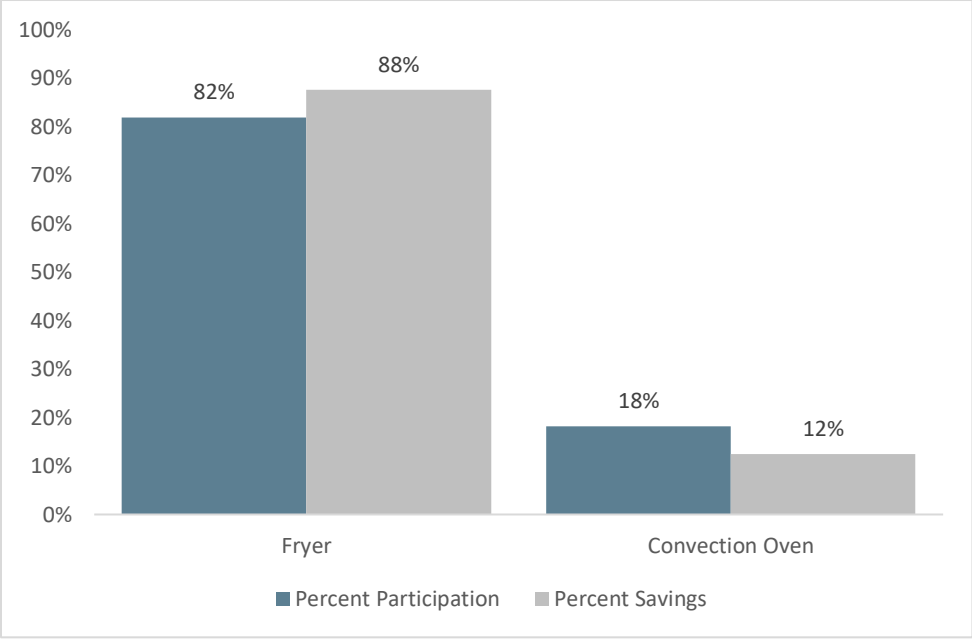

Figure 9-1 Participation by Measure Category

9.3 Commercial Food Service Impact Evaluation

9.3.1 Savings Calculation Methodologies

The Evaluators applied deemed savings algorithms from Section 3.8.4 – 3.8.6 of AR TRM V8.0 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 V8.0;
- Efficient specifications from the AR TRM V8.0; and
- Average verified specifications from the Evaluators' review of units rebated in the program.

9.3.1.1 Conveyor Ovens

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

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

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

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

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

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

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

Table 9-1 summarizes the deemed inputs for these equations as specified in AR TRM V8.0.

Table 9-1 Calculation Inputs for Conveyor Ovens

Parameter	Baseline Model	Efficient Model	Verified Equipment Input
Preheat Energy (Btu/Day)	35,000	18,000	23,070

Idle Rate (Btu/h)	70,000	57,000	37,465
Cooking Efficiency (%)	20%	42%	48.0%
Production Capacity (pizzas/hr.)	150	220	242
Number of Pizzas cooked/day	250	250	-
Efood (Btu/lb./)	190	190	190
Hours/Day	12	12	250

9.3.1.2 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 9-2 summarizes the inputs used in the savings algorithm.

Table 9-2 Calculation Inputs for Convection Ovens

Parameter	*Baseline Model*	*Efficient Model*	*Verified Equipment Input*
Preheat Energy (Btu/Day)	16,000	15,500	11,700/9,800
Idle Rate (Btu/h)	14,000	9,000	12,143/11,850
Cooking Eff. (%)	35%	50%	48.0%
Capacity (lbs./hr.)	60	65	112/80
Lbs. of food Cooked/Day	100	100	100
Efood (Btu/lb./)	250	250	250
Hours/Day	12	12	12

9.3.1.3 Fryer Savings Calculations

Savings for high efficiency fryers were calculated using similar algorithms as detailed for convection ovens. Table 9-3 summarizes the inputs used in the savings algorithm.

Table 9-3 Calculation Inputs for Fryers

Parameter	Baseline Model	Efficient Model	Verified Equipment Input
Preheat Energy (Btu/Day)	16,000	15,500	11,138/10,592
Idle Rate (Btu/h)	14,000	9,000	8,705/8,764
Cooking Eff. (%)	35%	50%	58.0%/54.0%
Capacity (lbs./hr.)	60	65	76/60
Lbs. of food Cooked/Day	150	150	150
Efood (Btu/lb./)	570	570	570
Hours/Day	12	12	12

9.4 Verified Savings

Table 9-4 presents the gross savings results of the evaluation of the 2019 Commercial Food Service Program. Total Gross Savings summarizes the savings calculations performed by TRM protocols for food service equipment.

Table 9-4 Commercial Food Service Program Verified Therms Savings

Measure Category	Expected Therms Savings	Verified Therms Savings	Gross Realization Rate	EUL	Lifetime Therms Savings
Fryer	3,868	5,084	131.4%	12	61,012
Convection Oven	702	724	103.1%	12	8,684
Total	**4,570**	**5,808**	**127.1%**	**-**	**69,696**

Net savings for the Commercial Food Service Program are presented in Table 9-6.

Table 9-6 Commercial Food Service Program Net Savings Summary

Net-to-Gross Ratio		Net Annual Savings		Net Realization Rate	Net Lifetime Therms Savings
Ex Ante	Ex Post	Ex Ante	Ex Post		
77.2%	77.2%	3,528	4,484	100%	53,805

10. 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.

10.1 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 10-1 summarizes the participation counts present for the 2017, 2018, and 2019 program years.

Table 10-1 Home Energy Reports Recipient Attrition

Program Year	Wave 1	Wave 2	Wave 3	Wave 4
2017	18,529	9,218	10,649	NA
2018	17,262	8,273	8,675	NA
2019	16,714	7,908	7,982	11,975

10.1.1 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

10.1.2 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.

10.2 Model Output Results

Table 10-2 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 10-2 Pre-period Interval

Wave	Start Year/Month	End Year/Month
1	2010-10	2011-09
2	2013-09	2014-08
3	2016-02	2017-01
4	2018-10	2019-09

10.2.1 Wave 1

Table 10-3 provides the model coefficients for the regression of customer billing data in the analysis of Wave 1.

Table 10-3 Regression Coefficients & Model Details – Wave 1

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
Intercept	0.86	0.02	36.71	<0.00001
Treatment	-0.04	0.00	-9.07	<0.00001
February	0.03	0.03	0.80	0.42
March	-0.19	0.03	-5.92	<0.00001
April	-0.54	0.03	-16.53	<0.00001
May	-0.68	0.03	-20.50	<0.00001
June	-0.70	0.03	-21.16	<0.00001
July	-0.67	0.03	-20.29	<0.00001
August	-0.67	0.03	-20.14	<0.00001
September	-0.70	0.03	-21.22	<0.00001
October	-0.62	0.03	-18.67	<0.00001
November	-0.34	0.03	-10.10	<0.00001
December	-0.20	0.03	-6.02	<0.00001
Pre-usage	-0.43	0.06	-7.56	<0.00001
Pre-summer	0.14	0.03	4.04	0.00
Pre-winter	1.10	0.02	44.94	<0.00001
Pre-usage:February	0.05	0.08	0.64	0.52
Pre-usage:March	0.81	0.08	10.11	<0.00001
Pre-usage:April	1.46	0.08	18.18	<0.00001
Pre-usage:May	1.24	0.08	15.31	<0.00001
Pre-usage:June	0.86	0.08	10.65	<0.00001
Pre-usage:July	0.70	0.08	8.60	<0.00001
Pre-usage:August	0.67	0.08	8.23	<0.00001
Pre-usage:September	0.81	0.08	9.93	<0.00001
Pre-usage:October	1.23	0.08	15.08	<0.00001
Pre-usage:November	0.77	0.08	9.40	<0.00001
Pre-usage:December	0.53	0.08	6.51	<0.00001
Pre-summer:February	0.00	0.05	-0.06	0.95
Pre-summer:March	-0.29	0.05	-6.11	<0.00001
Pre-summer:April	-0.39	0.05	-8.06	<0.00001
Pre-summer:May	-0.06	0.05	-1.27	0.21
Pre-summer:June	0.21	0.05	4.27	0.00
Pre-summer:July	0.14	0.05	2.98	0.00
Pre-summer:August	0.13	0.05	2.70	0.01

Pre-summer:September	0.11	0.05	2.29	0.02
Pre-summer:October	-0.30	0.05	-6.15	<0.00001
Pre-summer:November	-0.30	0.05	-6.20	<0.00001
Pre-summer:December	-0.21	0.05	-4.29	0.00
Pre-winter:February	0.02	0.03	0.45	0.65
Pre-winter:March	-0.64	0.03	-18.52	<0.00001
Pre-winter:April	-1.32	0.03	-38.14	<0.00001
Pre-winter:May	-1.36	0.03	-39.25	<0.00001
Pre-winter:June	-1.26	0.03	-36.24	<0.00001
Pre-winter:July	-1.20	0.03	-34.38	<0.00001
Pre-winter:August	-1.19	0.03	-34.00	<0.00001
Pre-winter:September	-1.23	0.03	-35.14	<0.00001
Pre-winter:October	-1.15	0.03	-33.02	<0.00001
Pre-winter:November	-0.60	0.03	-17.12	<0.00001
Pre-winter:December	-0.42	0.04	-11.97	<0.00001
Adjusted R-Square: 0.786				

The resulting annual savings are:

- Annual Savings = ∑ (0.04382 * Number of customers in month i * Number of days in month i) = 255,410 Therms
- 95% Confidence Interval: +/- 56,284 (22.0%)

10.2.2 Wave 2

Table 10-4 provides the model coefficients for the regression of customer billing data in the analysis of Wave 2.

Table 10-4 Regression Coefficients & Model Details – Wave 2

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
Intercept	0.46	0.02	22.87	<0.00001
Treatment	-0.03	0.00	-8.15	<0.00001
February	0.13	0.03	4.55	<0.00001
March	-0.02	0.03	-0.54	0.59
April	-0.20	0.03	-6.91	<0.00001
May	-0.34	0.03	-12.01	<0.00001
June	-0.38	0.03	-13.32	<0.00001
July	-0.32	0.03	-11.11	<0.00001
August	-0.32	0.03	-11.25	<0.00001
September	-0.36	0.03	-12.48	<0.00001
October	-0.28	0.03	-9.60	<0.00001
November	-0.15	0.03	-5.25	<0.00001
December	0.02	0.03	0.58	0.56
Pre-usage	-0.51	0.05	-10.15	<0.00001
Pre-summer	0.24	0.03	7.44	<0.00001
Pre-winter	1.04	0.02	47.60	<0.00001
Pre-usage:February	-0.07	0.07	-1.01	0.31
Pre-usage:March	0.53	0.07	7.46	<0.00001
Pre-usage:April	1.12	0.07	15.53	<0.00001
Pre-usage:May	0.98	0.07	13.53	<0.00001
Pre-usage:June	0.57	0.07	7.78	<0.00001
Pre-usage:July	0.48	0.07	6.55	<0.00001
Pre-usage:August	0.49	0.07	6.75	<0.00001
Pre-usage:September	0.65	0.07	8.86	<0.00001
Pre-usage:October	1.06	0.07	14.46	<0.00001
Pre-usage:November	0.58	0.07	7.85	<0.00001
Pre-usage:December	0.14	0.07	1.90	0.06
Pre-summer:February	0.02	0.05	0.52	0.60
Pre-summer:March	-0.19	0.05	-4.22	0.00
Pre-summer:April	-0.23	0.05	-5.13	<0.00001
Pre-summer:May	0.06	0.05	1.35	0.18
Pre-summer:June	0.48	0.05	9.79	<0.00001
Pre-summer:July	0.28	0.05	5.65	<0.00001
Pre-summer:August	0.25	0.05	5.04	<0.00001

Pre-summer:September	0.23	0.05	4.77	<0.00001
Pre-summer:October	-0.19	0.05	-3.78	0.00
Pre-summer:November	-0.22	0.05	-4.37	0.00
Pre-summer:December	-0.08	0.05	-1.64	0.10
Pre-winter:February	0.04	0.03	1.28	0.20
Pre-winter:March	-0.51	0.03	-16.39	<0.00001
Pre-winter:April	-1.13	0.03	-36.09	<0.00001
Pre-winter:May	-1.18	0.03	-37.42	<0.00001
Pre-winter:June	-1.06	0.03	-33.34	<0.00001
Pre-winter:July	-1.02	0.03	-32.20	<0.00001
Pre-winter:August	-1.03	0.03	-32.35	<0.00001
Pre-winter:September	-1.08	0.03	-33.94	<0.00001
Pre-winter:October	-1.06	0.03	-33.06	<0.00001
Pre-winter:November	-0.52	0.03	-16.20	<0.00001
Pre-winter:December	-0.27	0.03	-8.47	<0.00001
Adjusted R-Square: 0.797				

The resulting annual savings are:

- Annual Savings = ∑ (0.03368 * Number of customers in month i * Number of days in month i) = 91,691 Therms
- 95% Confidence Interval: +/- 22,462 (24.5%)

10.2.3 Wave 3

Table 10-5 provides the model coefficients for the regression of customer billing data in the analysis of Wave 3.

Table 10-5 Regression Coefficients & Model Details – Wave 3

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
Intercept	0.72	0.01	52.76	<0.00001
Treatment	-0.02	0.00	-6.29	<0.00001
February	0.00	0.02	0.07	0.94
March	-0.24	0.02	-12.22	<0.00001
April	-0.67	0.02	-34.50	<0.00001
May	-0.76	0.02	-39.47	<0.00001
June	-0.72	0.02	-36.90	<0.00001
July	-0.64	0.02	-32.65	<0.00001
August	-0.64	0.02	-32.91	<0.00001
September	-0.68	0.02	-34.52	<0.00001
October	-0.61	0.02	-31.20	<0.00001
November	-0.21	0.02	-10.60	<0.00001
December	-0.11	0.02	-5.54	<0.00001
Pre-usage	0.12	0.04	2.88	0.00
Pre-summer	-0.31	0.04	-8.50	<0.00001
Pre-winter	1.05	0.02	64.62	<0.00001
Pre-usage:February	0.08	0.06	1.33	0.18
Pre-usage:March	0.88	0.06	15.50	<0.00001
Pre-usage:April	1.32	0.06	22.98	<0.00001
Pre-usage:May	0.94	0.06	16.31	<0.00001
Pre-usage:June	0.25	0.06	4.41	0.00
Pre-usage:July	-0.27	0.06	-4.73	<0.00001
Pre-usage:August	-0.21	0.06	-3.58	0.00
Pre-usage:September	0.10	0.06	1.67	0.10
Pre-usage:October	0.48	0.06	8.21	<0.00001
Pre-usage:November	0.29	0.06	4.90	<0.00001
Pre-usage:December	0.10	0.06	1.79	0.07
Pre-summer:February	0.01	0.05	0.16	0.87
Pre-summer:March	-0.02	0.05	-0.37	0.71
Pre-summer:April	0.34	0.05	6.65	<0.00001
Pre-summer:May	0.68	0.05	13.29	<0.00001
Pre-summer:June	0.94	0.05	18.09	<0.00001
Pre-summer:July	1.00	0.05	19.27	<0.00001
Pre-summer:August	0.96	0.05	18.42	<0.00001

Pre-summer:September	0.87	0.05	16.68	<0.00001
Pre-summer:October	0.36	0.05	6.90	<0.00001
Pre-summer:November	-0.10	0.05	-1.90	0.06
Pre-summer:December	-0.12	0.05	-2.38	0.02
Pre-winter:February	0.02	0.02	0.71	0.48
Pre-winter:March	-0.72	0.02	-31.21	<0.00001
Pre-winter:April	-1.38	0.02	-59.12	<0.00001
Pre-winter:May	-1.38	0.02	-58.99	<0.00001
Pre-winter:June	-1.16	0.02	-49.60	<0.00001
Pre-winter:July	-0.97	0.02	-41.30	<0.00001
Pre-winter:August	-1.00	0.02	-42.38	<0.00001
Pre-winter:September	-1.11	0.02	-46.67	<0.00001
Pre-winter:October	-0.96	0.02	-40.52	<0.00001
Pre-winter:November	-0.48	0.02	-20.06	<0.00001
Pre-winter:December	-0.29	0.02	-12.15	<0.00001
Adjusted R-Square: 0.824				

The resulting annual savings are:

- Annual Savings = ∑ (0.02303 * Number of customers in month i * Number of days in month i) = 62,356Therms
- 95% Confidence Interval: +/- 19,4485 (31.2%)

10.2.4 Wave 4

Table 10-6 provides the model coefficients for the regression of customer billing data in the analysis of Wave 4.

Table 10-6 Regression Coefficients & Model Details – Wave 4

Variable Description	*Regression Coefficient*	*Standard Error*	*T-Stat*	*PR > |T|*
Intercept	-0.02	0.01	-1.56	0.12
Treatment	-0.01	0.01	-1.40	0.16
November	0.08	0.02	4.46	<0.00001
December	0.16	0.02	8.98	<0.00001
Pre-usage	-0.34	0.03	-11.29	<0.00001
Pre-summer	0.72	0.02	30.09	<0.00001
Pre-winter	0.65	0.01	47.03	<0.00001
Pre-usage:November	0.25	0.04	5.73	<0.00001
Pre-usage:December	0.08	0.04	1.84	0.07
Pre-summer:November	-0.39	0.03	-11.44	<0.00001
Pre-summer:December	-0.43	0.03	-12.52	<0.00001
Pre-winter:November	0.08	0.02	3.95	0.00
Pre-winter:December	0.25	0.02	12.48	<0.00001
Adjusted R-Square: 0.686				

The resulting annual savings are:

- Annual Savings = ∑ (0.00844 * Number of customers in month i * Number of days in month i) = 7,766 Therms
- 95% Confidence Interval: +/- 10,901 (140.37%)

Due to the wide confidence interval in this estimate, savings were not counted for Wave 4. There was insufficient treatment length in 2019 to demonstrate savings.

10.3 **Group Comparison**

The difference in consumption between the two groups is observable when presented graphically. Figure 10-1 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.

Similar representations for Wave 2 and Wave 3 are presented in Figure 10-2 and Figure 10-3, respectively. Wave 4 consumption, as modeled in Figure 10-5,does not yet show us any clear savings patterns, as this wave was recently launched in September 2019. The impact of the reports on Wave 3 is 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 Wave 3.

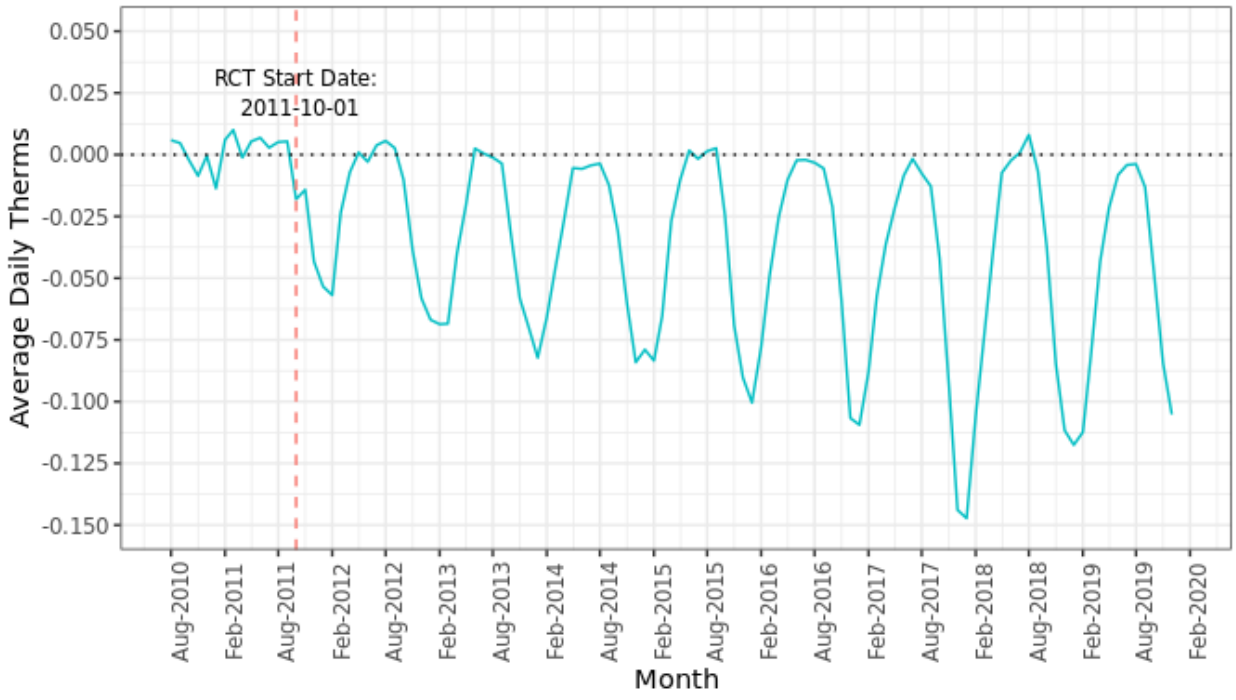

Figure 10-1 Daily Consumption between Recipient & Control Group – Wave 1

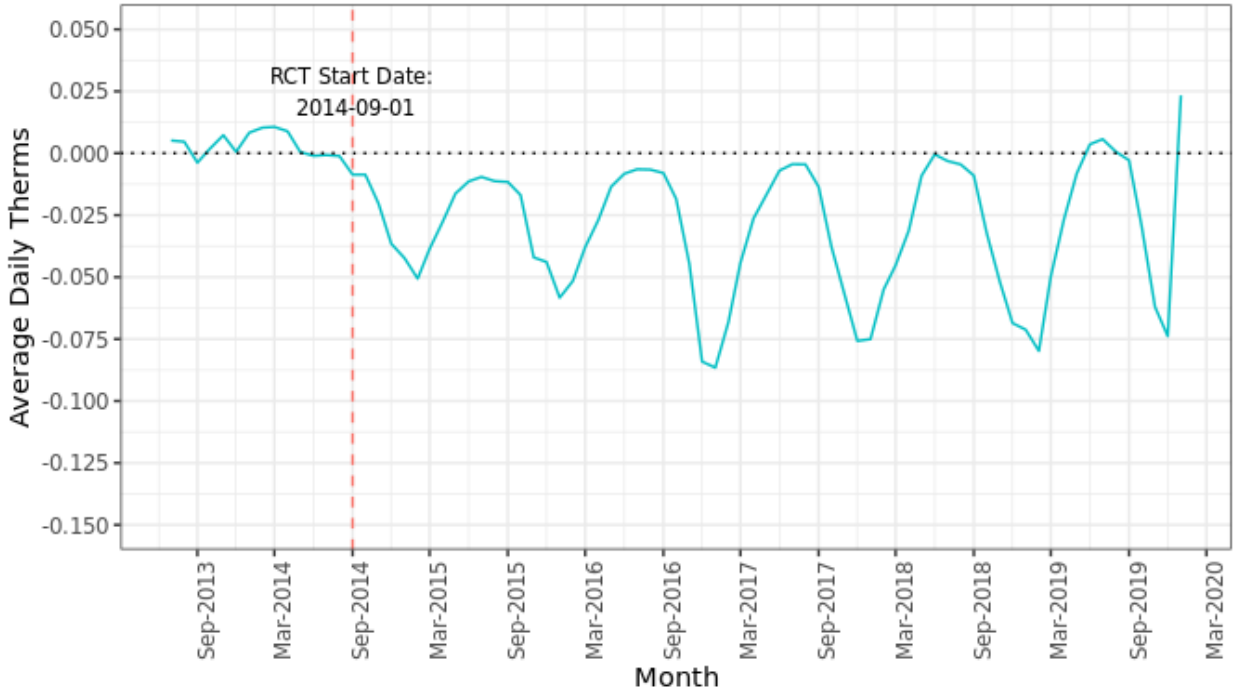

Figure 10-2 Daily Consumption between Recipient & Control Group – Wave 2

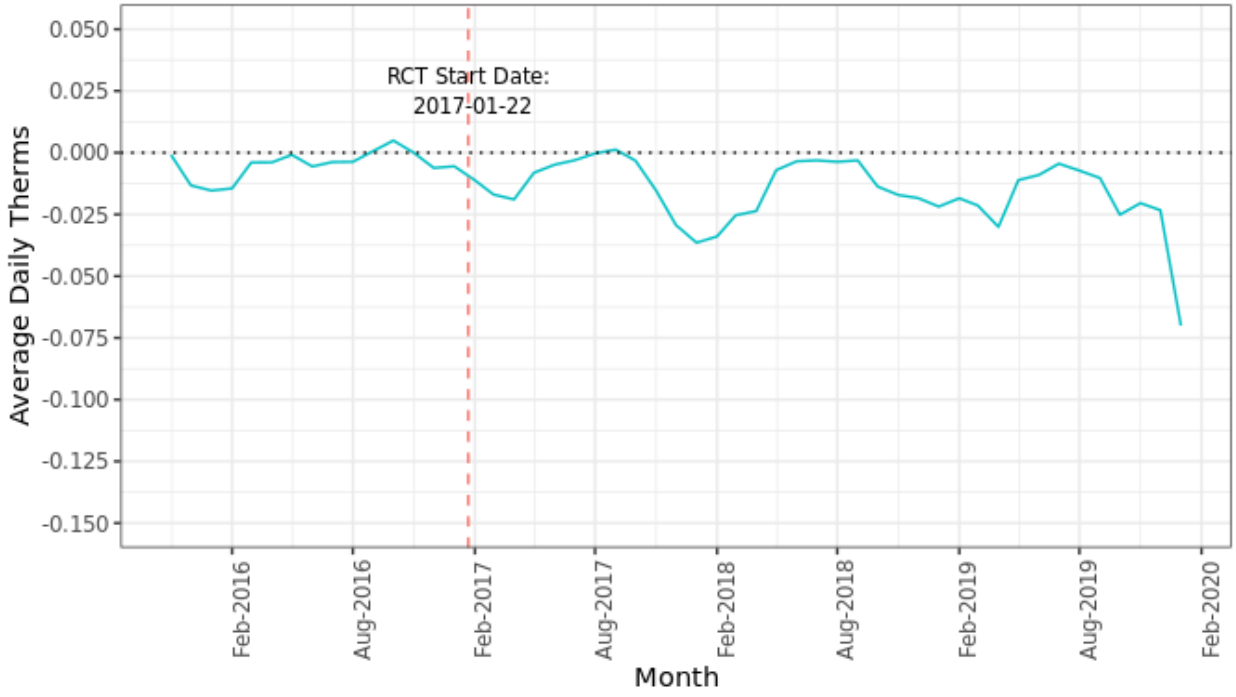

Figure 10-3 Daily Consumption between Recipient & Control Group – Wave 3

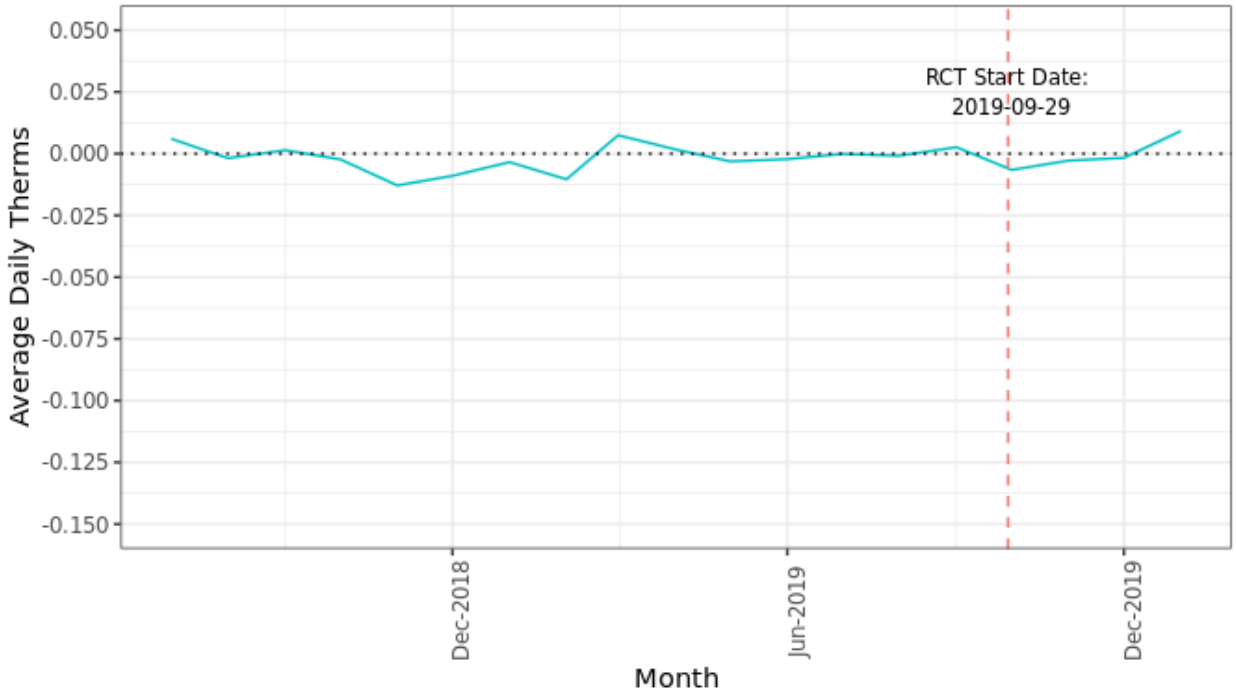

Figure 10-4 Daily Consumption between Recipient & Control Group – Wave 4

10.4 Per-Customer Performance

The annual savings per recipient for each wave is shown in Figure 10-5. Wave 1 had the highest savings at 15.99 Therms per recipient. The savings for Wave 2 was 12.29 Therms. Wave 3 had the lowest savings of 8.41 Therms, however, the savings per customer for this wave and the other waves has increased compared to the last program year. The savings value for Waves 1-3 are significant at the 95% confidence level. Wave 4, although calculated at 3.08 Therms per recipient, was not significant at the 95% confidence level.

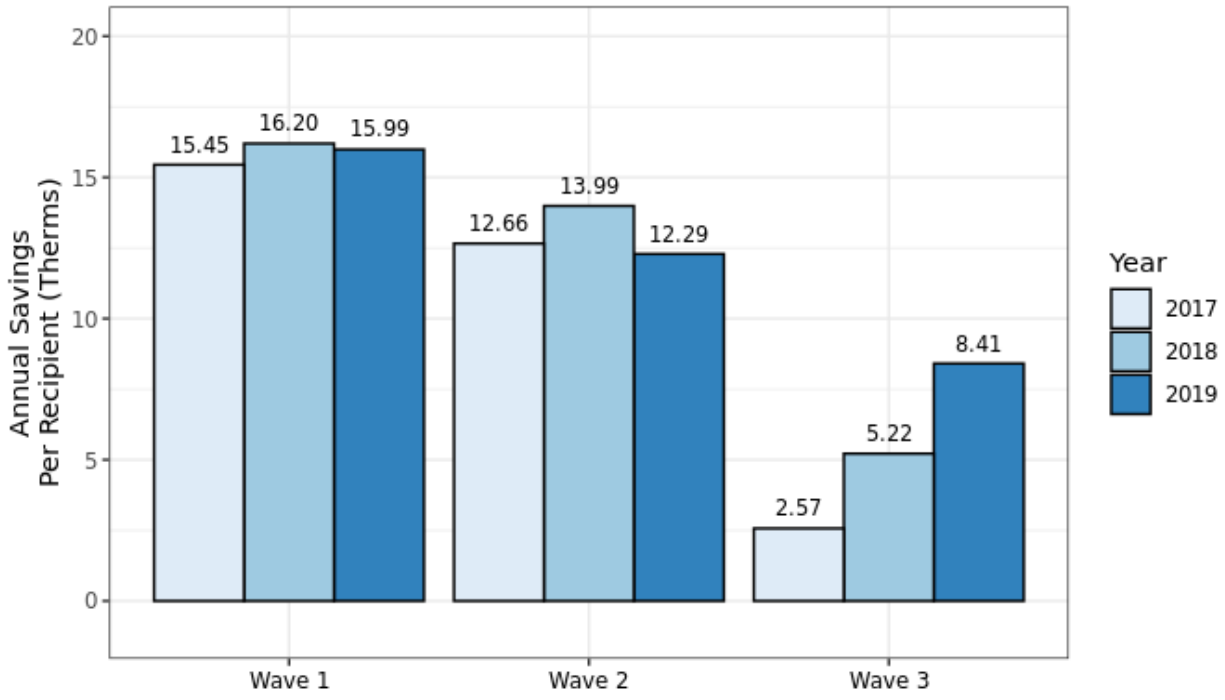

Figure 10-5 Savings per Recipient

10.5 Double Counting Analysis

Double counted savings is the difference in other-program-savings for the recipient and control groups, and this difference is subtracted from a behavioral program estimate to avoid double counting. If a program has more recipients than non-recipients in the analysis, then taking the straight sum of savings from other-program-savings would dramatically inflate the double counting effect. As there are more recipients than controls for this program, the Evaluators determined that it is more appropriate to evaluate double counting on the basis of the difference in per-participant savings. When comparing all of the other-program-savings, the Evaluators found:

- 1.4850 Therms per participant for the recipient group; and
- 1.4623 Therms per participant for the control group.

The difference between the groups is 0.0227 Therms per participant (1.53%), however, this difference is not statistically significant at the 95% level and was not deducted from the program.

Table 10-7 shows double counted savings for each wave and treatment status for each of the other residential program offerings. Furnace equipment savings account for the largest share of other program savings, followed by Low Flow (Showerhead and Faucet Aerators) and Water Heaters.

Table 10-7 Other Program Savings Summary

Wave	Treatment Status	Furnace Savings (Therms/ participant)	Water Heater Savings (Therms/ participant)	Low Flow Savings (Therms/ participant)	All Other Program Savings (Therms/ participant)
1	Control	1.38	0.03	0.30	1.71
1	Treatment	1.58	0.01	0.18	1.78
2	Control	0.67	0.05	0.23	0.95
2	Treatment	1.03	0.00	0.17	1.20
3	Control	1.18	0.07	0.20	1.46
3	Treatment	0.91	0.00	0.22	1.14
4	Control	1.15	0.18	0.30	1.62
4	Treatment	1.41	0.03	0.27	1.70

Table 10-8 shows the results of the double counted savings analysis by wave. The overall effect across all waves from the addition of double counted savings increases estimated savings by 707 Therms, or 0.170% of program savings.

Table 10-8 Double Counted Savings Summary

Wave	# of Participants	Other Program Savings- Recipient (Therms/participant)	Other Program Savings- Control (Therms / Participant)	Double Counted Savings (Therms / Participant)	Double Counted Savings (Therms)
1	16,714	1.78	1.71	0.07	1,135.01
2	7,908	1.20	0.95	0.26	1,949.01
3	7,982	1.14	1.46	(0.32)	(2,377.22)
4	11,975	1.70	1.62	0.08	206.82

10.6 **Verified Savings**

With the model output results and double count analysis, the Home Energy Reports Program has 414,901 annual Therms savings in 2019, shown in Table 10-9.

Table 10-9 HER Program Savings

Ex-ante Therms	Ex-post Therms	RR	95% Confidence	Precision
412,927	409,456	99.1%	43,633	10.5%

The Realization Rate is 100.3%

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

Table 10-10 Therms Savings Summary by Wave

Wave	# of Participants	Annual Therms Usage	Ex-post Savings	Savings as a % of Annual
1	16,714	12,258,273	255,410	2.08%
2	7,908	5,545,492	91,691	1.65%
3	7,982	2,915,166	62,356	2.14%
4	11,975	6,023,832	-	-
All[3]	**32,604**	**20,718,931**	**409,456**	**1.98%**

When aggregating across all waves, the Evaluators found that the overall 95% confidence interval was ±10.5% of program savings. In addition, across all waves, savings were 1.98% of annual usage.

[3] Totals do not include wave 4.

11. 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).

11.1 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.

11.2 Low Flow Showerhead & Faucet Aerator Program Participation Summary

In 2019, CenterPoint distributed 1,495 kits to their residential customers. Table 11-1 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 11-1 Low Flow Kit Composition

Showerheads		*Bathroom Aerators*		*Kitchen Aerators*	
Quantity	*% Selected*	*Quantity*	*% Selected*	*Quantity*	*% Selected*
0	4.15%	0	48.57%	0	40.34%
		1	14.29%	1	44.54%
		2	24.29%	2	13.45%
		3	12.86%	3	1.68%
1	21.68%	0	64.02%	0	60.14%
		1	18.07%	1	35.30%
		2	13.71%	2	4.05%
		3	4.21%	3	0.51%
2	32.00%	0	33.90%	0	40.22%
		1	13.63%	1	48.79%
		2	47.36%	2	8.35%
		3	5.11%	3	2.64%
3	42.17%	0	17.69%	0	24.10%
		1	12.23%	1	39.96%
		2	53.22%	2	20.72%
		3	16.86%	3	15.22%

11.3 Low Flow Showerhead & Faucet Aerator Program Impact Evaluation

11.3.1 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 V8.0 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 V8.0.

11.3.2 Unit Energy Savings

11.3.2.1 Faucet Aerators

Savings from faucet aerators are based upon AR TRM V8.0 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 11-2 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	2.69
Faucets per home	3.86
Gal./yr./faucet (Baseline)	2,467
Gal./yr./faucet (1.5 GPM)	2,094
Gal./yr./faucet (1.0 GPM)	1,828
Mixed Water Temperature	103°F
DHW gallons saved/yr./faucet for 1.5 GPM (V)	381
DHW gallons saved/yr./faucet for 1.0 GPM (V)	636

11.3.2.2 Low Flow Showerheads

Savings for low flow showerheads are detailed in Section 2.3.5 of the TRM Version 8.0. They are calculated in the same manner as faucet aerators, differing only in the volume of use estimates.

Table 11-3 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	2.69
Showers/home/day (baseline)	1.88
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)	8,657
Gal./yr./showerhead @ 1.5 GPM	5,411
Mixed Water Temperature	104.3 °F
1.5 GPM showerhead DHW gallons saved/yr. (V)	3,246

In addition, to account for the customers with electric water heating, the Evaluators incorporated the AR TRM V8.0

11.3.3 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%

11.4 Net-to-Gross

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

11.5 Verified Savings

Table 11-4 summarizes the total gross savings for the Low Flow Showerhead & Faucet Aerator Program.

Table 11-4 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	2,560	2,560	10	25,600	25,600	100.0%
Showerheads	21,751	21,751	10	209,459	209,459	100.0%
Total Gross Savings	**24,311**	**24,311**		**243,107**	**243,107**	**100.0%**

Table 11-5 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	100.1%	100.1%	24,352	24,352	10	243,518	243,518
Total Net Savings			**24,352**	**24,352**	**10**	**243,518**	**243,518**

Table 11-6 summarizes the net non-energy benefits from the 2019 Low Flow Showerhead & Faucet Aerator Program.

Table 11-6 Low Flow Showerhead & Faucet Aerator Program Net Non-Energy Benefits Summary

Non-Energy Benefit	Annual	EUL
Water Savings (Gallons)	5,671,873	10

11.6 Low Flow Showerhead & Faucet Aerator Process Evaluation Results

11.6.1 Program Awareness

There were 187 people surveyed between CenterPoint Oklahoma and CenterPoint Arkansas. The aggregate responses have been analyzed below and the subsequent sections.

Those surveyed were asked how they initially learned of the Low Flow Showerhead program, and respondents were able to select multiple sources. Fifty-one percent of respondents stated that they heard of the program through a CenterPoint bill message. None of the respondents heard about the program through their contractor. Figure 11-1 summarizes the sources of program awareness.

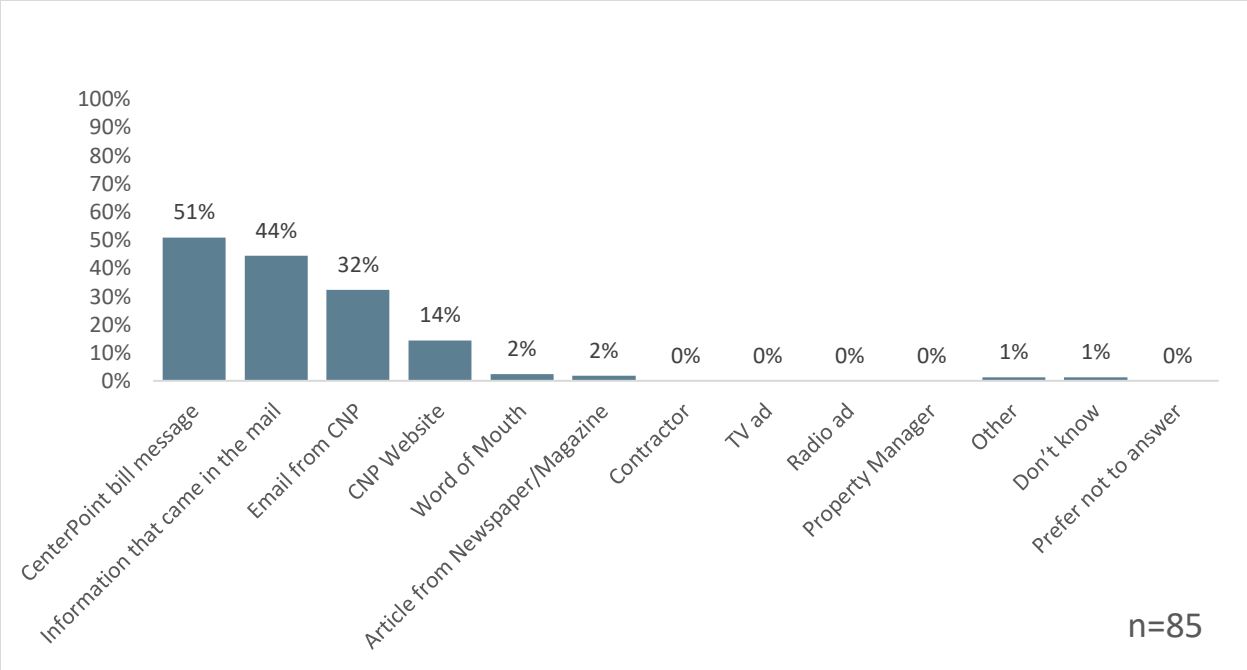

Figure 11-1 Sources of Awareness

Respondents were then asked about their reason for program participation, and they were able to provide multiple responses. Figure 11-2 shows a summary of reasons for participation in the program. The most frequent reason respondents chose to participate was that they thought it would save money on their water bill (71%). Other common responses included, thinking it would

save money on their CenterPoint bill (62%), helping the environment (58%), and having to pay no money for the equipment (53%).

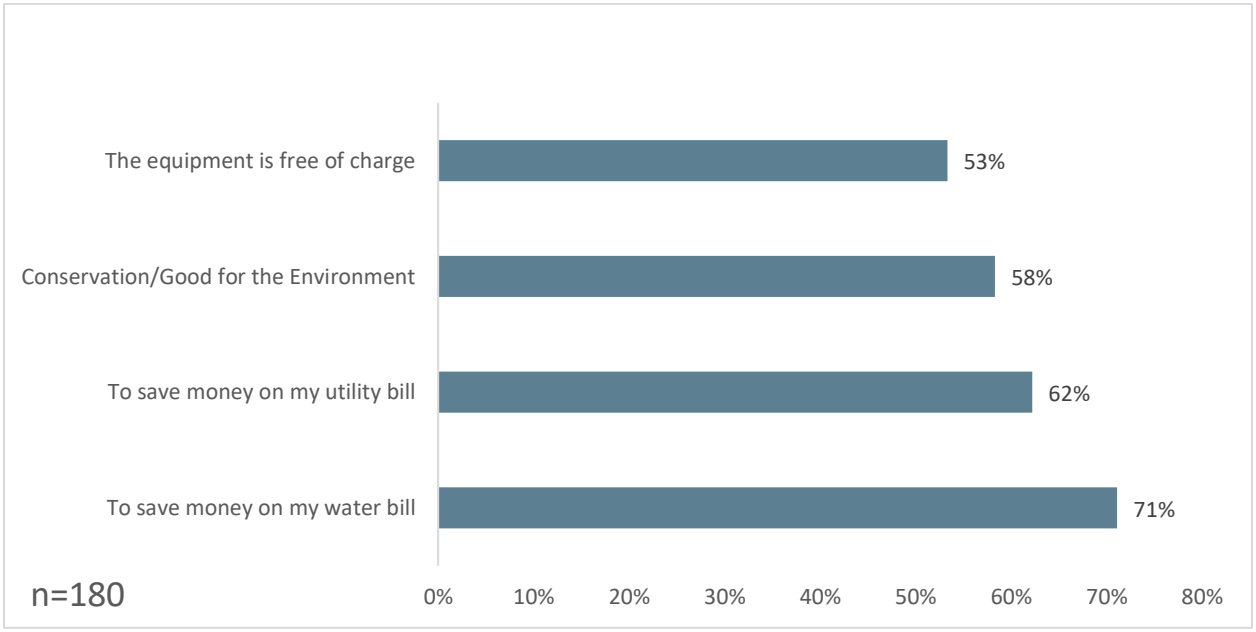

Figure 11-2 Reasons for Participation

11.6.2 Satisfaction with Program Measures

Respondents were asked a series of questions relating to their satisfaction with individual program measures. Figure 11-3 shows participant satisfaction with the low flow showerheads provided by the program. Overall, participants were "satisfied" or "very satisfied" with each at least 80% of respondents reporting satisfaction with each of the queries relating to the showerheads. The highest levels of satisfaction were with the ease of the installation (92%), followed by, the look of the showerhead (86%), the ability to adjust the spray (83%), the way it worked compared to the old one (82%), and the amount of flow (82%) from the showerhead. Eight percent of respondents were dissatisfied with the amount of flow from the showerhead and 7% of respondents were dissatisfied with the way the showerhead works compared to the old one.

Respondents were also asked whether they had removed and replaced any of the installed showerheads, and 15% (24 respondents) reported that they had while 83% (135 respondents) had not removed any of the showerheads installed. Of the respondents who responded about removing the showerheads, 53% removed the showerheads because there was not enough flow, 29% wanted one with a hose and 12% did not like the appearance or the spray function of the showerhead.

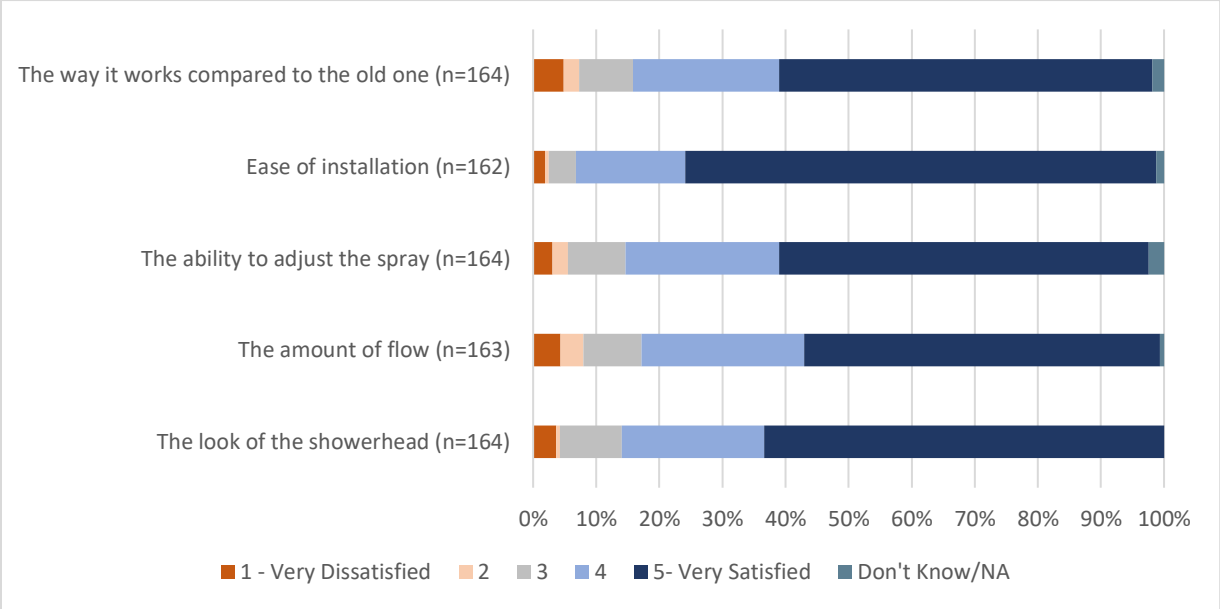

Figure 11-3 Satisfaction with Low Flow Showerheads

Figure 11-4 shows participant satisfaction with the kitchen aerators provided by the program. Overall, participants were quite satisfied, with at least 80% of respondents reporting satisfaction with each of the queries relating to the kitchen aerators. The highest levels of satisfaction were the ease of installation (93%), and the amount of flow (90%), and the way the new kitchen aerator works compared to the former kitchen aerator (87%).

Respondents who received more kitchen faucet aerators that were installed were asked the reason why. Forty-five percent of those respondents gave a reason under “other” with the most common complaint being that the kitchen faucet aerator did not fit with their appliances.

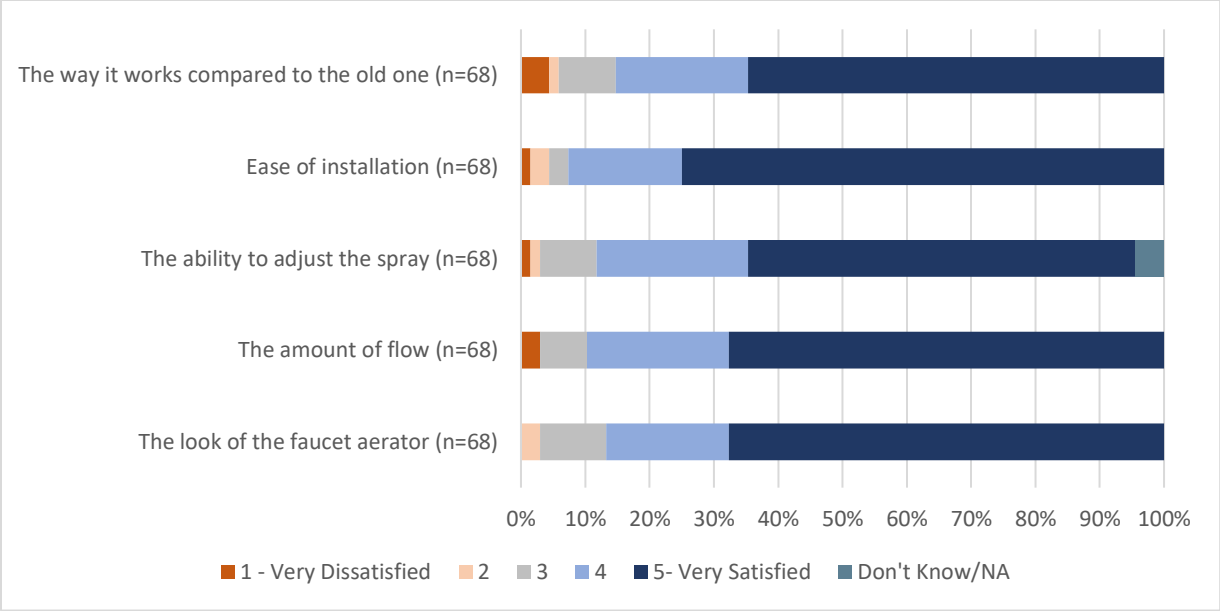

Figure 11-4 Satisfaction with Kitchen Aerators

Figure 11-5 shows participant satisfaction with the bathroom aerators provided by the program. Overall, participants were quite satisfied, with at least 80% of respondents reporting satisfaction with each of the queries relating to the bathroom aerators. The highest level of satisfaction was with the amount of flow and the ease of installation with 87% of respondents expressing satisfaction in these categories. The look of the bathroom faucet aerator and the way it works compared to the old one followed with 84% of the respondents expressing satisfaction. Seventy-four percent of respondents were satisfied with the ability to adjust the spray whereas 6% of respondents were dissatisfied with this.

Twelve percent of seventy-seven respondents removed some of the bathroom faucet aerators that were installed. The top reasons (44%) were that were not enough flow and respondents did not like the spray.

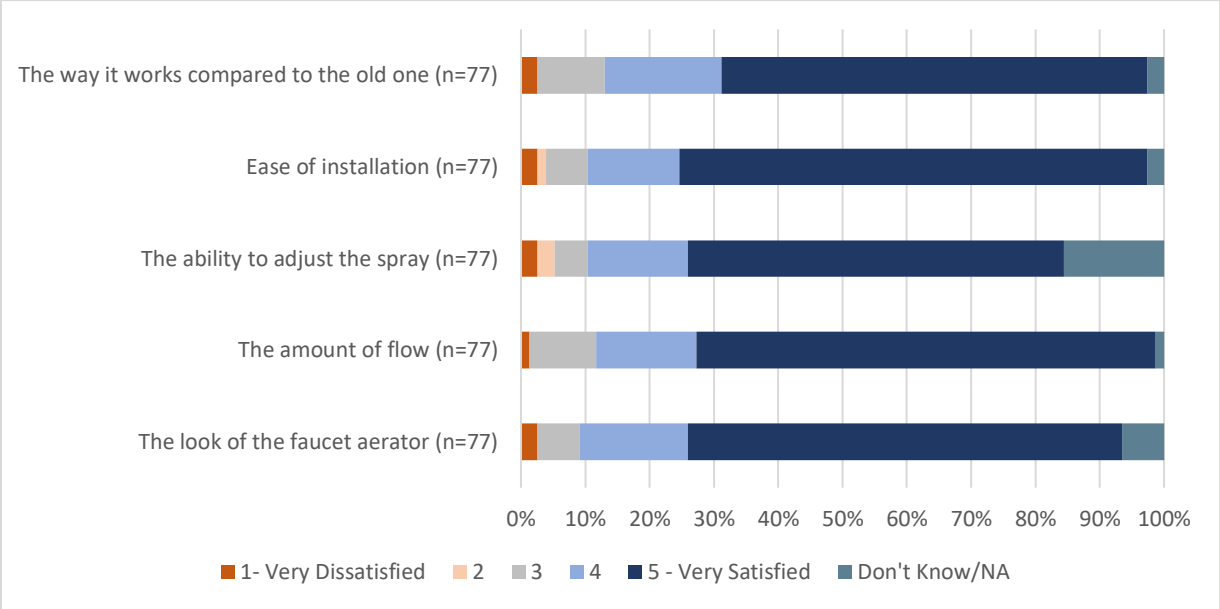

Figure 11-5 Satisfaction with Bath Faucet Aerators

This year, participants in the program received hot water temperature card to test their water temperature. Twenty-nine percent of respondents did not use the hot water card to test their water temperature, but the majority (55%) did use the card to test the water temperature. Those who did not use the card to test the water temperature were asked their reason for not doing so. Eighteen percent of respondents were not interested in using the card, and 55% selected another reason. Twenty-seven percent of respondents did not know why they did not use the card to test water temperature. Some of the "other" reasons include that the respondents misplaced the card, do not remember receiving a card, and did not see it in the package.

Table 11-7 Hot Water Card Testing

Did you use the card to test your water temperature?	*Percent of Respondents (n=38)*
Yes	55%
No	29%
Don't know	13%
Prefer not to answer	3%

The respondents who used the gauge were asked questions about their actions in response to if the gauge showed a high temperature in response to 150 degrees. Eighty-one percent of respondents stated that the water temperature gauge did not show a temperature exceeding 150 degrees. However, 14% stated that theirs showed this temperature.

Table 11-8 Water Temperature

Did the water temperature gauge show a high temperature, exceeding 150 degrees?	*Percent of Respondents (n=21)*
Yes	14%
No	81%
Don't know	5%
Prefer not to answer	0%

Sixty percent of respondents did not lower their water heater temperature in response to their test result. None of the respondents raised the water heater temperature in response to their test results.

Table 11-9 Hot Water Card Reactions

Did you lower your water heater temperature in response to your test result?	*Percent of Respondents (n=20)*
Yes	25%
No	60%
Don't know	15%
Prefer not to answer	0%

Those surveyed were asked about the source for their water heating equipment and the type of equipment in their home. Eighty-four percent out of the 180 respondents have natural gas water heating in their home. The other 13% have electric water heating. Most of the respondents (88%) have a storage tank water heater while the rest of the 12% either have a tankless water heater or do not know the source.

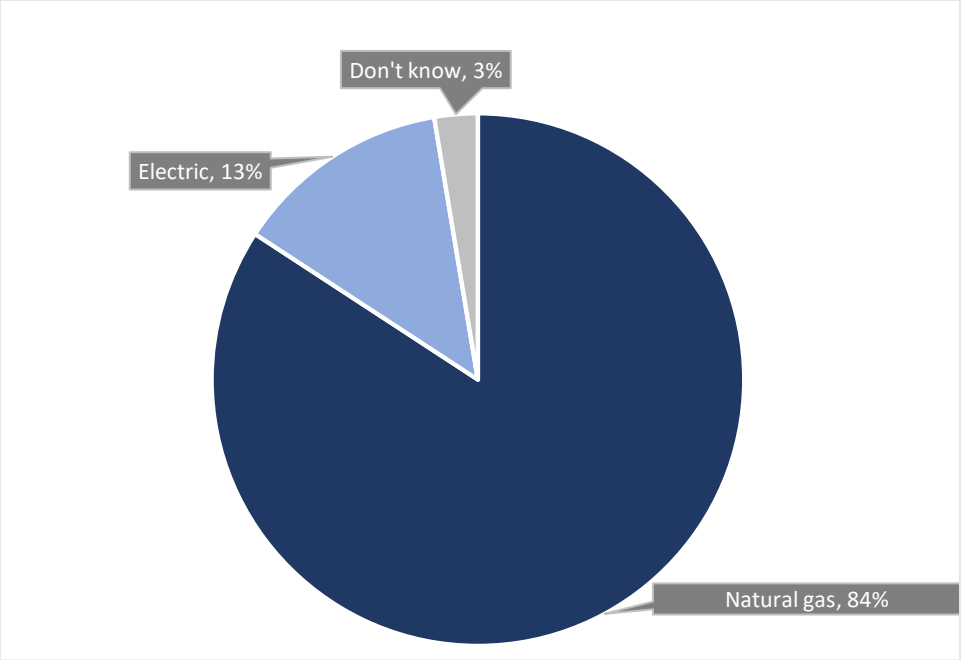

Figure 11-6 Heating in Home

11.6.2.1 Free Ridership

Forty-three percent of respondents would not have installed low flow showerheads in their home if were not provided free-of-charge by CNP. However, 20% would have installed low flow showerheads if they were free. Thirty-six percent of respondents did not know if they would or not. Thirty-six percent would have installed low flow showerheads within one year of the day that they installed them if the showerheads were not provided by CNP.

Table 11-10 Free rider Determination

How soon would you have installed low flow showerheads if they were not provided by CNP?	*Percent of Respondents (n=92)*
Within 6 months of when you installed it	20&
Between 6 months and one year	16%
1-2 years	10%
2-3 years	5%
Never	0%
Don't Know	48%
Refused	1%

Fifty-seven percent of respondents would not have installed faucet aerators in their home if they were not provided free of charge by CNP. However, 16% would have and 26% did not know if they would or not. Thirty-seven percent of respondents would have installed faucet

aerators within one year of the day they had installed it if the aerators were not provided by CNP.

Table 11-11 Free rider Determination

How soon would you have installed faucet aerators if they were not provided by CNP?	Percent of Respondents (n=43)
Within 6 months of when you installed it	23%
Between 6 months and one year	14%
1-2 years	14%
2-3 years	2%
Never	0%
Don't Know	47%
Refused	0%

Those surveyed were then asked questions about their financial ability to install the low flow devices without the program and their energy awareness. Thirty-seven percent would have been able to financially install the low flow devices without CNP's program. Thirty-five percent of respondents would not have been able to financially install the low flow devices without help, and 25% did not know. Before hearing about the CenterPoint low flow kit, 74% of participants were not aware of the energy savings available from low flow devices.

Table 11-12 Energy Awareness

Before hearing about the CNP low flow kit, were you aware of the energy savings available from low flow devices?	Percent of Respondents (n=180)
Yes	14%
No	74%
Don't Know	11%
Refused	0%

11.6.2.2 Overall Program Satisfaction

Overall satisfaction with the program is very high. Respondents were most satisfied with the overall program experience (87%) and the amount of effort required for the program application process (88%). The lowest levels of satisfaction were with savings on the monthly bill (59%), although only 6% of respondents reported being dissatisfied with monthly savings.

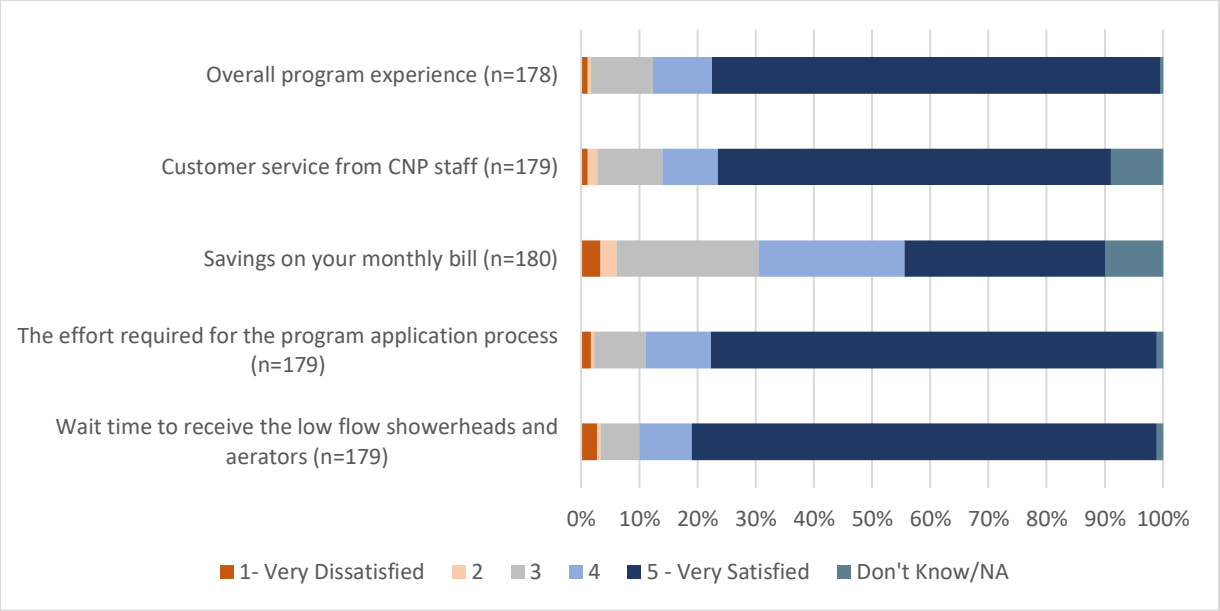

Figure 11-7 Participant Program Satisfaction

Respondents were asked if the online request process was easy for requesting the water conservation kit. Ninety-nine of the respondents stated that it was “very easy” or “somewhat easy” to fill out the online request for the water conservation kit.

Respondents were asked if they received a Thank You email from CenterPoint Arkansas after receiving the low flow kit. Eighty-five percent of respondents stated that they had received this email. Twenty-seven percent of those who responded stated that they installed the low flow kit before receiving the thank you email, and 20% installed the low flow kit after receiving the thank you email. Fifty-two percent either did not know or did not answer this question.

11.6.2.3 Participant Demographics

Respondents were asked numerous questions relating to their home, income, and educational level, and their responses are summarized below. Table 11-13 shows that for those who gave a response and knew the age of their home, 58% lived in a home built prior to 1990.

Table 11-13 Participant Home Age

When was your home built?	Percent of Respondents (n=177)
Before 1970's	29%
1970's	21%
1980's	8%
1990's	16%
2000-2009	12%
2010 or newer	3%
Other	2%
Don't know	7%
Refused	1%

Participants were also asked about the size of their home in square feet. Of those who gave an answer, 39% lived in a home less than or equal to 2,000 square feet. The most common response for respondents at 31% was a home between 1,001 and 1,500 square feet.

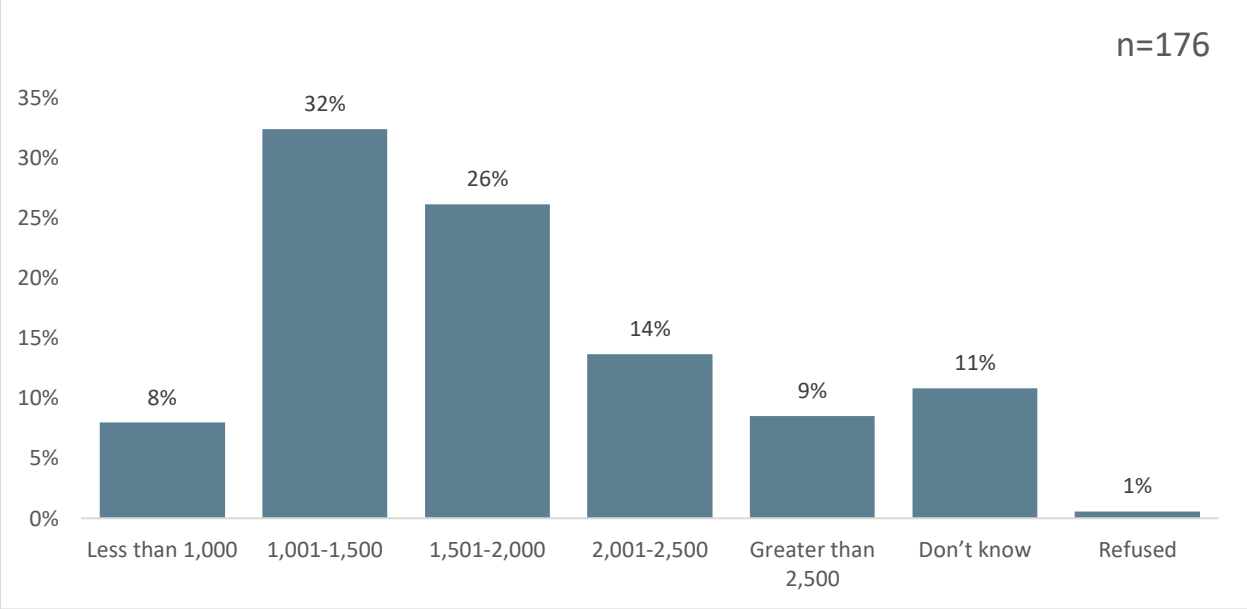

Figure 11-8 Participant Home Size

Respondents were next asked about their home ownership. Figure 11-9shows, 78% of respondents own their home, and 20% of respondents rent their home.

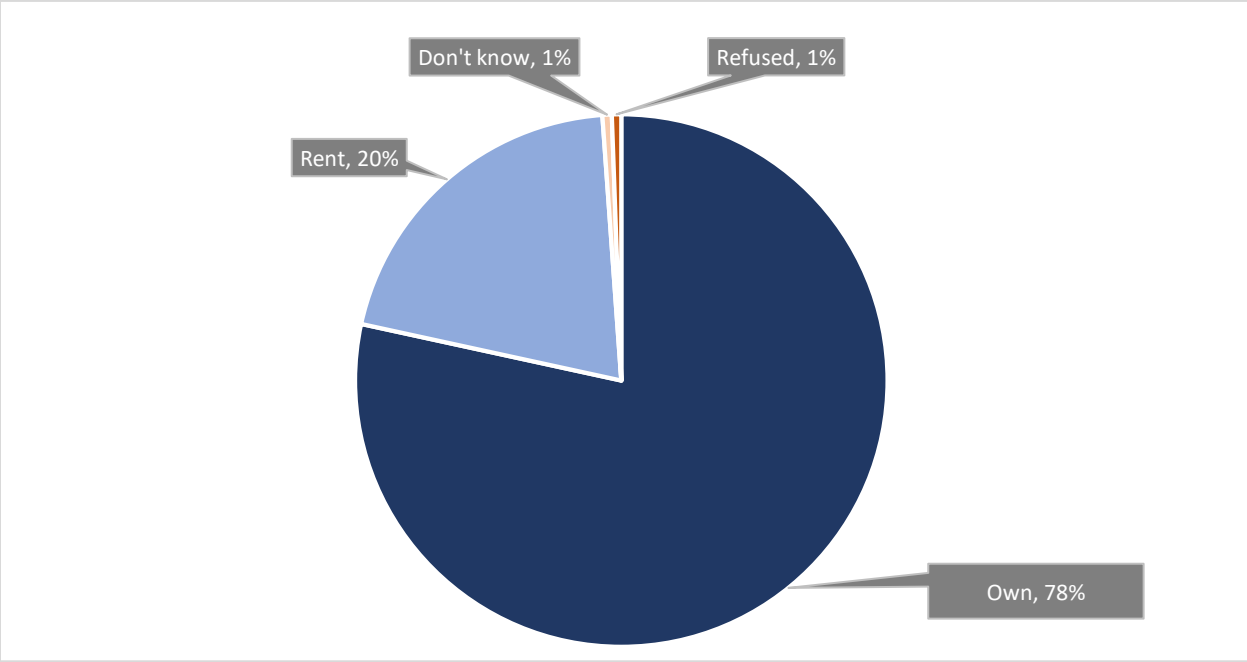

Figure 11-9 Home Ownership

Respondents were asked to identify the total number of occupants in their home. Based on this response, respondents were then asked a "yes or no" question addressing whether their income level was above or below a pre-specified value that maps to 150% of the Federal Poverty Line (FPL)[4] given their number of occupants. This survey approach was taken with the intent of mitigating refusal rates from survey respondents to income questions (which in past evaluations have been as high as in excess of 90%). The occupancy level, income cut-off, and percent indicating below this cutoff are summarized in Table 11-14.

[4] https://aspe.hhs.gov/poverty-guidelines

Table 11-14 Participant Income Level

How many occupants live in your home?	*Percent of Respondents (n =173)*	*Income Cut-off (150% of FPL)*	*Percent of Respondents Below Threshold*
1 person	18%	$18,735	32% (n=31)
2 people	47%	$25,365	17% (n=81)
3 people	18%	$31,995	32% (n=31)
4 people	9%	$38,625	50% (n=16)
5 people	2%	$45,225	50% (n=4)
6 people	1%	$51,885	0% (n=1)
7 people	1%	$58,515	0% (n=1)
8 or more people	N/A	$65,145	0% (n=0)
Don't know	1%	N/A	N/A
Prefer not to answer	3%	N/A	N/A

The Evaluators concluded that 27% of survey respondents qualify as low income (within 150% of the Federal Poverty Line).

12. Cooking Range Program

The Cooking Range Program was designed to provide financial incentives to encourage residential customers to switch from electric ranges to energy efficient natural gas ranges. the replacement of an electric stove to a natural gas model installation is eligible for a rebate.

12.1 Program Description

The Range Program provides mail-in rebates for energy efficient natural gas ranges. Table 12-1 summarizes the incentives provided through the program.

Table 12-1 Range Program Incentives

Equipment Type	*Rebate Amount*
Purchase and installationn costs of new gas range	Up to $300

Table 12-2 shows the number of rebated appliances and ex ante therms savings for the Range Program. There were 39 ranges rebated through the program that were expected to provide savings of 697 therms.

Table 12-2 Ex Ante Therms Savings of Range Program

Equipment Type	*Number of Appliances*	*Ex Ante Therms Savings*
Range	39	1,360

12.2 Gross Impact Evaluation

The following section presents the methodology that was used for estimating gross energy impacts resulting from the Range Program.

The estimated gross energy impacts were found using the assumptions provided in the Projected Incentive Calculation workbook provided by CenterPoint Energy Oklahoma.

12.2.1 Review of Documentation

To determine the quantity of measures rebated and installed, the Evaluators reviewed all entries in the tracking system to ensure there were no erroneous entries.

The approach for the calculation of gross energy impacts depended largely on the types of measures installed. Where applicable, deemed values and algorithms from the Arkansas TRM were used to calculate verified gross energy impacts.

12.2.2 Method for Analyzing Savings from Ranges

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 Btu/kWh

Btu to Therms conversion factor = 100,000 Btu/Therms

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

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

12.3 Gross Savings Results

The ex ante and ex post gross therms savings of the Range Program are summarized by fuel-switch status in Table 12-3.

Table 12-3 Gas Range Gross Ex Ante and Ex Post Annual Therms Savings

Fuel-switch Status	Ex Ante Therms Savings	Ex Post Gross Therms Savings	Gross Therms Savings Realization Rate
Electric-to-Gas	1,360	1,360	100.0%
Total	**1,360**	**1,360**	100.0%

12.4 Net Impact Evaluation

Due to the low participation in the program, the evaluator used the net-to-gross ratio (NTGR) from Oklahoma Natural Gas's PY2018 evaluation. Table 12-4 shows the NTGR used for gas ranges in PY2018.

Table 12-4 Range Program NTGR

Equipment Type	NTGR
Electric-to-Gas Range	80.0%

Table 12-5 summarizes the gross and net ex post Therms savings for the Range Program.

Table 12-5 Gas Range Program Gross and Net Ex Post Therms Savings

Equipment Type	Ex Post Gross Therms Savings	Ex Post Net Therms Savings	Net to Gross Ratio
Electric-to-Gas Range	1,360	1,088	80.0%
Total	1,360	1,088	**80.0%**

13. Clothes Dryer Program

The Clothes Dryer Program was designed to provide financial incentives to encourage residential customers to install energy efficient natural gas clothes dryers.

13.1 Program Description

The Clothes Dryer Program provides mail-in rebates for energy efficient natural gas clothes dryers. Table 13-1 summarizes the incentives provided through the program.

Table 13-1 Clothes Dryer Program Incentives

Equipment Type	*Rebate Amount*
Purchase and installation costs of new gas clothes dryer	Up to $450

Table 13-2 shows the number of rebated appliances and ex ante therms savings for the Clothes Dryer Program. There were 13 clothes dryers rebated through the program that were expected to provide savings of 839 therms.

Table 13-2 Ex Ante Therms Savings of Clothes Dryer Program

Equipment Type	*Number of Appliances*	*Ex Ante Therms Savings*
Clothes Dryers	13	839

13.2 Gross Impact Evaluation

The following section presents the methodology that was used for estimating gross energy impacts resulting from the Clothes Dryer Program.

The estimated gross energy impacts were found using the assumptions provided in the tracking data provided by CenterPoint Oklahoma.

13.2.1 Review of Documentation

To determine the quantity of measures rebated and installed, the Evaluators reviewed all entries in the tracking system to ensure there were no erroneous entries.

The Evaluators' approach for the calculation of gross energy impacts depended largely on the types of measures installed. Where applicable, deemed values and algorithms from the Arkansas TRM were used to calculate verified gross energy impacts.

13.2.2 Method for Analyzing Savings from Clothes Dryer Measures

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.

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

$$\text{therm}_{\text{baseline gas range}} = 3{,}723{,}583\ \text{Btu} \times \left(\frac{1}{100{,}000\ \frac{\text{Btu}}{\text{therm}}}\right) \times 1.05$$

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

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

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 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

13.3 Results of Ex Post Gross Savings Estimation

The ex ante and ex post gross Therms savings of the Clothes Dryer Program are summarized by fuel-switch.

Table 13-3 Clothes Dryer Gross Ex Ante and Ex Post Annual Therms Savings

Measure	*Ex Ante Therms Savings*	*Ex Post Gross Therms Savings*	*Gross Therms Savings Realization Rate*
Electric-to-Gas Clothes Dryers	839	1,294	154.2%

13.4 Results of Net Savings Estimation

Due to the low participation in the program, the Evaluators used the net-to-gross ratio (NTGR) from Oklahoma Natural Gas's PY2018 evaluation. Table 13-4 summarizes the gross and net ex post Therms savings for the Clothes Dryer Program.

Table 13-4 Clothes Dryer Program Gross and Net Ex Post Therms Savings

Equipment Type	*Ex Post Gross Therms Savings*	*Ex Post Net Therms Savings*	*Net to Gross Ratio*
Electric-to-Gas Clothes Dryers	1,294	1,035	80.0%

14. Appendix A: Site Reports

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

Program	C&I Solutions
Project ID	PRJ-2195038
Measures	Boiler Upgrade Compressor Heat Recovery Pipe and Valve Insulation Steam Leak Repairs Steam Trap Replacements

Project Background

The project is a manufacturing facility specializing in producing aerospace for military and civilian aircrafts. that received incentives from CenterPoint for:

- ECM #1: Boiler Upgrades
- ECM #2: Compressor Heat Recovery
- ECM #3: Pipe and Valve Insulation
- ECM #4: Steam leak repairs
- ECM #5: Steam trap replacements

The site has several production, storage, shipping, receiving, and warehouse areas. The production area contains several stages including metal bonding stations, ovens, freezers, machining equipment etc. Natural Gas is primarily used for steam generation for use in processing and comfort heating. The site adopted several energy efficient measures to reduce natural gas consumption. Savings will come from the improved boiler efficiency, repairing steam leaks, retrofitting the piping with insulation, and so on.

Steam Trap Replacement Parameters

Trap Size (inches)	Orifice Size (inches)	Feedwater Temperature (°F)	Inlet Pressure (psig)	Outlet Pressure (psig)	Applied Discharge Rate (lb/hr)
3/4	5/64	70	100	95	6
1	1/8	70	100	95	10
1 1/2	1/4	70	100	95	42

Steam Leak Repair Parameters

Leak No.	System Pressure (psig)	Feedwater Temperature (°F)	Plume Length (ft)	Operating Hours (hr)	Combustion Efficiency
1	100	210	1	8,760	84.8%
2	100	210	1	8,760	84.8%

Bare Pipe Insulated Parameters - Pipe

Length (feet)	Pipe Diameter (inches)	Insulation Thickness	Heat Loss (BTU/hr/ft)
10	4"	2	334.13
40	3"	2	262.33
350	2"	2	177.40
200	1"	2	101.03
70	0.5"	2	80.94

Bare Pipe Insulated Parameters - Valve

Pipe Size	Quantity	Insulation Thickness	Heat Loss (BTU/hr/ft)
4	4	2	334.13
3	2	2	262.33
2	25	2	177.40
1	40	2	101.03
0.75	18	2	80.94

M&V Methodology

Boiler Upgrades

This M&V Report loosely follows the International Performance Measurement and Verification Protocol (IPMVP) Option A - Retrofit Isolation: Key Parameter Measurement. This method calculates energy savings using key energy consumption parameters before the equipment retrofit begins and after the retrofit is completed.

All adjustments, assumptions, estimated values, and savings calculations follow exactly as laid out in the M&V Plan with the following exception:

- Post retrofit combustion efficiency was updated from the assumed 84.3% to the measured 84.8% under medium fire.

Compressor Heat Recovery

All adjustments, assumptions, estimated values, and savings calculations follow exactly as laid out in the M&V Plan with the following exception:

- Rated airflow from the installed fan was used. Since the fan was 2 speed, it was assumed that the fan would mostly run at the lower speed setting of 2893 CFM.
- A spot reading of the air temperature near the fan of 98°F was used.

- TMY3 data was updated to the nearest Oklahoma City of McAlester to calculated annual heating hours when temperature was below 55°F.
- Input power to the air compressor, air temperature leaving vents, and outdoor temperature interval logging was not done since the spot readings were sufficient due to the size of the project.

Steam Trap Replacement

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:

- Steam trap orifice sizes
    - ¾ inch (drip)
    - 1 inch (Process 1)
    - 1 ½ inch (Process 2)
- Annual Hours of Operation
    - 8,760 hours (drip)
    - 8,760 hours (Process 1)
    - 8,760 hours (Process 2)
- Inlet / outlet system pressures
- Boiler efficiency (84.8% estimated)

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.

Pipe and Valve Insulation

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. 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:

- The facility operates 8,760 hours annually

- Variable Insulation thickness: 2 in
- Insulation material type: 850F Min. Fiber Pipe and Tank, Type IIIB, C1393-14
- Boiler Efficiency: 84.8%
- The average annual ambient air temperature 75°F

Boiler Upgrades

Calculations for annual therms savings use the following formulas:

Equation 1 Equivalent Full Load Hours (EFLH)

$$EFLH\left(\frac{hrs}{yr}\right) = \frac{Base\ Load\ Annual\ Energy\ Usage\left(\frac{CCF}{yr}\right) \times 100{,}000\left(\frac{BTU}{CCF}\right)}{Boiler\ Capacity\left(\frac{BTU}{hr}\right)}$$

Equation 2 Annual Energy Savings

$$al\ Energy\ Savings\left(\frac{CCF}{yr}\right) = \frac{Boiler\ Capacity\left(\frac{BTU}{hr}\right) \times\ EFLH\left(\frac{hrs}{yr}\right) \times \left[1 - \frac{Boiler\ Efficiency_{Pre}(\%)}{Boiler\ Efficiency_{Post}(\%)}\right]}{100{,}000\left(\frac{BTU}{CCF}\right)}$$

Compressor Heat Recovery

Calculations for annual therms savings use the following formulas:

Equation 3 Heating Hours

$$Heating\ Hours\left(\frac{hrs}{yr}\right) = COUNTIF\left(Dry\ Bulb_{TMY3}(°F), < Balance\ Point(°F)\right)$$

Equation 4 Annual Energy Savings

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

Steam Trap Replacement

Calculations for annual therms savings use the following equation:

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

Where:

Steam Trap Discharge Rate = steam loss from the system (lb/hr)
OpHrs = annual hours the system is pressurized (hrs/yr)
H_{fg} = latent heat of evaporation (BTU/lb) = 1,152.5 BTU/lb
EC_{Base} = combustion efficiency of boiler (%)
Therm Conversion Factor = 100,000 (BTU/therm)
The discharge rate (lb/hr) was calculated using Armstrong's "Steam Loss Through Failed Trap Calculator" (found here: https://www.armstronginternational.com/knowledge/resources-library/calculators/steam-loss)

Steam Leak Repairs

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 4. Equating Steam Plume Length to Flow Rate

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

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

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

Where:

Leak Rate = calculated value using Equation 1.
Steam Enthalpy = saturated steam region based on system steam pressure
FW Enthalpy = steam look up table based on feedwater temperature
MV Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone

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

Where:

Annual Operating Hours = number of hours facility operates annually (obtained from facility representative)
Eff_{Boiler} = 84.8% (Note: only one boiler was tested)
100,000 Btu/CCF = conversion factor (BTU/yr to CCF/yr)

Pipe and Valve Insulation

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:

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

Where:

Heat loss = Difference between pre and post heat measurements (btu/hr/ft) multiplied by the pipe length

AOH = Annual operating hours (8,760 hours)

Boiler efficiency = 84.8%

Therms conversion factor = $\frac{1\ therm}{100{,}000\ BTU/CcF}$

Measure Life

Estimated Useful Life by Measure

Measure	*EUL*
Boiler Upgrades	20 years
Compressor Heat Recovery	15 years
Pipe and Valve Insulation	20 years
Steam Leak Repairs	10 years
Steam Trap Replacements	5 years

Calculated Savings:

Boiler Upgrades

Boiler Upgrades Savings

No.	*Load type*	*Capacity*	*Pre boiler efficiency*	*Post boiler Efficiency*	*Annual boiler usage (CCF)*	*Annual energy savings*
1	Base	3,348,000	67.6%	84.8%	95,306	19,331
					Total	19,331

Compressor Heat Recovery

Compressor Heat Recovery Savings

No.	*Fan CFM Flow*	*Average Production Room Temp*	*Average Duct Temp*	*Compressor Operating Hours*	*Balance Point*	*Heating Hours*	*Annual energy savings*
1	2,893	75	98	5,256	55	2,889	2,595
						Total	2,595

Steam Trap Repairs

Steam Trap Replacement Savings

Steam Trap #	Orifice Size (in.)	Inlet Pressure (psig)	Outlet Pressure (psig)	Discharge Rate (lb/hr)	Steam Enthalpy (BTU/lb)	Feedwater Enthalpy (BTU/lb)	Therms Savings
1	3/4”	100	95	6	1,190.6	38.08	714
2	1”	100	95	10	1,190.6	38.08	1,191
3	1 1/2”	100	95	42	1,190.6	38.08	5,000
						Total	**6,905**

Steam Leak Repairs

Steam Leak Repairs Savings

Steam Leak #	Plume Length (ft)	Steam Pressure (psig)	Leak Rate (lbs/hr)	System Enthalpy (BTU/lb)	Heat Loss (BTU/hr)	Therms Savings
1	1	100	9.93	1,154.62	11,465.85	1,184
2	1	100	9.93	1,154.62	11,465.85	1,184
					Total	**2,369**

Pipe and Valve Insulation

Using the above parameters, calculated savings of each insulation installation are presented in the table below.

Insulated pipe savings

Length (feet)	Pipe Diameter (inches)	Insulation Thickness	Heat Loss (BTU/hr/ft)	Gas Savings (Therms)
10	4	2	334.13	345
40	3	2	262.33	1,084
350	2	2	177.40	6,414
200	1	2	101.03	2,087
70	0.5	2	80.94	585
			Total	**10,516**

Insulated valves savings

Total Equivalent Length	Quantity	Insulation Thickness	Heat Loss (BTU/hr/ft)	Gas Savings (Therms)
4	4	2	334.13	479
3	2	2	262.33	182
2	25	2	177.40	1,374
1	40	2	101.03	939
0.75	18	2	80.94	301
			Total	**3,275**

Overall project savings are as follows:

Overall Project Savings

Measure	Expected Annual therms Savings	Realized Annual therms Savings	Realization Rate	Lifetime therms Savings
Boiler Upgrades	19,331	19,331	100.00%	386,620
Compressor Heat Recovery	2,595	2,595	100.00%	38,925
Insulation	13,791	13,791	100.14%	276,220
Steam Leak Repair	2,369	2,369	100.00%	23,690
Steam Trap Replacement	6,905	6,905	100.00%	34,525
TOTAL	**44,991**	**44,991**	**100.04%**	**759,980**

Program C&I Solutions
Project ID PRJ-1745684
Measures Steam Leak Repairs

Project Background

The participant is a consumer products manufacturer that received incentives from CenterPoint Oklahoma for:

- ECM #1: Steam leak repairs

The site uses steam throughout the facility primarily for space heating. Savings will come from repairing the steam leaks throughout the site'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 based on the AR TRM 8.0
- Annual operating hours for the site are 8,736 hours
- Combustion efficiency is 79.0%

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.

Equating Steam Plume Length to Flow Rate

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

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

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 **Error! Reference source not found.**.
Steam Enthalpy = saturated steam region based on system steam pressure
MW Enthalpy = steam look up table based on makeup water temperature, derived from average temperature of water main in each zone (34.2 BTU/lb)

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

Steam Leak Parameters

Steam Leak #	Description	Quantity of Leaks	Plume Length (ft)	Steam Pressure (psig)	Leak Rate (lbs/hr)	Boiler Efficiency
1	STD Blk mail 90 ELL	3	0.5	100	7.50	79.0%
2	3/4 150 BRZ GLB VLV TFE Disc	5	0.5	100	7.50	79.0%
3	4.5 300 press gauge	2	0.5	100	7.50	79.0%
4	3/4 steam safety vlv 150	2	0.5	100	7.50	79.0%
5	Pressuretrol 10-150, 10 psi Diff	1	0.5	100	7.50	79.0%

Energy Savings

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

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 = 8,736 hours

Boiler Efficiency = 79.0%

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

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).

Equation 5. Annual Energy Savings Unit Conversion (therms/year to BTU/year)

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

Equation 6. Calculation for Pounds of Steam Produced per Year

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

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

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	STD Blk mail 90 ELL	3	0.5	1,190.60	1,154.62	2,872
2	3/4 150 BRZ GLB VLV TFE Disc	5	0.5	1,190.60	1,154.62	4,787
3	4.5 300 press gauge	2	0.5	1,190.60	1,154.62	1,915
4	3/4 steam safety valve 150	2	0.5	1,190.60	1,154.62	1,915
5	Pressure trol 10-150, 10 psi Diff	1	0.5	1,190.60	1,154.62	957
					Total:	**12,445**

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	12,445	12,445	100.0%	124,451	102,221	1,022,212
TOTAL	**12,445**	**12,445**	**100.0%**	**124,451**	**102,221**	**1,022,212**

Program C&I Solutions
Project ID PRJ-2219444
Measures Pipe Insulation

Project Background

The participant is an industrial facility producing asphalt for road construction that received incentives from CenterPoint Energy for:

- ECM #1 – Pipe Insulation

The site uses steam throughout the facility primarily for asphalt production process. Savings will come from properly insulating sections of pipe on rotary kiln and hot oil piping and elbows 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:

- Combustion efficiency is 80.0% (for both pre-retrofit and post-retrofit condition)

Pipe Insulation

For this measure, 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:

- Hours of operation: 3,854 hours for Cylindrical tank, 8,760 hours for Pipe, valve and fitting.
- Insulation thickness: 2.0 in and 2.1 in
- Insulation material type: 850°F Min. Fiber Pipe and Tank, Type IIIB, C1393-14 and 850F MF BLANKET, Type IV, C553-13
- Boiler Efficiency: 80.0%
- Process temperatures: 330°F
- Ambient air temperature: 62°F

The 3E Plus software was used to calculate heat loss (btu/hr/ft) for bare piping (pre-retrofit) and piping with 2.0 inch and 2.1-inch insulation (post-retrofit). The software required these inputs: process temperature, ambient temperature, pipe size, base metal, insulation, and jacket material. Annual therms savings was calculated using the following equation:

Pipe Insulation Installation Annual Energy Savings

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

Where:

Annual Operating Hours = number of hours facility operates annually

Boiler Efficiency = 80.0%

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

Pipe/Vale Insulation Parameters

Entry #	*Description*	*Object to Insulate*	*Quantity*	*Tank surface(ft2) / Pipe or Valve Equivalent Length (ft)*	*Diameter (in)*	*Insulation Thickness*
1	Rotary Kiln	Cylindrical Tank	1	326.73	6	2.0
2	4 in Hot Oil Pipe	Pipe	1	159.33	4	2.0
3	4 in Hot Oil Fittings	Valve or Fitting	1	6.94	3	2.0
4	2 in Hot Oil Pipe	Pipe	1	109	2	2.1
5	2 in Hot Oil Fittings	Valve or Fitting	1	30	3	2.1
6	1 in Hot Oil Pipe	Pipe	1	97.83	3	2.1
7	1 in Hot Oil Fittings	Valve or Fitting	1	11.25	2	2.1

Measure Life

Estimated Useful Life by Measure

Measure	EUL
Pipe Insulation	20 years

Calculated Savings:

Pipe Insulation

Pipe Insulation Annual Energy Savings

Entry #	Object to Insulate	Equivalent length / surface (ft/ft2)	Process Temperature (°F)	Pre Surface Temp (°F)	Post Surface Temp (°F)	Pre Heat Loss	Post Heat Loss	Gas Savings	Therms Savings
1	Cylindrical Tank	326.73	330	329.5	100.2	747.4	43.07	704.33	11,060.26
2	Pipe	159.33	330	329.1	74.1	1582	76.04	1505.96	26,273.93
3	Valve or Fitting	6.94	330	329.1	73.5	1582	71.94	1510.06	1,147.54
4	Pipe	109	330	329.3	71.2	1019	48.54	970.46	11,582.93
5	Valve or Fitting	30	330	329.3	70.7	1019	45.89	973.11	3,196.67
6	Pipe	97.83	330	329.2	69.3	693.3	34.66	658.64	7,055.61
7	Valve or Fitting	11.25	330	329.3	69.3	693.3	34.66	658.64	811.36
								Total:	**61,128.29**

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
Pipe Insulation	61,131	61,128	100.0%	1,222,566	NA	NA
TOTAL	**61,131**	**61,128**	**100.0%**	**1,222,566**	**NA**	**NA**

The realization rate for the project is 100.0%.