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VIA ELECTRONIC FILING

Rosemary Chiavetta, Secretary
Pennsylvania Public Utility Commission
Commonwealth Keystone Building
400 North Street, 2nd Floor North
P.O. Box 3265
Harrisburg, PA 17105-3265

**Re: Columbia Gas of Pennsylvania, Inc. Residential Energy
Efficiency Program Plan
Docket Nos. R-2022-3031211, et al.**

Dear Secretary Chiavetta:

On December 8, 2022, at the above referenced docket, the Commission approved the Joint Petition for Partial Settlement in Columbia Gas, Inc.'s ("Columbia") rate case proceeding. The Partial Settlement, at paragraph No. 40, approved Columbia's three-year Residential Energy Efficiency Program, with a total budget of \$4 Million recovered through Rider EE. Attached hereto is a copy of Columbia's Residential Energy Efficiency Program Plan for 2023 through 2025, as well as a redline version that shows the changes made to the plan on account of the proposed \$8 Million budget being revised to \$4 Million. Columbia held a virtual meeting on December 14, 2022, at which Columbia presented the changes included in the attachments to the rate case parties.

Should you have any questions, please do not hesitate to contact me at (717) 210-9625 or via email at ahirakis@nisource.com.

Very truly yours,

Amy E. Hirakis
Counsel for
Columbia Gas of Pennsylvania, Inc.

Enclosure

Cc Certificate of Service

Columbia Gas of Pennsylvania

Three-Year Energy Efficiency Plan –
January 1, 2023 – December 31, 2025

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1 Introduction and Background

1.1 Plan Overview

This plan provides a detailed description of the design and implementation of the energy efficiency and conservation portfolio (“EE&C Portfolio” or “Portfolio”) that Columbia Gas of Pennsylvania, Inc. (“Columbia Gas” or “the Company”) is proposing to offer in its Three-Year Energy Efficiency (“EE Plan” or “Plan”). The Plan builds on other voluntary gas energy efficiency plans offered by natural gas distribution companies serving Pennsylvania, and specifically targets residential customers. This document provides an updated scenario that aligns with settlement conditions to maintain a budget of \$4 million over the 3-year period. In this scenario, the Residential Prescriptive program’s initial year participation was reduced and projected ramp up was taken down to minimal levels for 2024 and 2025, with associated reductions in variable administration and marketing costs. Similarly, the first year and ramp up for the Online Audit Kit Program was adjusted downward significantly for 2024 and 2025. Portfolio wide costs were maintained at current levels to maintain full oversight of the portfolio.

The Plan has a three-year duration, beginning January 1, 2023 and ending December 31, 2025. Over the three years of the Plan, Columbia Gas plans to spend \$4.0 million on the administration and delivery of two residential energy efficiency programs. The programs are projected to save 1.3 million Dth of natural gas over the lifetime of the measures installed. From a total resource perspective, the portfolio present value of benefits is \$10.9 million, with \$5.1 million in present value of costs, leading to a present value of net benefits of \$5.7 million and a TRC BCR of 2.12. Furthermore, the energy efficiency programs are expected to save 3,041 MWh of electricity, 84 million gallons of water, create between 38 and 76 jobs, and avoid the emission of CO₂ equivalent to over 2,900 cars being removed from the road over the lifetime of installed measures.

1.2 Plan Development

The Plan was developed to help Columbia Gas' residential customers to address barriers to using natural gas more efficiently. It has two programs:

- Residential Prescriptive (RP) Program
- Online Audit Kit (OAK) Program

The RP Program is based on rebate programs run in Pennsylvania by other natural gas distribution companies. The OAK Program is based on a successful program run by Columbia Gas of Virginia for over the past decade.

Various market characteristics were gathered for Columbia Gas' territory, including avoided costs for natural gas and electricity, demographic, building stock, and equipment market characteristics. Next, measures were characterized and screened for cost effectiveness using the TRC test. Incentive levels were established for these measures and projects, generally set to be in-line with the other programs in Pennsylvania. The cost-effective measures and projects were then used to calculate savings and maximum participation levels. Programs were staged to account for the ramp-up required for new programs. Finally, non-incentive budgets were developed to address fixed and variable costs associated with each program and the portfolio.

1.3 Portfolio Costs

The following table provides an overview of the spending by year and program for the total EE Plan. The maximum projected budget in a year is \$1.5 million in FY 2025, approximately 0.28% of Columbia Gas' FY 2020 revenues.¹ Although Act 129's requirements are not mandatory for voluntary natural gas distribution company energy efficiency programs, this level is well under the 2% cap that Act 129 imposes on electric efficiency programs in Pennsylvania.² Since only residential customers are eligible for the programs, it is anticipated that all costs

¹ \$3.8 million is 0.7% of total 2020 revenues of \$555 million from Columbia's Annual Report of Columbia Gas of Pennsylvania, Inc. Year Ended December 21, 2020 at p. 26.

² See 66 Pa.C.S. § 2806.1(g) (limiting the total cost of an EDC's EE&C Plan to 2% of the EDC's total annual revenue as of December 31, 2006).

will be recovered from the residential rate class, excluding Customer Assistance Program (“CAP”) customers.

Table 1. Projected Spending for EE Plan by Program

Projected Costs (Nominal)	2023	2024	2025	2023 - 2025
Residential Prescriptive Program	\$650,000	\$789,000	\$978,000	\$2,417,000
Online Audit Kit Program	\$216,630	\$242,720	\$311,650	\$771,000
Portfolio Wide Costs	\$300,000	\$254,000	\$258,000	\$812,000
Total	\$1,166,630	\$1,285,720	\$1,547,650	\$4,000,000

The portfolio-wide cost lines from the previous table are costs that apply to all programs in the EE portfolio. They are costs incurred at the portfolio level for program development, design, tracking, reporting, and administrative overhead. Development costs for the portfolio occur in the first year as programs are designed and reporting infrastructure is put in place. These costs become a smaller percentage of the portfolio as the rest of the programs ramp up. In the final year, the portfolio wide costs represent 17% of the portfolio total cost, and, over the three-year period, they represent 20% of the portfolio’s costs. The following table provides a portfolio-level look at costs by category.

Table 2. Projected Efficiency Portfolio Budgets by Category

Category	2023	2024	2025	2023 - 2025
Customer Incentives	\$487,630	\$703,720	\$832,650	\$2,024,000
Administration	\$504,000	\$453,000	\$481,000	\$1,438,000
Marketing	\$132,000	\$77,000	\$86,000	\$295,000
Inspections	\$23,000	\$32,000	\$38,000	\$93,000
Evaluation	\$20,000	\$20,000	\$110,000	\$150,000
Total	\$1,166,630	\$1,285,720	\$1,547,650	\$4,000,000

1.4 Portfolio Benefits

1.4.1 Natural Gas Savings

The following tables provide projected natural gas savings by program and sector for the EE Plan.

Table 3. Projected First Year Gas Savings by Program (Dth)

Program	2023	2024	2025	2023 - 2025
Residential Prescriptive Program	14,518	20,339	23,952	58,809
Online Audit Kit Program	2,666	5,367	6,709	14,743
Total	17,184	25,707	30,661	73,552

Table 4. Projected Lifetime Gas Savings by Program (Dth)

Program	2023	2024	2025	2023 - 2025
Residential Prescriptive Program	264,136	369,495	432,463	1,066,094
Online Audit Kit Program	35,903	72,154	90,192	198,248
Total	300,039	441,648	522,655	1,264,342

1.4.2 Other Resource Savings

The following table shows electric savings for measures installed under the energy efficiency programs in the EE&C Portfolio. The electric savings are secondary savings from measures that primarily save natural gas, such as air-conditioning savings from thermostats. This section contains ancillary water savings from gas efficiency measures that also save water, such as low-flow faucet aerators and showerheads.

Table 5. Projected Electric and Water Savings

	2023	2024	2025	2023 - 2025
First Year				
Energy (MWh)	65	95	116	276
Demand (kW)	11.7	16.9	20.8	49.3
Water (Million Gallons)	1.5	3.1	3.9	8.4
Lifetime				
Energy (MWh)	720	1,040	1,281	3,041
Water (Million Gallons)	15.1	30.8	38.5	84.4

1.4.3 Emission Reductions

This section contains projections for CO₂ emission reductions due to the energy efficiency programs. The total lifetime savings of 76 thousand tons of CO₂ is equivalent to removing over 2,900 cars off the road. The following table breaks out the emission reductions due to gas savings and electric savings. While the emissions reductions are projected below, the main TRC test for the portfolio does not include any monetized value for these emissions reductions.

Table 6. Projected Lifetime CO₂ Emission Reductions by Energy Source (Short Tons)

Savings Source	2023	2024	2025	2023 - 2025
Natural Gas	17,552	25,836	30,575	73,964
Electricity	658	950	1,170	2,778
Total	18,210	26,787	31,745	76,742

1.4.4 Job Creation

Investing in cost-effective energy efficiency creates jobs in two ways, one direct and the other indirect, as discussed in a 2012 white paper from the ACEEE.³ Direct job creation results from hiring related to implementing the programs. Indirect job creation results from the substitution of capital spent on natural gas with capital spent in the local economy. Additional jobs are created by the indirect or income effect from cost-effective energy efficiency investment. Further, the net economic benefits from efficiency investment reduce household and business gas bills and raise household disposable incomes and business profitability. Customers will tend to spend most of this additional money and save the rest. This additional spending creates a “multiplier” effect through the cycle of re-spending of the initial cost savings, which stimulates aggregate demand for goods and services. Satisfying increased demand for goods and services requires more labor. While some of the jobs created leak into the broader U.S. and global economy, a good portion (possibly higher than 80%) of jobs created due to energy efficiency stay within the Commonwealth. The approach of looking at net job

³ “Energy Efficiency Job Creation: Real World Experiences” Bell, Casey J. American Council for an Energy-Efficiency Economy. October 2012.

creation through both direct means and with economic multiplier effects is endorsed in the 2012 white paper from ACEEE.⁴

The number of jobs created from investments in energy efficiency directly relates to the total resource value of the energy that these measures save. Studies of employment impacts of Demand Side Management (“DSM”) use energy savings as a surrogate for total resource value. A meta-study of U.S. data found that estimates for the number of jobs created had a wide range, but that most studies estimate that between 30 and 60 net jobs are created by saving one TBtu.⁵ In New York, New Jersey, and Pennsylvania, the ACEEE projected that 164,320 jobs, or 59 for every TBtu saved, could be attributed to EE in 1997 through 2010.⁶

As shown in the following table, Columbia Gas estimates that its gas energy efficiency programs portfolio will generate between 38 and 76 net additional jobs over the lifetime of the efficiency measures installed over the next five-years. This range is based on assuming that each TBtu of gas savings creates between 30 and 60 full-time equivalent jobs in Pennsylvania.

Table 7. Estimated Job Creation due to Energy Efficiency Programs

JOB CREATION IMPACTS OF GAS EFFICIENCY PORTFOLIO			
	30 Jobs/TBtu	45 Jobs/TBtu	60 Jobs/TBtu
TOTAL PORTFOLIO			
2023	9	14	18
2024	13	20	26
2025	16	24	31
TOTAL	38	57	76

⁴ Energy Efficiency Job Creation: Real World Experiences” Bell, Casey J. American Council for an Energy-Efficiency Economy. October 2012.

⁵ Laitner, Skip, and Vanessa McKinney. June 2008. *Positive Returns: State Energy Efficiency Analyses Can Inform U.S. Energy Policy Assessments*. Washington, D.C.: American Council for an Energy Efficiency Economy.

⁶ Nadel, Steven, Skip Laitner, Marshall Goldberg, Neal Elliott, John DeCicco, Howard Geller, and Robert Mowris. 1997. *Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania*. Washington, D.C.: American Council for an Energy Efficiency Economy.

1.5 Cost-Effectiveness Analysis

The following table provides Total Resource Cost (TRC) test cost-effectiveness projections for the EE Plan.

Table 8. TRC Cost-effectiveness Summary of Portfolio (2022\$)

Program	Total Resource PV Benefits	Total Resource PV Costs	Total Resource PV Net Benefits	Total Resource B/C Ratio
Residential Prescriptive Program	\$8,383,549	\$3,690,323	\$4,693,226	2.27
Online Audit Kit Program	\$2,472,719	\$695,683	\$1,777,035	3.55
Portfolio Wide Costs	\$0	\$738,970	(\$738,970)	-
EE Programs	\$10,856,268	\$5,124,977	\$5,731,291	2.12

While the portfolio is cost effective using the primary TRC Test, if the values for demand-response induced pricing effects (“DRIFE”)⁷ and internalized market prices for carbon dioxide (“CO₂”) are included, the portfolio would show substantially more benefits.

1.5.1 Cost-Effectiveness Analysis Methodology

The cost-effectiveness results reported in the Plan followed standard industry practices for utilizing the TRC Test for cost effectiveness. The TRC Test methodology used is similar to that used by other natural gas distribution companies serving Pennsylvania that offer energy efficiency programs, and by the Act 129 Utilities. To calculate benefits, projected natural gas, electricity, and water savings are multiplied by avoided costs, and this stream of future values is discounted to the present. The cost side of the test consists of the present value of all incremental costs incurred by participants, including net operation and maintenance costs, and the non-incentive costs incurred by the portfolio administrator. If the benefits outweigh the costs (the benefit-cost ratio is above one), then the total cost of energy services for an average customer within the territory will fall and the portfolio is considered cost effective

⁷ DRIFE accounts for the suppression effects on wholesale prices from reduced usage due to DSM.

The analysis used a real discount rate (RDR) of 3%. The RDR was calculated using an assumption of a nominal discount rate (“NDR”) of 5% and inflation rate of 2.0%, which comes from the Act 129 Phase IV TRC Test Order.⁸

1.5.2 Avoided Costs

The avoided cost of natural gas for Columbia Gas of Pennsylvania was developed in a similar manner to other Pennsylvania natural gas distribution companies offering energy efficiency programs and includes the costs of baseload and storage capacity, along with an estimate of avoidable local distribution costs. The avoided costs for baseload capacity were computed as the cost of Columbia Gas Transmission (TCO) FTS, Henry Hub commodity was priced using NYMEX futures from March 7, 2022 through 2027. The futures prices and the 2022 Annual Energy Outlook (“AEO”) forecasts are very close to one another in 2027 and 2028, and differ by less than 10% on an annual basis through the end of the futures in 2034. The Annual Energy Outlook projections were used from 2028 onward. The avoided costs for heating load were computed from the Columbia Gas Transmission SST rate, plus refill from the Columbia FSS rate, adjusted for load factor over the heating season. Commodity costs include the commodity charge and gas retention from the TCO tariffs. The avoided costs also include an allowance for avoidable load-related distribution investments, borrowed from UGI’s estimates in its 2018 EE&C filing, at Docket No. R-2018-3006814.

The Plan also uses avoided costs for electric energy and peak demand based on weighted average annual values from the electric utilities in Columbia Gas’ territory, including Duquesne Light Company, Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, and West Penn. Values for the various electric utilities came from the respective Act 129 Phase IV filings for each utility.

Avoided costs for water came from the Act 129 Phase IV TRC Test Order.

⁸ Act 129 Phase IV 2021 Total Resource Cost (TRC) Test (Case No. M-2019-3006868). Final Order dated December 19, 2019. P. 20

1.6 Implementation

1.6.1 Program Staging

The Company anticipates that it will require six to nine months post Plan approval to finalize implementation details, hire vendors, and begin the marketing and outreach for ramping up the programs. All programs are projected to begin operations by July 1, 2023. This will give the programs a short year of activity in 2023, with significantly more activity projected in 2024 with the anticipation of full participation levels in 2025.

1.6.2 Administration

The Portfolio will be managed by Columbia Gas, who will engage the services of various contractors to fulfill all the roles required to implement the Plan. The table below describes the main roles in the management of the Plan.

Table 9. Overview of Administration Roles

Role	Description
Plan Administrator	Primarily responsible for program and portfolio planning, management and reporting. Supervises and manages all other roles.
Implementation and Design Consultants	Provides assistance in the design and implementation on multiple aspects of the portfolio, including, but not limited to, program design, reporting, marketing, and training.
Implementation Contractor	Directly responsible for main aspects of program delivery, including but not limited to, customer engagement and retention, technical assistance, measure installation, rebate processing, program tracking, inspection, and reporting.
Evaluator	Performs independent program and portfolio evaluations that are used to verify savings and guide future plans.

1.6.3 Marketing

Columbia Gas will investigate the use of a branded micro-website for the programs, for which multiple streams of advertising will lead back to, such as print, online ads, social media, bill inserts, trade ally outreach and residential canvassing efforts. These efforts are anticipated to be particularly important for driving

participation in the Online Audit Kit program, which in turn may feed into the Residential Prescriptive Program.

Columbia Gas will also look to partner with local businesses and trade organizations (builders, contractors, electricians, plumbers, HVAC service providers, equipment suppliers, etc.) to familiarize them with program opportunities, energy efficiency practices and implementation requirements and to utilize them, where appropriate, as one of the program's service delivery channels.

- Targeting equipment manufacturers, distributors, installation contractors and retailers/vendors to make sure they offer high-efficiency equipment and can make customers aware of available incentives.
- Partnering with community-based organizations to develop outreach and program delivery strategies.
- Working with Act 129 electric administrators to combine marketing and delivery options and address all aspects of efficiency at the same time.

Additional details for each program are in the individual program plans, and Columbia Gas will develop a more detailed marketing strategy for each of the programs and for the entire portfolio as part of the program setup.

1.6.4 Reporting

Columbia Gas will submit an annual report on the EE Plan each April, three months after the close of the program year. This report will provide information on activity for the previous year and progress towards three-year goals, including, but not limited to:

- First year and lifetime savings;
- Participation;
- Spending;
- Cost effectiveness;
- Highlights of portfolio and program activity; and
- Updates to program delivery and design.

In-order to tie savings and costs together as effectively as possible, results will be reported based on commitments made. Any measures that have been

verified as installed within a program year along with any costs committed to these measures, including administration costs, will be counted for that year.

1.6.5 Program Flexibility

To make sure that the EE&C Portfolio is able to address changing market conditions and improve service delivery as quickly as possible, Columbia Gas requires flexibility in the allocation of budgets and implementation of program improvements. This plan document provides the principles and three-year goals that Columbia Gas is seeking, but certain adjustments, such as providing incentives for new measures or moving budgets between years and programs, may be required to meet these goals. Columbia Gas will include any such adjustments in its annual report but does not anticipate seeking initial approval for such updates, considering that all costs are anticipated to be collected from the same rate class. Columbia Gas will file an updated EE Plan in anticipation of material changes that may have a serious effect on goals, such as:

- The addition or removal of a program;
- A need for total funding levels above those approved for the plan term; and
- Significant changes to cost-effectiveness projections, such as an update to avoided costs or a large reduction in portfolio spending projections.

1.7 Evaluation, Measurement, and Verification

1.7.1 Technical Reference Manual

To maintain consistency with existing gas efficiency programs in Pennsylvania, Columbia Gas will utilize a Technical Reference Manual (“TRM”) based on the most recent version of the UGI Gas, Inc. TRM and Columbia Gas VA’s experience with its online audit program. The Columbia Gas TRM will only contain those measures relevant to the programs proposed in this plan, and will include updates to some measure assumptions to calibrate them to Columbia Gas’ service territory (such as equivalent full load heating hours and heating degree days). In the future, any results from program evaluations that affect deemed savings calculations will

also be added to the TRM. The proposed TRM is included as Attachment A to this plan.

1.7.2 Tracking System

Columbia Gas will require that its coordinators collect all relevant customer, application, measure, and contractor information and that this data is provided in a timely fashion. Columbia Gas will regularly review this data, and will aggregate cost, savings, and participation data to a centralized database controlled by Columbia Gas that will be the source for program management and reporting.

1.7.3 Inspections

Inspections may be performed on a sub-set of applications before any incentive is paid. Inspectors will determine whether the measure is operational and matches the application, and they will solicit customer feedback on the programs. Inspection rates for prescriptive programs will be designed to gather a statistically significant sample of program activity. See individual program plans for additional details.

1.7.4 Evaluations

Columbia Gas will monitor the ongoing progress of the EE Plan to provide the highest possible service to customers, while maintaining controls to maximize the potential for savings and costs to be properly verified and counted. Columbia Gas will closely track program data, perform inspections of completed projects, and perform periodic evaluations for all the programs.

Columbia Gas will, at a minimum, evaluate each of its programs once adequate participation levels have been reached and a full 12 months of post-participation billing data has been collected. As part of the initial program development, Columbia Gas will work with the selected evaluator to establish the methodology and goals of the evaluation. Initial objectives include:

- Verifying energy savings and associated costs;
- Assessing market attitudes towards the program, including contractors, customers, and efficient equipment suppliers; and

- Measuring the effectiveness of current program design, marketing, and service delivery.

The evaluation section of the individual program descriptions includes additional details on evaluation schedules and goals unique to that program.

2 Program Plans

2.1 Residential Prescriptive

Objective	<p>The Residential Prescriptive (RP) program is designed to overcome market barriers to energy efficient space and water heating equipment in the residential sector through rebates and customer awareness. The objective of the program is to avoid lost opportunities by encouraging consumers to install the most efficient gas heating technologies available when replacing older, less efficient equipment. The program also aims to strengthen Columbia Gas' relationship with HVAC contractors, suppliers, and other trade allies.</p>				
Eligible Rate Class	RDS/RSS				
Cost Effectiveness	<i>Three-Year Cost-Effectiveness Results (2022\$)</i>				
	CE Test	PV Benefits	PV Costs	PV Net	BCR
	TRC Test	\$8,383,549	\$3,690,323	\$4,693,226	2.27
Gas Admin Test	\$8,246,078	\$2,179,527	\$6,066,551	3.78	
Savings Projections	<i>Three-Year Savings Projections</i>				
	First Year Savings	2023	2024	2025	2023 - 2025
	Natural Gas (Dth)	14,518	20,339	23,952	58,809
	Electric Energy (MWh)	65.5	94.6	116.4	276.5
	Peak Demand (kW)	11.7	16.9	20.8	49.3
Water (Million Gallons)	0.0	0.0	0.0	0.0	

	Lifetime Savings	2023	2024	2025	2023 - 2025
	Natural Gas (Dth)	264,136	369,495	432,463	1,066,094
	Electric Energy (MWh)	720.3	1,040.5	1,280.6	3,041.4
	Water (Million Gallons)	0.0	0.0	0.0	0.0
Budget Projections	Three-Year Budgets (Nominal)				
	Costs by Category	2023	2024	2025	2023 - 2025
	Customer Incentives	\$462,000	\$652,000	\$768,000	\$1,882,000
	Administration	\$91,000	\$73,000	\$78,000	\$242,000
	Marketing	\$74,000	\$32,000	\$34,000	\$140,000
	Inspections	\$23,000	\$32,000	\$38,000	\$93,000
	Evaluation	\$0	\$0	\$60,000	\$60,000
	Total	\$650,000	\$789,000	\$978,000	\$2,417,000
Participation Projections	Three-Year Participation Projections				
	Projected Units	2023	2024	2025	2023 - 2025
	Furnace - ENERGY STAR	520	700	800	2,020
	Boiler - 94+ AFUE	20	30	40	90
	Combi Boiler - 94+ AFUE	80	120	140	340
	Wifi Thermostat - ENERGY STAR	900	1,300	1,600	3,800
	Tankless Water Heater - ENERGY STAR	120	170	200	490
	Total	1,640	2,320	2,780	6,740
Program Rollout	<p><i>Jan 2023 – Jun 2023</i> Finalize program process and implementation details, select vendors, and develop initial marketing push</p> <p><i>Jul 2023</i> Launch Program</p>				

	<p>2023 - 2024 Continue engagement activities with customers and trade allies.</p> <p>2025 Reach full anticipated participation levels.</p>
Program Design	<p>The RP Program offers rebates for qualifying residential-sized space and water heating equipment and controls. For most measures, customers will have a contractor install the measure and receive a rebate to offset some of the incremental cost of the higher efficiency equipment. Smaller measures, such as Wi-Fi enabled thermostats, will only require a valid proof of purchase before a rebate is issued. Customers will be encouraged to process rebates through an online portal, but may also submit a paper application through the mail. Columbia Gas may also provide the option to purchase qualified smart thermostats via an online marketplace.</p> <p>If program funds begin to run low, incentive levels may be lowered, or equipment removed from the program if additional budget adjustments cannot be made. Columbia Gas will aim to provide as little interruption to customers as possible due to such adjustments.</p> <p>Columbia Gas will continue to examine other equipment for potential inclusion in the program, as well as the relative market adoption of equipment already receiving incentives.</p>
Target Market and End Uses	<p>The RP targets residential consumers who use natural gas to heat their homes and/or generate hot water. In general, the program aims to incentivize only the highest levels of efficient equipment on the market. The minimum level of efficiency for measures offered through the RP program will be ENERGY STAR®, when available, and in some cases may exceed ENERGY STAR®.</p>

	<p>On the space heating side, the program provides incentives for ENERGY STAR® labeled smart thermostats, furnaces, high efficiency boilers, and combination boilers. ENERGY STAR® smart thermostats offer the potential for deeper savings than traditional programmable thermostats due to the wide range of features and feedback they offer. ENERGY STAR® requirements for furnaces drive customers toward the highest efficiency tier of condensing units (95+ AFUE) and require efficient fans that save electricity. The program would also require boilers to go towards the highest efficiency tier with an AFUE of at least 94. Finally, offering incentives for combination space and water heating boilers addresses two types of end-use with one piece of equipment. These “combi boilers” also address issues with orphaned water heaters having existing atmospheric venting systems that are no longer adequate, when switching to condensing heating equipment. The program also addresses water heating savings by offering incentives for ENERGY STAR® tankless water heaters.</p>
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Financial Incentives	<p>Incentives were designed to be in line with other offerings in the region and/or cover approximately two-thirds of the incremental cost of the measure. The table below lists the proposed incentive schedule.</p> <p><i>Proposed Residential Prescriptive Program Rebates (Nominal)</i></p> <table border="1" data-bbox="464 505 1906 857"> <thead> <tr> <th data-bbox="464 545 877 581">Equipment</th> <th data-bbox="877 545 1234 581">Minimum Efficiency</th> <th data-bbox="1234 545 1703 581">Proposed Incentive</th> <th data-bbox="1703 505 1906 581">Maximum Incentive</th> </tr> </thead> <tbody> <tr> <td data-bbox="464 597 877 633">Smart Thermostat</td> <td data-bbox="877 597 1234 633">ENERGY STAR®</td> <td data-bbox="1234 597 1703 633">\$100</td> <td data-bbox="1703 597 1906 633">\$100</td> </tr> <tr> <td data-bbox="464 649 877 685">Furnace</td> <td data-bbox="877 649 1234 685">ENERGY STAR®</td> <td data-bbox="1234 649 1703 685">\$400</td> <td data-bbox="1703 649 1906 685">\$500</td> </tr> <tr> <td data-bbox="464 701 877 737">Boiler</td> <td data-bbox="877 701 1234 737">94+ AFUE</td> <td data-bbox="1234 701 1703 737">\$1,000</td> <td data-bbox="1703 701 1906 737">\$1,500</td> </tr> <tr> <td data-bbox="464 753 877 789">Combi Boiler</td> <td data-bbox="877 753 1234 789">94+ AFUE</td> <td data-bbox="1234 753 1703 789">\$1,200</td> <td data-bbox="1703 753 1906 789">\$1,800</td> </tr> <tr> <td data-bbox="464 805 877 841">Tankless Water Heater</td> <td data-bbox="877 805 1234 841">ENERGY STAR®</td> <td data-bbox="1234 805 1703 841">\$400</td> <td data-bbox="1703 805 1906 841">\$500</td> </tr> </tbody> </table> <p>All equipment besides the Wi-Fi thermostat must be powered by natural gas.</p>	Equipment	Minimum Efficiency	Proposed Incentive	Maximum Incentive	Smart Thermostat	ENERGY STAR®	\$100	\$100	Furnace	ENERGY STAR®	\$400	\$500	Boiler	94+ AFUE	\$1,000	\$1,500	Combi Boiler	94+ AFUE	\$1,200	\$1,800	Tankless Water Heater	ENERGY STAR®	\$400	\$500
Equipment	Minimum Efficiency	Proposed Incentive	Maximum Incentive																						
Smart Thermostat	ENERGY STAR®	\$100	\$100																						
Furnace	ENERGY STAR®	\$400	\$500																						
Boiler	94+ AFUE	\$1,000	\$1,500																						
Combi Boiler	94+ AFUE	\$1,200	\$1,800																						
Tankless Water Heater	ENERGY STAR®	\$400	\$500																						
Marketing Approach	<p>The RP program may be marketed through inclusion on Columbia’s website and through social media, as well as through bill inserts and other media messaging. The main way that many customers will hear about the RP Program is through HVAC contractors and plumbers, and the program will be a key part of trade ally outreach efforts. Incentives will help these contractors sell jobs, and efforts such as cobranding and potentially assigning incentives to contractors will provide trade allies with even more tools to move customers to higher efficiency levels.</p>																								
Evaluation, Measurement,	<u>Quality Assurance</u>																								

<p>and Verification</p>	<p>All applications will require proof of purchase and a valid Columbia Gas account number. Rebates received as an instant rebate via a qualified participating contractor or equipment distributor will be accompanied by an invoice showing the point of sale discount passed on to the customer. The rebate processor will verify that the equipment is eligible for the rebate based on the model's Air-Conditioning Heating and Refrigeration Institute (AHRI) number before issuing any rebate. The program's rebate processor will maintain a real-time database of rebate activity, which will be periodically reviewed by Columbia Gas and stored separately for long-term purposes.</p> <p>There will be inspections of approximately five percent (5%) of non-thermostat equipment rebates and approximately one percent (1%) of Wi-Fi thermostat rebates to obtain a statistically significant sample of activity. The inspection will consist of verifying that the rebated equipment is installed and operational and conclude with a short informational interview with the participant. Virtual inspections will be explored to reduce program costs and increase inspection rates.</p> <p><u>Evaluations</u></p> <p>A third-party vendor will evaluate the program's process and impacts after sufficient participation has occurred in the third year of the Plan.</p>
<p>Program Administration</p>	<p><u>Rebate Processing and Inspection</u></p> <p>The rebate processor will accept customer applications, track and verify application information, notify the customer of any issues, maintain a call center, and report results to Columbia Gas. The rebate</p>

processor may also be responsible for other programs to streamline portfolio management. The rebate processor will also be responsible for inspections.

Marketing and Outreach

Columbia Gas and their vendors will handle marketing and outreach for the RP program.

Evaluator

A third-party evaluator will be retained to perform evaluations.

2.2 Online Audit Kit

Objective	The Online Audit Kit (OAK) Program is designed to provide residential customers with information on how to improve the efficiency of their homes along with free, targeted energy savings kits. The program also provides a way for customers to engage with Columbia Gas and learn about the RP Program.																																													
Eligible Rate Class	RSD/RSS																																													
Cost Effectiveness	<p>Three-Year Cost-Effectiveness Results (2022\$)</p> <table border="1"> <thead> <tr> <th>CE Test</th> <th>PV Benefits</th> <th>PV Costs</th> <th>PV Net</th> <th>BCR</th> </tr> </thead> <tbody> <tr> <td>TRC Test</td> <td>\$2,472,719</td> <td>\$695,683</td> <td>\$1,777,035</td> <td>3.55</td> </tr> <tr> <td>Gas Admin Test</td> <td>\$1,548,703</td> <td>\$695,683</td> <td>\$853,020</td> <td>2.23</td> </tr> </tbody> </table>	CE Test	PV Benefits	PV Costs	PV Net	BCR	TRC Test	\$2,472,719	\$695,683	\$1,777,035	3.55	Gas Admin Test	\$1,548,703	\$695,683	\$853,020	2.23																														
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Budget Projections	Three-Year Budgets (Nominal)				
	Costs by Category	2023	2024	2025	2023 - 2025
	Customer Incentives	\$25,630	\$51,720	\$64,650	\$142,000
	Administration	\$113,000	\$126,000	\$145,000	\$384,000
	Marketing	\$58,000	\$45,000	\$52,000	\$155,000
	Inspections	\$0	\$0	\$0	\$0
	Evaluation	\$20,000	\$20,000	\$50,000	\$90,000
	Total	\$216,630	\$242,720	\$311,650	\$771,000
Participation Projections	Three-Year Participation Projections				
	Projected Kits	2023	2024	2025	2023 - 2025
	Water Heating Kit	470	960	1,200	2,630
	Space Heating Kit	780	1,560	1,950	4,290
	Total	1,250	2,520	3,150	6,920
Program Rollout	<i>Jan 2023 – Jun 2023</i>	Finalize program process and implementation details, select vendors, and develop initial marketing push			
	<i>Jul 2023</i>	Launch Program			
	<i>2023 - 2024</i>	Continue engagement activities with customers and trade allies.			
	<i>2025</i>	Reach full anticipated participation levels.			
Program Design	The OAK Program provides a way for customers to undergo an online audit of their home, which will result in a customized set of recommendations. The customer will then be eligible to receive up to				

	<p>two targeted energy saving kits, shipped to their home at no cost. The first kit is for customers who use natural gas for water heating, and the second kit is for customers who utilize natural gas to heat their homes. Participating customers will also be referred to the RP program incentives if appropriate. To reach customers who do not have easy access to the internet, a phone version of the audit will be made available.</p>
Target Market and End Uses	<p>There will be two kits available for customers. The water heating kit will include measures such as high-efficiency showerheads and low-flow faucet aerators. The space heating kit will include low-cost measures such as outlet and light switch gaskets, caulk, and foam sealant along with instructions on effective installation.</p>
Financial Incentives	<p>Kits will be provided at no cost to the customer.</p>
Marketing Approach	<p>The OAK program will be marketed through bill inserts, social media, and on Columbia Gas' website. Other outreach efforts may include email, radio, and print advertisements. The program will also act as a referral service for customers who may want to participate in the RP program.</p>
Evaluation, Measurement, and Verification	<p><u>Quality Assurance</u></p> <p>Columbia Gas will perform a survey of participants every year to determine installation rates for energy saving kits and assess customers satisfaction with program recommendations.</p> <p><u>Evaluations</u></p>

	<p>The program will undergo a process and impact evaluation in the third year once sufficient time has passed for the program to achieve meaningful participation.</p>
<p>Program Administration</p>	<p><u>Online Audit and Kit Provider</u></p> <p>Columbia Gas will hire a vendor to provide an online audit solution and package and send energy saving kits to customers.</p> <p><u>Marketing and Outreach</u></p> <p>Columbia Gas and their vendors will handle marketing and outreach for the program.</p> <p><u>Evaluator</u></p> <p>A third-party evaluator will be retained to perform annual participant surveys and regular program evaluations.</p>

3 Appendices

3.1 Avoided Cost Tables

Gas Avoided Costs (2022\$/Dth)

Year	Base	Space Heating	Domestic Hot Water
2023	\$4.67	\$10.49	\$6.12
2024	\$4.48	\$10.42	\$5.97
2025	\$4.46	\$10.47	\$5.96
2026	\$4.47	\$10.57	\$6.00
2027	\$4.49	\$10.67	\$6.04
2028	\$4.66	\$10.90	\$6.22
2029	\$4.84	\$11.14	\$6.41
2030	\$4.92	\$11.30	\$6.51
2031	\$5.04	\$11.49	\$6.66
2032	\$5.10	\$11.62	\$6.73
2033	\$5.20	\$11.79	\$6.85
2034	\$5.21	\$11.87	\$6.87
2035	\$5.22	\$11.96	\$6.91
2036	\$5.25	\$12.06	\$6.95
2037	\$5.29	\$12.17	\$7.01
2038	\$5.32	\$12.28	\$7.06
2039	\$5.34	\$12.38	\$7.10
2040	\$5.40	\$12.52	\$7.18
2041	\$5.43	\$12.63	\$7.23
2042	\$5.43	\$12.70	\$7.24
2043	\$5.45	\$12.81	\$7.29
2044	\$5.40	\$12.85	\$7.26
2045	\$5.39	\$12.93	\$7.27
2046	\$5.40	\$13.03	\$7.30
2047	\$5.41	\$13.13	\$7.34
2048	\$5.46	\$13.27	\$7.41
2049	\$5.46	\$13.37	\$7.43
2050	\$5.47	\$13.48	\$7.47

Developed by Resource Insight, Inc.

Other Resource Avoided Costs (2022\$)

Year	All-Year Energy (\$/kWh)	Generation Capacity (\$/kW-yr)	T&D (\$/kW-yr)	Water (\$/gal)
2023	\$0.0324	\$54.63	\$53.93	\$0.013
2024	\$0.0324	\$54.63	\$53.93	\$0.013
2025	\$0.0323	\$54.63	\$53.93	\$0.013
2026	\$0.0335	\$54.64	\$53.93	\$0.013
2027	\$0.0348	\$54.64	\$53.93	\$0.013
2028	\$0.0362	\$54.64	\$53.93	\$0.013
2029	\$0.0374	\$54.63	\$53.93	\$0.013
2030	\$0.0380	\$54.63	\$53.93	\$0.013
2031	\$0.0390	\$54.63	\$53.93	\$0.013
2032	\$0.0404	\$54.63	\$53.93	\$0.013
2033	\$0.0413	\$54.63	\$53.93	\$0.013
2034	\$0.0420	\$54.63	\$53.93	\$0.013
2035	\$0.0415	\$54.64	\$53.93	\$0.013
2036	\$0.0411	\$54.63	\$53.93	\$0.013
2037	\$0.0414	\$54.63	\$53.93	\$0.013
2038	\$0.0415	\$54.63	\$53.93	\$0.013
2039	\$0.0414	\$54.63	\$53.93	\$0.013
2040	\$0.0416	\$54.63	\$53.93	\$0.013
2041	\$0.0418	\$54.63	\$53.93	\$0.013
2042	\$0.0418	\$54.63	\$53.93	\$0.013
2043	\$0.0418	\$54.63	\$53.93	\$0.013
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2047	\$0.0418	\$54.63	\$53.93	\$0.013
2048	\$0.0418	\$54.63	\$53.93	\$0.013
2049	\$0.0418	\$54.63	\$53.93	\$0.013
2050	\$0.0418	\$54.63	\$53.93	\$0.013

3.2 Detailed Measure Assumptions

Measure Name	Costs		Savings				
	Incentive	Incr. Cost	Lifetime (Yrs)	Dth	kWh	kW	Water (Gal)
Residential Prescriptive Program							
Furnace - ENERGY STAR	\$400.00	\$758.40	20	13.99	0	0	0
Boiler - 94+ AFUE	\$1,000.00	\$1,785.00	25	12.83	0	0	0
Combi Boiler - 94+ AFUE	\$1,200.00	\$2,526.18	25	22.72	0	0	0
Wifi Thermostat - ENERGY STAR	\$100.00	\$150.00	11	4.52	73	0.01	0
Tankless Water Heater - ENERGY STAR	\$400.00	\$592.85	20	9.18	0	0	0

Online Audit Kit Program

Web Faucet Aerator - Kitchen	\$2.70	\$2.70	10	0.51	0	0	941
Web Faucet Aerator - Bathroom	\$0.70	\$0.70	10	0.11	0	0	201
Web High Efficiency Showerhead	\$4.96	\$4.96	10	0.51	0	0	934
Web Switch/Outlet Cover	\$2.40	\$2.40	15	1.64	0	0	-
Web Caulk	\$3.12	\$3.12	15	0.37	0	0	-
Web Foam Sealant	\$6.21	\$6.21	15	0.37	0	0	-
Water Heating Kit	\$8.98	\$8.98	1	-	0	0	-
Space Heating Kit	\$7.27	\$7.27	1	-	0	0	-

3.3 Detailed Program and Portfolio Cost-effectiveness

Energy Efficiency Programs' Cost Effectiveness over Three-Year Portfolio (2022\$)

Program	Total Resource		PV of Net Benefits	Gas Energy System		PV of Net Benefits
	Present Value			Present Value		
	<u>Benefit</u>	<u>Cost</u>		<u>Benefit</u>	<u>Cost</u>	
<u>Portfolio Total</u>	\$10,856,268	\$5,124,977	\$5,731,291	\$9,794,781	\$3,614,180	\$6,180,601
Non-Measure Costs		\$1,792,202			\$1,792,202	
Total Measure Costs	\$10,856,268	\$3,332,775	\$7,523,493	\$9,794,781	\$1,821,979	\$7,972,803
<u>Program</u>						
Residential Prescriptive Program						
Program Total	\$8,383,549	\$3,690,323	\$4,693,226	\$8,246,078	\$2,179,527	\$6,066,551
Non-Measure Costs		\$484,717			\$484,717	
Total Measure Costs	\$8,383,549	\$3,205,607	\$5,177,942	\$8,246,078	\$1,694,810	\$6,551,268
Online Audit Kit Program						
Program Total	\$2,472,719	\$695,683	\$1,777,035	\$1,548,703	\$695,683	\$853,020
Non-Measure Costs		\$568,515			\$568,515	
Total Measure Costs	\$2,472,719	\$127,168	\$2,345,551	\$1,548,703	\$127,168	\$1,421,535
Portfolio Wide Costs						
Program Total	-	\$738,970	\$(738,970)	-	\$738,970	\$(738,970)
Non-Measure Costs		\$738,970			\$738,970	
Total Measure Costs	-	-	-	-	-	-

3.4 Technical Reference Manual (TRM)

Technical Reference Manual

Measure Savings Algorithms

Columbia Gas of Pennsylvania

March 18, 2022

Prepared by:



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Prepared by: Green Energy Economics Group, Inc.

1 Cross-Sector TRM Issues

1.1 Establishing Baselines

The savings methods and assumptions can differ substantially based on the program delivery mechanism for each measure type. Within each of the measure protocols in the TRM, there is a definition for the measure's baseline efficiency, a critical input into the savings calculations. Most measures will fall into one of two categories, each with a baseline that is most commonly used:

- One for market-driven choices – often called “lost opportunity” and either replacing equipment that has failed (replace on burnout) or new installations (new construction)
- One for discretionary installations – either early replacement or retrofit

For all new construction (NC) and replace on burnout (ROB) scenarios, the baseline is typically a jurisdictional code or a national standard; however, there may be cases where a market baseline is appropriate. In these scenarios, the Commission has a preference for codes and standards as it is too expensive and time consuming to conduct annual market baseline and characterization research. Additionally, the TRM provides estimates for gross energy savings only, whereas net savings “...include the effects of free-ridership, spillover, and induced market effects.”

For discretionary installation scenarios, the baseline is typically the existing equipment efficiency, but in the case of early replacement (EREP), at some point the savings calculations must incorporate changes to the baseline for new installations (e.g., code or market changes) to account for eventual natural replacement of the equipment. This approach encourages residential and business consumers to replace working inefficient equipment and appliances with new high-efficiency products rather than taking no action to upgrade or only replacing them with new standard-efficiency products.

All baselines are designed to reflect current market practices that are updated periodically to reflect upgrades in federal equipment standards, building code, or information from evaluation results. Specifically for commercial and industrial measures, Pennsylvania has adopted the 2015 International Energy Conservation Code (IECC) per 34 Pa. Code Section 403.21, effective October 1, 2018. Per Section 401.2 of IECC 2015, commercial buildings must comply with either “[t]he requirements of ANSI/ASHRAE/IESNA Standard 90.1[-2013]” or comply with the requirements outlined in IECC 2015 Chapter 4. In accordance with IECC 2015, commercial protocols relying on code standards as the baseline condition may refer to either IECC 2015 or ASHRAE 90.1-2013 per the program design.

The baseline estimates used in the TRM are based on applicable federal standards, or are documented in baseline studies or other market information. This TRM reflects the most up-to-date codes, practices, and market transformation effects. The measures herein include, where appropriate, schedules for the implementation of Federal standards to coincide with the beginning of a program year. These implementation schedules apply to measures where the Federal standard is considered the baseline, as described herein or otherwise required by law. In cases where the ENERGY STAR criterion is considered the eligibility requirement and the existing ENERGY STAR Product Specification Version expires in a given year, the new ENERGY STAR Product Specification Version will become the eligibility requirement at the start of the next consecutive program year.

The combined effect of measure retention and persistence is the ability of installed measures to maintain the initial level of energy savings or generation over the measure life. If the measure is subject to a reduction in savings or generation over time, the reduction in retention or persistence is accounted for using factors in the calculation of resource savings.

2 Residential Time of Replacement Market

2.1 Space Heating End Use

2.1.1 Efficient Space Heating System

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure applies to residential-sized gas furnaces and boilers purchased at the time of natural replacement. A qualifying furnace or boiler must meet minimum efficiency requirements (AFUE).

Definition of Baseline Condition

The efficiency levels of the gas-fired furnaces or boilers that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline AFUE
Gas Furnace	80%
Gas Boiler	84%

Definition of Efficient Condition

The installed gas furnace or boiler must have an AFUE greater than that shown in the table below. Efficient model minimum AFUE requirements are detailed below.

Equipment Type	Minimum AFUE
Gas Furnace	95%
Gas Furnace with ECM Fan	95%
Gas Boiler	94%

Gas Savings Algorithms

MMBtu savings are realized due to the increase in AFUE of the new equipment. MMBtu savings vary by equipment type due to differences in model specific baseline AFUE and high efficiency AFUE percentages. Savings are calculated from the baseline new unit to the installed efficient unit.

$$\text{Annual Gas Savings (MMBtu)} = \frac{\text{Capacity}_{\text{Out}}}{1,000} \times \left(\frac{1}{\text{AFUE}_{\text{Base}}} - \frac{1}{\text{AFUE}_{\text{Eff}}} \right) \times \text{EFLH}_{\text{Heat}}$$

Where:

$\text{Capacity}_{\text{Out}}$ = Output capacity of equipment to be installed (kBtu/hr)
 1,000 = Conversion from kBtu to MMBtu

$AFUE_{Base}$ = Efficiency of new baseline equipment (Annual Fuel Utilization Efficiency)
 $AFUE_{Eff}$ = Efficiency of new equipment
 $EFLH_{Heat}$ = Equivalent Full Load Heating Hours (Refer to EFLH table by climate zone in References Section)

Electric Savings Algorithms

Energy Savings

$$DkWh = 0 \text{ kWh}$$

Demand Savings

$$DkW = 0 \text{ kW}$$

Where:

$DkWh$ = Gross customer annual kWh savings for the measure.
 DkW = Gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Furnace	0%	0%
Gas Furnace with ECM Fan	0%	0%
Gas Boiler	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Furnaces	20
Gas Boilers	25

Source: Lifetime estimates used by Efficiency Vermont, PGW and UGI.

Water Savings

There are no water savings for this measure.

2.1.2 WiFi Thermostat – ENERGY STAR®

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This is an ENERGY STAR® WiFi thermostat controlling a residential-sized gas furnace or boiler.

Definition of Baseline Condition

The baseline is a manual thermostat where each temperature setting change requires human intervention or a conventional programmable.

Definition of Efficient Condition

The efficient thermostat is one that is WiFi enabled, ENERGY STAR® certified and can be programmed to automatically increase or lower the temperature setting at different times of the day and week.

Gas Savings Algorithms

$$\text{Annual Gas Savings (MMBtu)} = SH_{pre} \times ESF$$

Where:

SH_{pre}	=	Space Heat MMBtu gas usage with manual thermostat = 70.6 ¹
ESF	=	Percentage savings from WiFi thermostat compared to non-WiFi connected thermostat. See table below by installation method.

Heating Energy Savings Factors (ESF)

¹ Space-heat usage assumption from examination of Columbia Gas PA residential usage by month.

Program Type	Baseline	Air Source Heat Pump	Furnace/Boiler Heating (Electric or Fossil)
Upstream buy-down (Customer Self-Installation)	Unknown Mix Default	6.4% ^a	6.4% ^a
Customer Self-Installation with Education	Unknown Mix Default	7.9% ^b	7.9% ^b
Professional Installation	Manual	11.5% ^c	11.5% ^c
	Conventional programmable	7.9% ^d	7.9% ^d

^a Average of heating estimates from two studies.

^b Heating savings are based on average of savings from unknown mix default with customer self-installation and average of professional installation savings from manual and programmable thermostats. In this case, $7.9\% = ((11.5\% \times 0.42 + 7.9\% \times 0.58) + 6.4\%) / 2$

^c Average of four heating savings estimates from four studies.

^d The ESF value for a is applied here as an estimate until information becomes available showing different savings incented through a direct install program.

Source for table values: Act 129 Phase IV TRM.

Electric Savings Algorithms

If the type of air conditioning is known, then use the appropriate algorithm below. If the type or existence of air-conditioning is not known, then assume that 45% have central air-conditioning and estimate the cooling savings as 45% of a house with central air conditioning.²

Reduced furnace fan or boiler circulator pump usage is also likely to occur and provide electricity savings during both the heating and cooling seasons, but these auxiliary savings are not accounted for in the following algorithms.

Energy Savings

$$DkWh = DkWh_{Aux} + DkWh_{Cool}$$

$$DkWh_{Aux} = \text{Furnace Fan kWh savings}$$

$$DkWh_{Cool} = \begin{aligned} &= 0 \text{ kWh if house has no air conditioning} \\ &= \Delta kWh_{CAC} \text{ if house has central air conditioning} \\ &= 0 \text{ if house has room air conditioning} \\ &= 45\% \times \Delta kWh_{CAC} \text{ if no information about air conditioner} \end{aligned}$$

Deemed Savings DkWh

Program Type	Baseline	Fossil Fuel Furnace (Fan Only) DkWh _{Aux}	CAC Cooling ΔkWh_{CAC}
Upstream buy-down (Customer Self-Installation)	Unknown Mix Default	48	77

² Percentage of houses with central air-conditioning from 2009 RECS data.

Customer Self-Installation with Education	Unknown Mix Default	60	120
Professional Installation	Manual	87	182
	Conventional programmable	60	150

Source: Act 129 Phase IV TRM.

Demand Savings

$DkW = 0$ kW

Where:

$DkWh$ = gross customer annual kWh savings for the measure.
 DkW = gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
WiFi Thermostat	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
WiFi Thermostat	11

Source: August 2019 Act 129 TRM, Volume 2, p.47.

Water Savings

There are no water savings for this measure.

2.2 Water Heating End Use

2.2.1 Tankless Water Heater

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure is an on-demand gas water heater.

Definition of Baseline Condition

The efficiency levels of the gas-fired stand-alone storage water heater that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Usage Draw Pattern	Baseline UEF ³
Gas Stand-alone Storage Water Heater	Very Small	0.27
Gas Stand-alone Storage Water Heater	Low	0.52
Gas Stand-alone Storage Water Heater	Medium	0.58
Gas Stand-alone Storage Water Heater	High	0.64

Baseline usage draw pattern is established by the capacity of the installed tankless water heater, using the table below:

Usage Draw Pattern	Max GPM	Daily Volume in Gallons (V)
Very Small	$0 \leq \text{GPM} < 1.7$	10
Low	$1.7 \leq \text{GPM} < 2.8$	38
Medium	$2.8 \leq \text{GPM} < 4.0$	55
High	$4.0 \leq \text{GPM}$	84

If the tankless water heater capacity is not available, assume medium usage draw pattern.

Definition of Efficient Condition

The installed tankless water heater must have an UEF greater than that shown in the table below. Efficient model minimum UEF requirements are detailed below.

Equipment Type	Minimum UEF
Gas Tankless Water Heater	0.87

Gas Savings Algorithms

The following formula for gas savings is based on the DOE test procedure for water heaters⁴.

³ Based on the federal standard for residential gas-fired water heater as of June 2017 and assumed typical 40 gallon storage. <https://www.law.cornell.edu/cfr/text/10/430.32>

⁴ 10 CFR Appendix E to Subpart B of Part 430, Uniform Test Method for Measuring the Energy Consumption of Water Heaters

$$\text{Annual Gas Savings (MMBtu)} = \frac{\left(\frac{1}{UEF_{Base}} - \frac{1}{UEF_{Eff}} \right) \times V \times \rho \times c_p \times 67 \times 365}{1,000,000}$$

Where:

UEF_{Base}	=	Uniform Energy Factor of baseline water heater based on usage draw pattern
UEF_{Eff}	=	Uniform Energy Factor of efficient water heater
V	=	Daily volume of hot water usage in gallons. See table in baseline section. If usage draw pattern is unknown, assume medium (55 gallons/day).
ρ	=	Water density at 125°F (8.24 lb/gal)
c_p	=	Specific heat of water (1.00 Btu/lb °F)
67	=	°F temperature rise between inlet and outlet of water heater
365	=	Days per year
1,000,000	=	Btu per MMBtu

Electric Savings Algorithms

There are no electric savings from this measure.

Energy Savings

$$DkWh = 0 \text{ kWh}$$

Demand Savings

$$DkW = 0 \text{ kW}$$

Where:

$DkWh$	=	gross customer annual kWh savings for the measure.
DkW	=	gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Tankless Water Heater	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Tankless Water Heater	20

Source: Energy Star Residential Water Heaters: Final Criteria Analysis, April 1, 2008, p. 10.

Water Savings

There are no water savings for this measure.

2.3 Combined Space and Domestic Hot Water Usage**2.3.1 Combination Boiler - Space Heating and DHW**

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure applies to residential-sized combination boilers purchased at the time of natural replacement. These are integrated boilers that provide hot water for space heating and on-demand domestic hot water and have minimal or no hot water storage. A qualifying combination boiler (combi boiler) must meet minimum efficiency requirements (AFUE).

Definition of Baseline Condition

The efficiency levels of the gas-fired boiler and stand-alone storage water heater that would have been purchased absent this or another DSM program are shown in the following table.

Equipment Type	Baseline⁵
Gas Boiler	84% AFUE

Equipment Type	Usage Draw Pattern	Baseline UEF⁶
Gas Stand-alone Storage Water Heater	Very Small	0.27
Gas Stand-alone Storage Water Heater	Low	0.52
Gas Stand-alone Storage Water Heater	Medium	0.58
Gas Stand-alone Storage Water Heater	High	0.64

Baseline usage draw pattern is established by the capacity of the water heater, using the table below:

Usage Draw Pattern	Max GPM	Daily Volume in Gallons (V)
Very Small	$0 \leq \text{GPM} < 1.7$	10
Low	$1.7 \leq \text{GPM} < 2.8$	38
Medium	$2.8 \leq \text{GPM} < 4.0$	55

⁵ Existing residential boiler federal standard as of 10/1/2022.

⁶ Based on the federal standard for residential gas-fired water heater as of June 2017 and assumed typical 40 gallon storage. <https://www.law.cornell.edu/cfr/text/10/430.32>

High	$4.0 \leq \text{GPM}$	84
------	-----------------------	----

If the water heater capacity is not available, assume medium usage draw pattern.

Definition of Efficient Condition

The installed gas furnace or boiler must have an AFUE greater than that shown in the table below. Efficient model minimum AFUE requirements are detailed below.

Equipment Type	Minimum AFUE
Gas Combi Boiler	94% AFUE 0.94 UEF

Gas Savings Algorithms

MMBtu savings are realized due to the increase in AFUE of the new equipment. MMBtu savings vary by equipment type due to differences in model specific baseline AFUE and high efficiency AFUE percentages. Savings are calculated from the baseline new unit to the installed efficient unit.

$$\text{Annual Gas Savings (MMBtu)} = \text{Annual Gas Savings}_{SH} + \text{Annual Gas Savings}_{DHW}$$

$$\text{Annual Gas Savings}_{SH} = \frac{\text{Capacity}_{Out}}{1,000} \times \left(\frac{1}{AFUE_{Base}} - \frac{1}{AFUE_{Eff}} \right) \times EFLH_{Heat}$$

Where:

$\text{Annual Gas Savings}_{SH}$	=	Space heating annual gas savings (MMBtu)
$\text{Annual Gas Savings}_{DHW}$	=	Domestic Hot Water annual gas savings (MMBtu)
Capacity_{Out}	=	Output capacity of equipment to be installed (kBtu/hr)
1,000	=	Conversion from kBtu to MMBtu
$AFUE_{Base}$	=	Efficiency of new baseline equipment (Annual Fuel Utilization Efficiency)
$AFUE_{Eff}$	=	Efficiency of new equipment
$EFLH_{Heat}$	=	Equivalent Full Load Heating Hours (Refer to EFLH table by climate zone in References Section)

The following formula for DHW gas savings is based on the DOE test procedure for water heaters.

$$\text{Annual Gas Savings}_{DHW} = \frac{\left(\frac{1}{UEF_{Base}} - \frac{1}{UEF_{Eff}} \right) \times V \times \rho \times c_p \times 67 \times 365}{1,000,000}$$

Where:

UEF_{Base}	=	Uniform Energy Factor of baseline water heater. See UEF based on usage draw pattern in Baseline section above. If draw pattern cannot be established assume medium draw pattern.
UEF_{Eff}	=	Uniform Energy Factor of efficient combi boiler. Since the combi boiler has no or little storage, standby losses are assumed to be negligible and the UEF is assumed to be the same as the AFUE.
V	=	Daily volume of hot water usage in gallons. See table in baseline section. If usage draw pattern is unknown, assume medium (55 gallons/day).

ρ	=	Water density at 125°F (8.24 lb/gal)
c_p	=	Specific heat of water (1.00 Btu/lb °F)
67	=	°F temperature rise between inlet and outlet of water heater
365	=	Days per year
1,000,000	=	Btu per MMBtu

Electric Savings Algorithms

Energy Savings

$$DkWh = 0 \text{ kWh}$$

Demand Savings

$$DkW = 0 \text{ kW}$$

Where:

DkWh	=	Gross customer annual kWh savings for the measure.
DkW	=	Gross customer summer load kW savings for the measure.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Gas Combi Boiler	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Equipment Type	Measure Lifetime
Gas Combi Boiler	20

Source: Same as lifetime estimate used for tankless water heater.

Water Savings

There are no water savings for this measure.

2.4 All End Uses

2.4.1 Custom Measure

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure applies to all residential time of replacement custom measures, not otherwise specified in this TRM.

Definition of Baseline Condition

The baseline represents the typical equipment that is installed without a DSM program. The efficiency level is based on the current Federal standards, or state and local building codes that are applicable.

Definition of Efficient Condition

The efficient measure is any equipment that uses less energy than the baseline equipment.

Gas Savings Algorithms

The generalized equation for a custom measure compares the baseline usage to the efficient usage.

$$\text{Annual Gas Savings (MMBtu)} = \text{BaselineUse} - \text{EfficientUse}$$

Where:

BaselineUse = The gas usage of baseline equipment or building.

EfficientUse = The gas usage of efficient equipment or building.

Electric Savings Algorithms

Energy Savings

$$\text{DkWh} = \text{BaselinekWh} - \text{EfficientkWh}$$

Demand Savings

$$\text{DkW} = \text{BaselinekW} - \text{EfficientkW}$$

Where:

DkWh = Gross customer annual kWh savings for the measure.

DkW = Gross customer summer load kW savings for the measure.

BaselinekWh = The electric kWh usage of baseline equipment or building.

EfficientkWh = The electric kWh usage of efficient equipment or building.

BaselinekW = The electric kW usage of baseline equipment or building.

EfficientkW = The electric kW usage of efficient equipment or building.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Equipment Type	Free Ridership	Spillover
Custom Measure	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Where available, custom measure lifetimes should be based on similar measures defined elsewhere in this TRM.

Water Savings

The water savings are the difference between the baseline and efficient equipment annual water usage in gallons.

3 Residential Early Replacement Market

3.1 Space Heating End Use

3.1.1 Kit Infiltration Reduction

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This involves decreasing the amount of air exchange between the inside of the house or unit and the outdoors using simple air sealing items included in kits mailed to customers.

Definition of Baseline Condition

The baseline is the house in its pre-treatment condition, with opportunities for infiltration reductions.

Definition of Efficient Condition

Any decrease in infiltration will reduce energy consumption compared to the pre-treated house.

Gas Savings Algorithms

$$\text{Annual Gas Savings (MMBtu)} = \text{Default Savings}$$

Where:

Default Savings = Deemed savings from kit air sealing measures. See table of default savings by measure.

Electric Savings Algorithms

Though there may be some electric cooling savings, however, no savings are currently assumed.

Default savings values for Kit Air Sealing Measures

Air Sealing Measure	MMBtu Savings	Source
Switch/Outlet Covers	1.64	Columbia Gas VA (CVA) savings assumption adjusted by HDD in Columbia Gas PA (CPA) territory relative to CVA HDD.
Caulk	0.37	CVA savings assumption adjusted by HDD in CPA territory relative to CVA HDD.
Foam Sealant	0.37	CVA savings assumption adjusted by HDD in CPA territory relative to CVA HDD.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Measure	Free Ridership	Spillover
Infiltration Reduction	0%	0%

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

Measure	Measure Lifetime
Kit Infiltration Reduction	15

Source: Current assumption used by Columbia Gas VA.

Water Savings

There are no water savings for this measure.

3.2 Domestic Hot Water End Use

3.2.1 Low Flow Showerhead

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure relates to the installation of a low flow showerhead in a home. This is an early replacement direct install or kit measure.

Definition of Baseline Condition

The baseline is the flow rate of the showerhead being replaced. If this is not available a baseline value of 2.5 GPM will be used.

Definition of Efficient Condition

The flow rate of the efficient showerhead should be greater than the flow rate of the baseline condition. If this value is not available it is assumed to be 1.5 GPM⁷.

Water Savings Algorithms

The water savings for low flow showerheads are due to the reduced amount of water being used per shower.

$$\Delta Gallons = \frac{(GPM_{base} - GPM_{eff}) \times N_{persons} \times T_{person-day} \times N_{showers-day} \times 365 \times ISR}{N_{showerheads-home}}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Maximum gallons per minute of baseline showerhead. Default = 2.5 GPM if measured rate is not available ⁸
GPM_{eff}	=	Maximum gallons per minute of the efficient showerhead
$N_{persons}$	=	Average number of people per household. Actual or defaults: SF=2.5, MF=1.7, Unknown=2.5 ⁹
$T_{person-day}$	=	Average minutes per person per day used for showering. 7.8 min/day ¹⁰
$N_{showers-day}$	=	Average number of showers per person per day. 0.6 showers/person/day ¹¹
365	=	Days per year
ISR	=	In service rate. Kit Default = 35%. Direct install Default = 100%. ¹²
$N_{showerheads-home}$	=	Average number of showers per home. Actual or defaults: SF=1.6, MF=1.1, Unknown=1.5 ¹³

⁷ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (August 2019)

⁸ The Energy Policy Act of 1992 established the maximum flow rate for showerheads at 2.5 gallons per minute (GPM)

⁹ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (August 2019)

¹⁰ Ibid.

¹¹ Ibid.

¹² Ibid.

¹³ Ibid.

Natural Gas Savings Algorithms

Gas energy savings result from reducing the amount of incoming cold water required to be heated due to the efficient showerhead.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (T_{out} - T_{in})] / 1,000,000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs.)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb·°F)
T_{out}	=	Assumed temperature of water coming out of showerhead (degrees Fahrenheit) 101 °F
T_{in}	=	Assumed temperature of water entering house (degrees Fahrenheit) 52 °F
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75% ¹⁴

Electric Savings Algorithms

It is assumed that all low flow showerheads are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

The measure life of a low flow showerhead is assumed to be 9 years¹⁵.

3.2.2 Low Flow Faucet Aerators

Unique Measure Code(s): TBD

Draft date: 3/6/22

Effective date: TBD

End date: TBD

Measure Description

This measure relates to the installation of a low flow faucet aerator in either a kitchen or bathroom.

Definition of Baseline Condition

The baseline is the flow rate of the existing faucet. If this is not available, it is generally assumed that a faucet will already have a standard faucet aerator using 2.2 GPM.

Definition of Efficient Condition

¹⁴ Review of AHRI Directory suggests range of recovery efficiency ratings for new Gas DHW units of 70-87%. The average of existing units is estimated at 75% by the Northeast Energy Efficiency Partnerships' Mid-Atlantic Technical Reference Manual Version 1.1 (October 2010).

¹⁵ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (June 2011)

The efficient condition is a faucet aerator that has a flow rate lower than the baseline condition. If this value is not available than the flow rate is assumed to be 1.5 GPM¹⁶.

Water Savings Algorithms

The water savings for low flow faucet aerators are due to the reduced amount of water being used per minute that flows down the drain (instead of being collected in the sink).

$$\Delta Gallons = \frac{(GPM_{base} - GPM_{eff}) \times N_{persons} \times T_{person-day} \times DF \times 365 \times ISR}{N_{faucets-home}}$$

Where:

$\Delta Gallons$	=	Gallons of water saved
GPM_{base}	=	Gallons per minute of baseline aerator = 2.2 GMP ¹⁷
GPM_{eff}	=	Gallons per minute of the efficient aerator
$N_{persons}$	=	Average number of people per household. Actual or Defaults: SF=2.5, MF=1.7, Unknown=2.5 ¹⁸
$T_{person-day}$	=	Average minutes per person per day of faucet hot water usage. Kitchen=4.5, Bathroom=1.6, Unknown=6.1 ¹⁹
365	=	Days per year
DF	=	Drain rate, the percentage of water flowing down the drain. Kitchen=75%, Bathroom=90%, Unknown=79.5% ²⁰
ISR	=	In service rate. Kit delivery default = 28%, Direct install default = 100% ²¹
$N_{faucets-home}$	=	Average Number of Faucets per home. Actual or for defaults see table below.

Average Number of Faucets per Home²²

Faucet Type	Single Family	Multifamily	Unknown
Kitchen	1.1	1.0	1.0
Bathroom	2.2	1.2	2.0
Unknown	3.3	2.2	3.0

Natural Gas Savings Algorithms

Gas energy savings result from avoiding having to heat the saved water due to the efficient aerator.

$$\Delta MMBtu = \frac{[\Delta Gallons \times 8.3 \times c_p \times (T_{out} - T_{in})] / 1,000,000}{RE_{DHW}}$$

Where:

$\Delta MMBtu$	=	MMBtu of saved natural gas
8.3	=	Constant to convert gallons to pounds (lbs.)
c_p	=	Average specific heat of water at temperature range (1.00 Btu/lb. °F)

¹⁶ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (August 2019)

¹⁷ Ibid

¹⁸ Ibid

¹⁹ Ibid

²⁰ Ibid

²¹ Ibid

²² Ibid

T_{out}	=	Average mixed water temperature flowing from the faucet (degrees Fahrenheit) Kitchen=93 °F, Bathroom=86 °F, Unknown=87.8 °F ²³
T_{in}	=	Assumed temperature of water entering house (degrees Fahrenheit) 52 °F ²⁴
RE_{DHW}	=	Recovery efficiency of the domestic hot water heater = 75% ²⁵

Electric Savings Algorithms

It is assumed that all faucet aerators as part of the gas utility's program are installed in homes that heat water using natural gas. There are no additional electric savings claimed.

Freeridership/Spillover

Until studies have been performed to determine the free ridership and spillover, the values are assumed to be zero.

Persistence

The persistence factor is assumed to be one.

Measure Lifetimes

The measure life of a faucet aerator is assumed to be 10 years²⁶.

²³ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (August 2019)

²⁴ Ibid

²⁵ See assumption for low flow shower head.

²⁶ Pennsylvania Public Utility Commission Act 129 Technical Reference Manual (August 2019)

4 Reference Tables

4.1 Residential

4.1.1 Heating and Cooling EFLH

Heating and Cooling Equivalent Full Load Heating Hours

Reference Location	Zone	Heating EFLH for non-HP (Fossil Fuel Furnace or Boiler)
Allentown	C	906
Binghamton, NY	A	1,152
Bradford	G	1,347
Erie	I	1,054
Harrisburg	E	997
Philadelphia	D	761
Pittsburgh	H	942
Scranton	B	1,000
Williamsport	F	935
Weighted Avg CPA		1013

Source: Act 129 August 2019 TRM, Appendix A

Notes: ZIP codes associated with each PA climate zone may be found in the Act 129 August 2019 TRM, Appendix A, tab "Zip code lookup table."

Columbia Gas of Pennsylvania

Three-Year Energy Efficiency Plan January 1, 2023 – December 31, 2025

~~March 18, 2022~~

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1 Introduction and Background

1.1 Plan Overview

This plan provides a detailed description of the design and implementation of the energy efficiency and conservation portfolio (“EE&C Portfolio” or “Portfolio”) that Columbia Gas of Pennsylvania, Inc. (“Columbia Gas” or “the Company”) is proposing to offer in its Three-Year Energy Efficiency (“EE Plan” or “Plan”). The Plan builds on other voluntary gas energy efficiency plans offered by natural gas distribution companies serving Pennsylvania, and specifically targets residential customers. This document provides an updated scenario that aligns with settlement conditions to maintain a budget of \$4 million over the 3-year period. In this scenario, the Residential Prescriptive program’s initial year participation was reduced and projected ramp up was taken down to minimal levels for 2024 and 2025, with associated reductions in variable administration and marketing costs. Similarly, the first year and ramp up for the Online Audit Kit Program was adjusted downward significantly for 2024 and 2025. Portfolio wide costs were maintained at current levels to maintain full oversight of the portfolio.

The Plan has a three-year duration, beginning January 1, 2023 and ending December 31, 2025. Over the three years of the Plan, Columbia Gas plans to spend ~~\$8.14.0~~ million on the administration and delivery of two residential energy efficiency programs. The programs are projected to save ~~31.3~~ million Dth of natural gas over the lifetime of the measures installed. From a total resource perspective, the portfolio present value of benefits is ~~\$27.610.9~~ million, with ~~\$11.45.1~~ million in present value of costs, leading to a present value of net benefits of ~~\$16.25.7~~ million and a TRC BCR of ~~2.4212~~. Furthermore, the energy efficiency programs are expected to save ~~8,7243,041~~ MWh of electricity, ~~14684~~ million gallons of water, create between ~~9938~~ and ~~19976~~ jobs, and avoid the emission of CO₂ equivalent to over ~~7,7002,900~~ cars being removed from the road over the lifetime of installed measures.

1.2 Plan Development

The Plan was developed to help Columbia Gas' residential customers to address barriers to using natural gas more efficiently. It has two programs:

- Residential Prescriptive (RP) Program
- Online Audit Kit (OAK) Program

The RP Program is based on rebate programs run in Pennsylvania by other natural gas distribution companies. The OAK Program is based on a successful program run by Columbia Gas of Virginia for over the past decade.

Various market characteristics were gathered for Columbia Gas' territory, including avoided costs for natural gas and electricity, demographic, building stock, and equipment market characteristics. Next, measures were characterized and screened for cost effectiveness using the TRC test. Incentive levels were established for these measures and projects, generally set to be in-line with the other programs in Pennsylvania. The cost-effective measures and projects were then used to calculate savings and maximum participation levels. Programs were staged to account for the ramp-up required for new programs. Finally, non-incentive budgets were developed to address fixed and variable costs associated with each program and the portfolio.

1.3 Portfolio Costs

The following table provides an overview of the spending by year and program for the total EE Plan. The maximum projected budget in a year is ~~\$3.8~~\$1.5 million in FY 2025, approximately ~~0.7~~0.728% of Columbia Gas' FY 2020 revenues.¹ Although Act 129's requirements are not mandatory for voluntary natural gas distribution company energy efficiency programs, this level is well under the 2% cap that Act 129 imposes on electric efficiency programs in Pennsylvania.² Since only residential customers are eligible for the programs, it is anticipated that all costs

¹ \$3.8 million is 0.7% of total 2020 revenues of \$555 million from Columbia's Annual Report of Columbia Gas of Pennsylvania, Inc. Year Ended December 21, 2020 at p. 26.

² See 66 Pa.C.S. § 2806.1(g) (limiting the total cost of an EDC's EE&C Plan to 2% of the EDC's total annual revenue as of December 31, 2006).

will be recovered from the residential rate class, excluding Customer Assistance Program (“CAP”) customers.

Table 1. Projected Spending for EE Plan by Program

Projected Costs (Nominal)	2023	2024	2025	
Residential Prescriptive Program	\$898,650,000	\$2,243,789,000	\$3,021,978,000	
Online Audit Kit Program	\$241,860,216,630	\$356,510,242,720	\$501,300,311,650	\$1,000,000,000
Portfolio Wide Costs	\$300,000	\$254,000	\$258,000	
Total	\$1,439,860,166,630	\$2,853,510,285,720	\$3,780,300,1,547,650	\$8,000,000,000

The portfolio-wide cost lines from the previous table are costs that apply to all programs in the EE portfolio. They are costs incurred at the portfolio level for program development, design, tracking, reporting, and administrative overhead. Development costs for the portfolio occur in the first year as programs are designed and reporting infrastructure is put in place. These costs become a smaller percentage of the portfolio as the rest of the programs ramp up. In the final year, the portfolio wide costs represent 717% of the portfolio total cost, and, over the three-year period, they represent 1020% of the portfolio’s costs. The following table provides a portfolio-level look at costs by category.

Table 2. Projected Efficiency Portfolio Budgets by Category

Category	2023	2024	2025	2023 - 2025 Total
Customer Incentives	\$685,860,487,630	\$2,058,510,703,720	\$2,747,300,832,650	\$5,491,670,023,000
Administration	\$561,504,000	\$558,453,000	\$643,481,000	\$1,762,938,000
Marketing	\$140,132,000	\$120,777,000	\$154,866,000	\$415,775,000
Inspections	\$332,000	\$97,320,000	\$129,380,000	\$259,702,000
Evaluation	\$20,000	\$20,000	\$110,000	\$150,000
Total	\$1,439,860,166,630	\$2,853,510,285,720	\$3,780,300,1,547,650	\$8,073,670,000

1.4 Portfolio Benefits

1.4.1 Natural Gas Savings

The following tables provide projected natural gas savings by program and sector for the EE Plan.

Table 3. Projected First Year Gas Savings by Program (Dth)

Program	2023	2024	2025	2023 - 2025
Residential Prescriptive Program	20,619,14,518	61,632,20,339	82,196,23,952	164,448,58,809
Online Audit Kit Program	2,684,666	9,393,367	13,418,709	25,495,14,743
Total	23,303,17,184	71,025,25,707	95,614,30,661	189,942,73,552

Table 4. Projected Lifetime Gas Savings by Program (Dth)

Program	2023	2024	2025	2023 - 2025
Residential Prescriptive Program	375,092,264,136	1,111,639,369,495	1,480,422,432,463	2,967,153,1,06
Online Audit Kit Program	36,077,35,903	126,269,72,154	180,384,90,192	342,730,19
Total	411,169,300,039	1,237,908,441,648	1,660,807,522,655	3,309,883,1,26

1.4.2 Other Resource Savings

The following table shows electric savings for measures installed under the energy efficiency programs in the EE&C Portfolio. The electric savings are secondary savings from measures that primarily save natural gas, such as air-conditioning savings from thermostats. This section contains ancillary water savings from gas efficiency measures that also save water, such as low-flow faucet aerators and showerheads.

Table 5. Projected Electric and Water Savings

	2023	2024	2025	2023 - 2025
First Year				
Energy (MWh)	9565	29895	400116	793276
Demand (kW)	11.746.9	16.953.2	71.420.8	141.449.3
Water (Million Gallons)	1.5	5.43.1	7.73.9	14.68.4
Lifetime				
Energy (MWh)	7201,040	1,0403,282	4,4021,281	8,7243,041
Water (Million Gallons)	15.41	53.930.8	77.038.5	14684.4

1.4.3 Emission Reductions

This section contains projections for CO₂ emission reductions due to the energy efficiency programs. The total lifetime savings of ~~20276~~ thousand tons of CO₂ is equivalent to removing over ~~7,7002,900~~ cars off the road. The following table breaks out the emission reductions due to gas savings and electric savings. While the emissions reductions are projected below, the main TRC test for the portfolio does not include any monetized value for these emissions reductions.

Table 6. Projected Lifetime CO₂ Emission Reductions by Energy Source (Short Tons)

Savings Source	2023	2024	2025	2023 - 2025
Natural Gas	24,05317,552	72,41825,836	97,15730,575	193,62873,964
Electricity	950658	2,997950	4,0241,170	7,9692,778
Total	25,00418,210	75,41526,787	101,17831,745	201,59776,742

1.4.4 Job Creation

Investing in cost-effective energy efficiency creates jobs in two ways, one direct and the other indirect, as discussed in a 2012 white paper from the ACEEE.³ Direct job creation results from hiring related to implementing the programs. Indirect job creation results from the substitution of capital spent on natural gas with capital spent in the local economy. Additional jobs are created by the indirect or income effect from cost-effective energy efficiency investment. Further, the net economic benefits from efficiency investment reduce household and business gas bills and raise household disposable incomes and business profitability. Customers will tend to spend most of this additional money and save the rest. This additional spending creates a “multiplier” effect through the cycle of re-spending of the initial cost savings, which stimulates aggregate demand for goods and services. Satisfying increased demand for goods and services requires more labor. While some of the jobs created leak into the broader U.S. and global economy, a good portion (possibly higher than 80%) of jobs created due to energy efficiency stay within the Commonwealth. The approach of looking at net job

³ “Energy Efficiency Job Creation: Real World Experiences” Bell, Casey J. American Council for an Energy-Efficiency Economy. October 2012.

creation through both direct means and with economic multiplier effects is endorsed in the 2012 white paper from ACEEE.⁴

The number of jobs created from investments in energy efficiency directly relates to the total resource value of the energy that these measures save. Studies of employment impacts of Demand Side Management (“DSM”) use energy savings as a surrogate for total resource value. A meta-study of U.S. data found that estimates for the number of jobs created had a wide range, but that most studies estimate that between 30 and 60 net jobs are created by saving one TBtu.⁵ In New York, New Jersey, and Pennsylvania, the ACEEE projected that 164,320 jobs, or 59 for every TBtu saved, could be attributed to EE in 1997 through 2010.⁶

As shown in the following table, Columbia Gas estimates that its gas energy efficiency programs portfolio will generate between **9938** and **19976** net additional jobs over the lifetime of the efficiency measures installed over the next five-years. This range is based on assuming that each TBtu of gas savings creates between 30 and 60 full-time equivalent jobs in Pennsylvania.

Table 7. Estimated Job Creation due to Energy Efficiency Programs

JOB CREATION IMPACTS OF GAS EFFICIENCY PORTFOLIO			
	30 Jobs/TBtu	45 Jobs/TBtu	60 Jobs/TBtu
TOTAL PORTFOLIO			
2023	129	1914	2518
2024	3713	5620	7426
2025	5916	7524	10031
TOTAL	9938	14957	19976

⁴ Energy Efficiency Job Creation: Real World Experiences” Bell, Casey J. American Council for an Energy-Efficiency Economy. October 2012.

⁵ Laitner, Skip, and Vanessa McKinney. June 2008. *Positive Returns: State Energy Efficiency Analyses Can Inform U.S. Energy Policy Assessments*. Washington, D.C.: American Council for an Energy Efficiency Economy.

⁶ Nadel, Steven, Skip Laitner, Marshall Goldberg, Neal Elliott, John DeCicco, Howard Geller, and Robert Mowris. 1997. *Energy Efficiency and Economic Development in New York, New Jersey, and Pennsylvania*. Washington, D.C.: American Council for an Energy Efficiency Economy.

1.5 Cost-Effectiveness Analysis

The following table provides Total Resource Cost (TRC) test cost-effectiveness projections for the EE Plan.

Table 8. TRC Cost-effectiveness Summary of Portfolio (2022\$)

Program	Total Resource PV Benefits	Total Resource PV Costs	Total Resource PV Net Benefits	Total Resource B/C Ratio
Residential Prescriptive Program	\$23,311,494,838,549	\$9,685,588,690,323	\$13,625,903,469,226	2.4127
Online Audit Kit Program	\$4,264,882,472,719	\$986,750,695,683	\$3,278,132,177,035	4.323.55
Portfolio Wide Costs	\$0	\$738,970	(\$738,970)	-
EE Programs	\$27,576,373,10,856,268	\$11,411,307,5,124,977	\$16,165,065,731,291	2.4212

While the portfolio is cost effective using the primary TRC Test, if the values for demand-response induced pricing effects (“DRIFE”)⁷ and internalized market prices for carbon dioxide (“CO₂”) are included, the portfolio would show substantially more benefits.

1.5.1 Cost-Effectiveness Analysis Methodology

The cost-effectiveness results reported in the Plan followed standard industry practices for utilizing the TRC Test for cost effectiveness. The TRC Test methodology used is similar to that used by other natural gas distribution companies serving Pennsylvania that offer energy efficiency programs, and by the Act 129 Utilities. To calculate benefits, projected natural gas, electricity, and water savings are multiplied by avoided costs, and this stream of future values is discounted to the present. The cost side of the test consists of the present value of all incremental costs incurred by participants, including net operation and maintenance costs, and the non-incentive costs incurred by the portfolio administrator. If the benefits outweigh the costs (the benefit-cost ratio is above

⁷ DRIFE accounts for the suppression effects on wholesale prices from reduced usage due to DSM.

one), then the total cost of energy services for an average customer within the territory will fall and the portfolio is considered cost effective

The analysis used a real discount rate (RDR) of 3%. The RDR was calculated using an assumption of a nominal discount rate ("NDR") of 5% and inflation rate of 2.0%, which comes from the Act 129 Phase IV TRC Test Order.⁸

1.5.2 Avoided Costs

The avoided cost of natural gas for Columbia Gas of Pennsylvania was developed in a similar manner to other Pennsylvania natural gas distribution companies offering energy efficiency programs and includes the costs of baseload and storage capacity, along with an estimate of avoidable local distribution costs. The avoided costs for baseload capacity were computed as the cost of Columbia Gas Transmission (TCO) FTS, Henry Hub commodity was priced using NYMEX futures from March 7, 2022 through 2027. The futures prices and the 2022 Annual Energy Outlook ("AEO") forecasts are very close to one another in 2027 and 2028, and differ by less than 10% on an annual basis through the end of the futures in 2034. The Annual Energy Outlook projections were used from 2028 onward. The avoided costs for heating load were computed from the Columbia Gas Transmission SST rate, plus refill from the Columbia FSS rate, adjusted for load factor over the heating season. Commodity costs include the commodity charge and gas retention from the TCO tariffs. The avoided costs also include an allowance for avoidable load-related distribution investments, borrowed from UGI's estimates in its 2018 EE&C filing, at Docket No. R-2018-3006814.

The Plan also uses avoided costs for electric energy and peak demand based on weighted average annual values from the electric utilities in Columbia Gas' territory, including Duquesne Light Company, Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, and West Penn. Values for the various electric utilities came from the respective Act 129 Phase IV filings for each utility.

⁸ Act 129 Phase IV 2021 Total Resource Cost (TRC) Test (Case No. M-2019-3006868). Final Order dated December 19, 2019. P. 20

Avoided costs for water came from the Act 129 Phase IV TRC Test Order.

1.6 Implementation

1.6.1 Program Staging

The Company anticipates that it will require six to nine months post Plan approval to finalize implementation details, hire vendors, and begin the marketing and outreach for ramping up the programs. All programs are projected to begin operations by July 1, 2023. This will give the programs a short year of activity in 2023, with significantly more activity projected in 2024 with the anticipation of full participation levels in 2025.

1.6.2 Administration

The Portfolio will be managed by Columbia Gas, who will engage the services of various contractors to fulfill all the roles required to implement the Plan. The table below describes the main roles in the management of the Plan.

Table 9. Overview of Administration Roles

Role	Description
Plan Administrator	Primarily responsible for program and portfolio planning, management and reporting. Supervises and manages all other roles.
Implementation and Design Consultants	Provides assistance in the design and implementation on multiple aspects of the portfolio, including, but not limited to, program design, reporting, marketing, and training.
Implementation Contractor	Directly responsible for main aspects of program delivery, including but not limited to, customer engagement and retention, technical assistance, measure installation, rebate processing, program tracking, inspection, and reporting.
Evaluator	Performs independent program and portfolio evaluations that are used to verify savings and guide future plans.

1.6.3 Marketing

Columbia Gas will investigate the use of a branded micro-website for the programs, for which multiple streams of advertising will lead back to, such as print, online ads, social media, bill inserts, trade ally outreach and residential canvassing efforts. These efforts are anticipated to be particularly important for driving

participation in the Online Audit Kit program, which in turn may feed into the Residential Prescriptive Program.

Columbia Gas will also look to partner with local businesses and trade organizations (builders, contractors, electricians, plumbers, HVAC service providers, equipment suppliers, etc.) to familiarize them with program opportunities, energy efficiency practices and implementation requirements and to utilize them, where appropriate, as one of the program's service delivery channels.

- Targeting equipment manufacturers, distributors, installation contractors and retailers/vendors to make sure they offer high-efficiency equipment and can make customers aware of available incentives.
- Partnering with community-based organizations to develop outreach and program delivery strategies.
- Working with Act 129 electric administrators to combine marketing and delivery options and address all aspects of efficiency at the same time.

Additional details for each program are in the individual program plans, and Columbia Gas will develop a more detailed marketing strategy for each of the programs and for the entire portfolio as part of the program setup.

1.6.4 Reporting

Columbia Gas will submit an annual report on the EE Plan each April, three months after the close of the program year. This report will provide information on activity for the previous year and progress towards three-year goals, including, but not limited to:

- First year and lifetime savings;
- Participation;
- Spending;
- Cost effectiveness;
- Highlights of portfolio and program activity; and
- Updates to program delivery and design.

In-order to tie savings and costs together as effectively as possible, results will be reported based on commitments made. Any measures that have been

verified as installed within a program year along with any costs committed to these measures, including administration costs, will be counted for that year.

1.6.5 Program Flexibility

To make sure that the EE&C Portfolio is able to address changing market conditions and improve service delivery as quickly as possible, Columbia Gas requires flexibility in the allocation of budgets and implementation of program improvements. This plan document provides the principles and three-year goals that Columbia Gas is seeking, but certain adjustments, such as providing incentives for new measures or moving budgets between years and programs, may be required to meet these goals. Columbia Gas will include any such adjustments in its annual report but does not anticipate seeking initial approval for such updates, considering that all costs are anticipated to be collected from the same rate class. Columbia Gas will file an updated EE Plan in anticipation of material changes that may have a serious effect on goals, such as:

- The addition or removal of a program;
- A need for total funding levels above those approved for the plan term; and
- Significant changes to cost-effectiveness projections, such as an update to avoided costs or a large reduction in portfolio spending projections.

1.7 Evaluation, Measurement, and Verification

1.7.1 Technical Reference Manual

To maintain consistency with existing gas efficiency programs in Pennsylvania, Columbia Gas will utilize a Technical Reference Manual (“TRM”) based on the most recent version of the UGI Gas, Inc. TRM and Columbia Gas VA’s experience with its online audit program. The Columbia Gas TRM will only contain those measures relevant to the programs proposed in this plan, and will include updates to some measure assumptions to calibrate them to Columbia Gas’ service territory (such as equivalent full load heating hours and heating degree days). In the future, any results from program evaluations that affect deemed savings calculations will

also be added to the TRM. The proposed TRM is included as Attachment A to this plan.

1.7.2 Tracking System

Columbia Gas will require that its coordinators collect all relevant customer, application, measure, and contractor information and that this data is provided in a timely fashion. Columbia Gas will regularly review this data, and will aggregate cost, savings, and participation data to a centralized database controlled by Columbia Gas that will be the source for program management and reporting.

1.7.3 Inspections

Inspections may be performed on a sub-set of applications before any incentive is paid. Inspectors will determine whether the measure is operational and matches the application, and they will solicit customer feedback on the programs. Inspection rates for prescriptive programs will be designed to gather a statistically significant sample of program activity. See individual program plans for additional details.

1.7.4 Evaluations

Columbia Gas will monitor the ongoing progress of the EE Plan to provide the highest possible service to customers, while maintaining controls to maximize the potential for savings and costs to be properly verified and counted. Columbia Gas will closely track program data, perform inspections of completed projects, and perform periodic evaluations for all the programs.

Columbia Gas will, at a minimum, evaluate each of its programs once adequate participation levels have been reached and a full 12 months of post-participation billing data has been collected. As part of the initial program development, Columbia Gas will work with the selected evaluator to establish the methodology and goals of the evaluation. Initial objectives include:

- Verifying energy savings and associated costs;
- Assessing market attitudes towards the program, including contractors, customers, and efficient equipment suppliers; and

- Measuring the effectiveness of current program design, marketing, and service delivery.

The evaluation section of the individual program descriptions includes additional details on evaluation schedules and goals unique to that program.

2 Program Plans

2.1 Residential Prescriptive

Objective	The Residential Prescriptive (RP) program is designed to overcome market barriers to energy efficient space and water heating equipment in the residential sector through rebates and customer awareness. The objective of the program is to avoid lost opportunities by encouraging consumers to install the most efficient gas heating technologies available when replacing older, less efficient equipment. The program also aims to strengthen Columbia Gas' relationship with HVAC contractors, suppliers, and other trade allies.				
Eligible Rate Class	RDS/RSS				
Cost Effectiveness	Three-Year Cost-Effectiveness Results (2022\$)				
	CE Test	PV Benefits	PV Costs	PV Net	BCR
	TRC Test	\$ 23,311,491 83,549	\$ 9,685,588 3,690,323	\$ 13,625,903 4,693,226	2.4127
Gas Admin Test	\$ 22,918,272 46,078	\$ 5,499,359 2,179,527	\$ 17,418,913 6,066,551	4.173.78	
Savings Projections	Three-Year Savings Projections				
	First Year Savings	2023	2024	2025	2023 - 2025
	Natural Gas (Dth)	20,619 14,518	61,63220,339	82,19623,952	164,448 58,809
Electric Energy (MWh)	65.594 6	94.6298.3	400.2116.4	793.427 6.5	

	Peak Demand (kW)	<u>11.716.9</u>	<u>16.953.2</u>	<u>71.420.8</u>	<u>141.449.3</u>
	Water (Million Gallons)	0.0	0.0	0.0	0.0
	Lifetime Savings	2023	2024	2025	2023 - 2025
	Natural Gas (Dth)	<u>375,092,264</u> <u>.136</u>	<u>1,111,6393</u> <u>69,495</u>	<u>1,480,4224</u> <u>32,463</u>	<u>2,967,1531,066</u> <u>094</u>
	Electric Energy (MWh)	<u>1,040.5720</u> <u>3</u>	<u>3,2841.040</u> <u>5</u>	<u>4,402.01.28</u> <u>0.6</u>	<u>8,724.03,041.4</u>
	Water (Million Gallons)	0.0	0.0	0.0	0.0
Budget Projections	Three-Year Budgets (Nominal)				
	Costs by Category	2023	2024	2025	2023 - 2025
	Customer Incentives	<u>\$660,462,00</u> <u>0</u>	<u>\$1,968,652,00</u> <u>0</u>	<u>\$2,618,768,00</u> <u>0</u>	<u>\$5,246,1,882,000</u>
	Administration	<u>\$123,91,000</u>	<u>\$122,73,000</u>	<u>\$146,78,000</u>	<u>\$391,242,000</u>
	Marketing	<u>\$82,74,000</u>	<u>\$56,32,000</u>	<u>\$68,34,000</u>	<u>\$206,140,000</u>
	Inspections	<u>\$33,23,000</u>	<u>\$97,32,000</u>	<u>\$129,38,000</u>	<u>\$259,93,000</u>
	Evaluation	<u>\$0</u>	<u>\$0</u>	<u>\$60,000</u>	<u>\$60,000</u>
	Total	<u>\$898,650,00</u> <u>0</u>	<u>\$2,243,789,00</u> <u>0</u>	<u>\$3,021,978,00</u> <u>0</u>	<u>\$6,162,2,417,000</u>
Participation Projections	Three-Year Participation Projections				
	Projected Units	2023	2024	2025	2023 - 2025
	Furnace - ENERGY STAR	<u>720,520</u>	<u>2,100,700</u>	<u>2,800</u>	<u>5,620,2,020</u>
	Boiler - 94+ AFUE	<u>3020</u>	<u>11030</u>	<u>14040</u>	<u>28090</u>
	Combi Boiler - 94+ AFUE	<u>12080</u>	<u>340120</u>	<u>450140</u>	<u>910340</u>
Wifi Thermostat - ENERGY STAR	<u>1,300,900</u>	<u>4,100,1,30</u> <u>0</u>	<u>5,500,1,60</u> <u>0</u>	<u>10,900,3,800</u>	

	Tankless Water Heater - ENERGY STAR	<u>170120</u>	<u>500170</u>	<u>670200</u>	<u>1,340490</u>
	Total	<u>2,3401,64</u> <u>0</u>	<u>7,1502,32</u> <u>0</u>	<u>9,5602,78</u> <u>0</u>	<u>19,0506,740</u>
Program Rollout	<p><i>Jan 2023 – Jun 2023</i> Finalize program process and implementation details, select vendors, and develop initial marketing push</p> <p><i>Jul 2023</i> Launch Program</p> <p><i>2023 - 2024</i> Continue engagement activities with customers and trade allies.</p> <p><i>2025</i> Reach full anticipated participation levels.</p>				
Program Design	<p>The RP Program offers rebates for qualifying residential-sized space and water heating equipment and controls. For most measures, customers will have a contractor install the measure and receive a rebate to offset some of the incremental cost of the higher efficiency equipment. Smaller measures, such as Wi-Fi enabled thermostats, will only require a valid proof of purchase before a rebate is issued. Customers will be encouraged to process rebates through an online portal, but may also submit a paper application through the mail. Columbia Gas may also provide the option to purchase qualified smart thermostats via an online marketplace.</p> <p>If program funds begin to run low, incentive levels may be lowered, or equipment removed from the program if additional budget adjustments cannot be made. Columbia Gas will aim to provide as little interruption to customers as possible due to such adjustments.</p> <p>Columbia Gas will continue to examine other equipment for potential inclusion in the program, as well as the relative market adoption of equipment already receiving incentives.</p>				

Target Market and End Uses

The RP targets residential consumers who use natural gas to heat their homes and/or generate hot water. In general, the program aims to incentivize only the highest levels of efficient equipment on the market. The minimum level of efficiency for measures offered through the RP program will be ENERGY STAR®, when available, and in some cases may exceed ENERGY STAR®.

On the space heating side, the program provides incentives for ENERGY STAR® labeled smart thermostats, furnaces, high efficiency boilers, and combination boilers. ENERGY STAR® smart thermostats offer the potential for deeper savings than traditional programmable thermostats due to the wide range of features and feedback they offer. ENERGY STAR® requirements for furnaces drive customers toward the highest efficiency tier of condensing units (95+ AFUE) and require efficient fans that save electricity. The program would also require boilers to go towards the highest efficiency tier with an AFUE of at least 94. Finally, offering incentives for combination space and water heating boilers addresses two types of end-use with one piece of equipment. These “combi boilers” also address issues with orphaned water heaters having existing atmospheric venting systems that are no longer adequate, when switching to condensing heating equipment. The program also addresses water heating savings by offering incentives for ENERGY STAR® tankless water heaters.

Financial Incentives	<p>Incentives were designed to be in line with other offerings in the region and/or cover approximately two-thirds of the incremental cost of the measure. The table below lists the proposed incentive schedule.</p> <p><i>Proposed Residential Prescriptive Program Rebates (Nominal)</i></p> <table border="1" data-bbox="464 505 1892 857"> <thead> <tr> <th>Equipment</th> <th>Minimum Efficiency</th> <th>Proposed Incentive</th> <th>Maximum Incentive</th> </tr> </thead> <tbody> <tr> <td>Smart Thermostat</td> <td>ENERGY STAR®</td> <td>\$100</td> <td>\$100</td> </tr> <tr> <td>Furnace</td> <td>ENERGY STAR®</td> <td>\$400</td> <td>\$500</td> </tr> <tr> <td>Boiler</td> <td>94+ AFUE</td> <td>\$1,000</td> <td>\$1,500</td> </tr> <tr> <td>Combi Boiler</td> <td>94+ AFUE</td> <td>\$1,200</td> <td>\$1,800</td> </tr> <tr> <td>Tankless Water Heater</td> <td>ENERGY STAR®</td> <td>\$400</td> <td>\$500</td> </tr> </tbody> </table> <p>All equipment besides the Wi-Fi thermostat must be powered by natural gas.</p>	Equipment	Minimum Efficiency	Proposed Incentive	Maximum Incentive	Smart Thermostat	ENERGY STAR®	\$100	\$100	Furnace	ENERGY STAR®	\$400	\$500	Boiler	94+ AFUE	\$1,000	\$1,500	Combi Boiler	94+ AFUE	\$1,200	\$1,800	Tankless Water Heater	ENERGY STAR®	\$400	\$500
Equipment	Minimum Efficiency	Proposed Incentive	Maximum Incentive																						
Smart Thermostat	ENERGY STAR®	\$100	\$100																						
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Combi Boiler	94+ AFUE	\$1,200	\$1,800																						
Tankless Water Heater	ENERGY STAR®	\$400	\$500																						
Marketing Approach	<p>The RP program may be marketed through inclusion on Columbia’s website and through social media, as well as through bill inserts and other media messaging. The main way that many customers will hear about the RP Program is through HVAC contractors and plumbers, and the program will be a key part of trade ally outreach efforts. Incentives will help these contractors sell jobs, and efforts such as cobranding and potentially assigning incentives to contractors will provide trade allies with even more tools to move customers to higher efficiency levels.</p>																								
Evaluation, Measurement,	<u>Quality Assurance</u>																								

<p>and Verification</p>	<p>All applications will require proof of purchase and a valid Columbia Gas account number. Rebates received as an instant rebate via a qualified participating contractor or equipment distributor will be accompanied by an invoice showing the point of sale discount passed on to the customer. The rebate processor will verify that the equipment is eligible for the rebate based on the model's Air-Conditioning Heating and Refrigeration Institute (AHRI) number before issuing any rebate. The program's rebate processor will maintain a real-time database of rebate activity, which will be periodically reviewed by Columbia Gas and stored separately for long-term purposes.</p> <p>There will be inspections of approximately five percent (5%) of non-thermostat equipment rebates and approximately one percent (1%) of Wi-Fi thermostat rebates to obtain a statistically significant sample of activity. The inspection will consist of verifying that the rebated equipment is installed and operational and conclude with a short informational interview with the participant. Virtual inspections will be explored to reduce program costs and increase inspection rates.</p> <p><u>Evaluations</u></p> <p>A third-party vendor will evaluate the program's process and impacts after sufficient participation has occurred in the third year of the Plan.</p>
<p>Program Administration</p>	<p><u>Rebate Processing and Inspection</u></p> <p>The rebate processor will accept customer applications, track and verify application information, notify the customer of any issues, maintain a call center, and report results to Columbia Gas. The rebate</p>

processor may also be responsible for other programs to streamline portfolio management. The rebate processor will also be responsible for inspections.

Marketing and Outreach

Columbia Gas and their vendors will handle marketing and outreach for the RP program.

Evaluator

A third-party evaluator will be retained to perform evaluations.

2.2 Online Audit Kit

Objective	The Online Audit Kit (OAK) Program is designed to provide residential customers with information on how to improve the efficiency of their homes along with free, targeted energy savings kits. The program also provides a way for customers to engage with Columbia Gas and learn about the RP Program.																																																	
Eligible Rate Class	RSD/RSS																																																	
Cost Effectiveness	<p>Three-Year Cost-Effectiveness Results (2022\$)</p> <table border="1"> <thead> <tr> <th data-bbox="449 621 646 654">CE Test</th> <th data-bbox="890 621 1073 654">PV Benefits</th> <th data-bbox="1192 621 1339 654">PV Costs</th> <th data-bbox="1549 621 1661 654">PV Net</th> <th data-bbox="1808 621 1885 654">BCR</th> </tr> </thead> <tbody> <tr> <td data-bbox="449 711 604 743">TRC Test</td> <td data-bbox="785 675 1073 748">\$4,264,882<u>2,472,719</u></td> <td data-bbox="1100 675 1339 748">\$986,750<u>695,683</u></td> <td data-bbox="1367 675 1661 748">\$3,278,132<u>1,777,035</u></td> <td data-bbox="1751 691 1885 724"><u>4.32355</u></td> </tr> <tr> <td data-bbox="449 800 695 833">Gas Admin Test</td> <td data-bbox="785 764 1073 837">\$2,669,506<u>1,548,703</u></td> <td data-bbox="1100 764 1339 837">\$986,750<u>695,683</u></td> <td data-bbox="1367 764 1661 837">\$1,682,756<u>853,020</u></td> <td data-bbox="1776 781 1885 813"><u>2.7123</u></td> </tr> </tbody> </table>					CE Test	PV Benefits	PV Costs	PV Net	BCR	TRC Test	\$4,264,882 <u>2,472,719</u>	\$986,750 <u>695,683</u>	\$3,278,132 <u>1,777,035</u>	<u>4.32355</u>	Gas Admin Test	\$2,669,506 <u>1,548,703</u>	\$986,750 <u>695,683</u>	\$1,682,756 <u>853,020</u>	<u>2.7123</u>																														
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Savings Projections	<p>Three-Year Savings Projections</p> <table border="1"> <thead> <tr> <th data-bbox="449 907 695 940">First Year Savings</th> <th data-bbox="890 907 957 940">2023</th> <th data-bbox="1100 907 1167 940">2024</th> <th data-bbox="1310 907 1377 940">2025</th> <th data-bbox="1444 907 1598 940">2023 - 2025</th> </tr> </thead> <tbody> <tr> <td data-bbox="449 959 674 992">Natural Gas (Dth)</td> <td data-bbox="842 959 957 992">2,684,666</td> <td data-bbox="1024 959 1167 992">9,393,367</td> <td data-bbox="1213 959 1356 992">13,418,709</td> <td data-bbox="1430 959 1598 992">25,495,743</td> </tr> <tr> <td data-bbox="449 1008 730 1040">Electric Energy (MWh)</td> <td data-bbox="919 1008 957 1040">0.0</td> <td data-bbox="1129 1008 1167 1040">0.0</td> <td data-bbox="1339 1008 1377 1040">0.0</td> <td data-bbox="1556 1008 1598 1040">0.0</td> </tr> <tr> <td data-bbox="449 1057 695 1089">Peak Demand (kW)</td> <td data-bbox="919 1057 957 1089">0.0</td> <td data-bbox="1129 1057 1167 1089">0.0</td> <td data-bbox="1339 1057 1377 1089">0.0</td> <td data-bbox="1556 1057 1598 1089">0.0</td> </tr> <tr> <td data-bbox="449 1105 730 1138">Water (Million Gallons)</td> <td data-bbox="919 1105 957 1138">1.5</td> <td data-bbox="1087 1105 1167 1138">5.43<u>1</u></td> <td data-bbox="1297 1105 1377 1138">7.73<u>9</u></td> <td data-bbox="1507 1105 1598 1138">14.68<u>4</u></td> </tr> <tr> <th data-bbox="449 1146 674 1179">Lifetime Savings</th> <th data-bbox="890 1146 957 1179">2023</th> <th data-bbox="1100 1146 1167 1179">2024</th> <th data-bbox="1310 1146 1377 1179">2025</th> <th data-bbox="1444 1146 1598 1179">2023 - 2025</th> </tr> <tr> <td data-bbox="449 1198 674 1230">Natural Gas (Dth)</td> <td data-bbox="793 1198 957 1230">36,077,359<u>36,077,359</u></td> <td data-bbox="982 1198 1167 1230">126,269,721<u>126,269,721</u></td> <td data-bbox="1192 1198 1377 1230">180,384,901<u>180,384,901</u></td> <td data-bbox="1402 1198 1598 1230">342,730,198<u>342,730,198</u></td> </tr> <tr> <td data-bbox="449 1247 730 1279">Electric Energy (MWh)</td> <td data-bbox="919 1247 957 1279">0.0</td> <td data-bbox="1129 1247 1167 1279">0.0</td> <td data-bbox="1339 1247 1377 1279">0.0</td> <td data-bbox="1556 1247 1598 1279">0.0</td> </tr> <tr> <td data-bbox="449 1295 730 1328">Water (Million Gallons)</td> <td data-bbox="890 1295 957 1328">15.41</td> <td data-bbox="1058 1295 1167 1328">53.930<u>8</u></td> <td data-bbox="1268 1295 1377 1328">77.038<u>5</u></td> <td data-bbox="1499 1295 1598 1328">146.84<u>4</u></td> </tr> </tbody> </table>					First Year Savings	2023	2024	2025	2023 - 2025	Natural Gas (Dth)	2,684,666	9,393,367	13,418,709	25,495,743	Electric Energy (MWh)	0.0	0.0	0.0	0.0	Peak Demand (kW)	0.0	0.0	0.0	0.0	Water (Million Gallons)	1.5	5.43 <u>1</u>	7.73 <u>9</u>	14.68 <u>4</u>	Lifetime Savings	2023	2024	2025	2023 - 2025	Natural Gas (Dth)	36,077,359 <u>36,077,359</u>	126,269,721 <u>126,269,721</u>	180,384,901 <u>180,384,901</u>	342,730,198 <u>342,730,198</u>	Electric Energy (MWh)	0.0	0.0	0.0	0.0	Water (Million Gallons)	15.41	53.930 <u>8</u>	77.038 <u>5</u>	146.84 <u>4</u>
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Budget Projections	Three-Year Budgets (Nominal)				
	Costs by Category	2023	2024	2025	2023 - 2025
	Customer Incentives	\$25,860,630	\$90,510,720	\$129,300,650	\$245,670,142,000
	Administration	\$138,113,000	\$182,126,000	\$239,145,000	\$559,384,000
	Marketing	\$58,000	\$644,000	\$835,000	\$205,155,000
	Inspections	\$0	\$0	\$0	\$0
	Evaluation	\$20,000	\$20,000	\$50,000	\$90,000
Total	\$241,860,216,630	\$356,510,242,720	\$501,300,311,650	\$1,099,670,771,000	
Participation Projections	Three-Year Participation Projections				
	Projected Kits	2023	2024	2025	2023 - 2025
	Water Heating Kit	480,470	1,680,960	2,400,120	4,560,2630
	Space Heating Kit	780	2,730,1560	3,900,1950	7,410,4290
	Total	1,260,250	4,410,2520	6,300,3150	11,970,6920
Program Rollout	<i>Jan 2023 – Jun 2023</i>	Finalize program process and implementation details, select vendors, and develop initial marketing push			
	<i>Jul 2023</i>	Launch Program			
	<i>2023 - 2024</i>	Continue engagement activities with customers and trade allies.			
	<i>2025</i>	Reach full anticipated participation levels.			
Program Design	The OAK Program provides a way for customers to undergo an online audit of their home, which will result in a customized set of recommendations. The customer will then be eligible to receive up to two				

	targeted energy saving kits, shipped to their home at no cost. The first kit is for customers who use natural gas for water heating, and the second kit is for customers who utilize natural gas to heat their homes. Participating customers will also be referred to the RP program incentives if appropriate. To reach customers who do not have easy access to the internet, a phone version of the audit will be made available.
Target Market and End Uses	There will be two kits available for customers. The water heating kit will include measures such as high-efficiency showerheads and low-flow faucet aerators. The space heating kit will include low-cost measures such as outlet and light switch gaskets, caulk, and foam sealant along with instructions on effective installation.
Financial Incentives	Kits will be provided at no cost to the customer.
Marketing Approach	The OAK program will be marketed through bill inserts, social media, and on Columbia Gas' website. Other outreach efforts may include email, radio, and print advertisements. The program will also act as a referral service for customers who may want to participate in the RP program.
Evaluation, Measurement, and Verification	<p><u>Quality Assurance</u></p> <p>Columbia Gas will perform a survey of participants every year to determine installation rates for energy saving kits and assess customers satisfaction with program recommendations.</p> <p><u>Evaluations</u></p>

	<p>The program will undergo a process and impact evaluation in the third year once sufficient time has passed for the program to achieve meaningful participation.</p>
<p>Program Administration</p>	<p><u>Online Audit and Kit Provider</u></p> <p>Columbia Gas will hire a vendor to provide an online audit solution and package and send energy saving kits to customers.</p> <p><u>Marketing and Outreach</u></p> <p>Columbia Gas and their vendors will handle marketing and outreach for the program.</p> <p><u>Evaluator</u></p> <p>A third-party evaluator will be retained to perform annual participant surveys and regular program evaluations.</p>

3 Appendices

3.1 Avoided Cost Tables

Gas Avoided Costs (2022\$/Dth)

Year	Base	Space Heating	Domestic Hot Water
2023	\$4.67	\$10.49	\$6.12
2024	\$4.48	\$10.42	\$5.97
2025	\$4.46	\$10.47	\$5.96
2026	\$4.47	\$10.57	\$6.00
2027	\$4.49	\$10.67	\$6.04
2028	\$4.66	\$10.90	\$6.22
2029	\$4.84	\$11.14	\$6.41
2030	\$4.92	\$11.30	\$6.51
2031	\$5.04	\$11.49	\$6.66
2032	\$5.10	\$11.62	\$6.73
2033	\$5.20	\$11.79	\$6.85
2034	\$5.21	\$11.87	\$6.87
2035	\$5.22	\$11.96	\$6.91
2036	\$5.25	\$12.06	\$6.95
2037	\$5.29	\$12.17	\$7.01
2038	\$5.32	\$12.28	\$7.06
2039	\$5.34	\$12.38	\$7.10
2040	\$5.40	\$12.52	\$7.18
2041	\$5.43	\$12.63	\$7.23
2042	\$5.43	\$12.70	\$7.24
2043	\$5.45	\$12.81	\$7.29
2044	\$5.40	\$12.85	\$7.26
2045	\$5.39	\$12.93	\$7.27
2046	\$5.40	\$13.03	\$7.30
2047	\$5.41	\$13.13	\$7.34
2048	\$5.46	\$13.27	\$7.41
2049	\$5.46	\$13.37	\$7.43
2050	\$5.47	\$13.48	\$7.47

Developed by Resource Insight, Inc.

Other Resource Avoided Costs (2022\$)

Year	All-Year Energy (\$/kWh)	Generation Capacity (\$/kW-yr)	T&D (\$/kW-yr)	Water (\$/gal)
2023	\$0.0324	\$54.63	\$53.93	\$0.013
2024	\$0.0324	\$54.63	\$53.93	\$0.013
2025	\$0.0323	\$54.63	\$53.93	\$0.013
2026	\$0.0335	\$54.64	\$53.93	\$0.013
2027	\$0.0348	\$54.64	\$53.93	\$0.013
2028	\$0.0362	\$54.64	\$53.93	\$0.013
2029	\$0.0374	\$54.63	\$53.93	\$0.013
2030	\$0.0380	\$54.63	\$53.93	\$0.013
2031	\$0.0390	\$54.63	\$53.93	\$0.013
2032	\$0.0404	\$54.63	\$53.93	\$0.013
2033	\$0.0413	\$54.63	\$53.93	\$0.013
2034	\$0.0420	\$54.63	\$53.93	\$0.013
2035	\$0.0415	\$54.64	\$53.93	\$0.013
2036	\$0.0411	\$54.63	\$53.93	\$0.013
2037	\$0.0414	\$54.63	\$53.93	\$0.013
2038	\$0.0415	\$54.63	\$53.93	\$0.013
2039	\$0.0414	\$54.63	\$53.93	\$0.013
2040	\$0.0416	\$54.63	\$53.93	\$0.013
2041	\$0.0418	\$54.63	\$53.93	\$0.013
2042	\$0.0418	\$54.63	\$53.93	\$0.013
2043	\$0.0418	\$54.63	\$53.93	\$0.013
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2048	\$0.0418	\$54.63	\$53.93	\$0.013
2049	\$0.0418	\$54.63	\$53.93	\$0.013
2050	\$0.0418	\$54.63	\$53.93	\$0.013

3.2 Detailed Measure Assumptions

Measure Name	Costs		Savings				
	Incentive	Incr. Cost	Lifetime (Yrs)	Dth	kWh	kW	Water (Gal)
Residential Prescriptive Program							
Furnace - ENERGY STAR	\$400.00	\$758.40	20	13.99	0	0	0
Boiler - 94+ AFUE	\$1,000.00	\$1,785.00	25	12.83	0	0	0
Combi Boiler - 94+ AFUE	\$1,200.00	\$2,526.18	25	22.72	0	0	0
Wifi Thermostat - ENERGY STAR	\$100.00	\$150.00	11	4.52	73	0.01	0
Tankless Water Heater - ENERGY STAR	\$400.00	\$592.85	20	9.18	0	0	0

Online Audit Kit Program

Web Faucet Aerator - Kitchen	\$2.70	\$2.70	10	0.51	0	0	941
Web Faucet Aerator - Bathroom	\$0.70	\$0.70	10	0.11	0	0	201
Web High Efficiency Showerhead	\$4.96	\$4.96	10	0.51	0	0	934
Web Switch/Outlet Cover	\$2.40	\$2.40	15	1.64	0	0	-
Web Caulk	\$3.12	\$3.12	15	0.37	0	0	-
Web Foam Sealant	\$6.21	\$6.21	15	0.37	0	0	-
Water Heating Kit	\$8.98	\$8.98	1	-	0	0	-
Space Heating Kit	\$7.27	\$7.27	1	-	0	0	-

3.3 Detailed Program and Portfolio Cost-effectiveness

Energy Efficiency Programs' Cost Effectiveness over Three-Year Portfolio (2022\$)

Program	Total Resource		PV of Net Benefits	Gas Energy System	
	Present Value			Present Value	
	<u>Benefit</u>	<u>Cost</u>		<u>Benefit</u>	<u>Cost</u>
Portfolio Total	<u>\$27,576,373,10,856,268</u>	<u>\$11,411,3075,124,977</u>	<u>\$16,165,0655,731,291</u>	<u>\$25,587,7779,794,781</u>	<u>\$7,225,0783,614,1</u>
Non-Measure Costs		<u>\$2,331,5281,792,202</u>			<u>\$2,331,5281,792,2</u>
Total Measure Costs	<u>\$27,576,373,10,856,268</u>	<u>\$9,079,7793,332,775</u>	<u>\$18,496,5937,523,493</u>	<u>\$25,587,7779,794,781</u>	<u>\$4,893,5501,821,9</u>
Program					
Residential Prescriptive Program					
Program Total	<u>\$23,311,4918,383,549</u>	<u>\$9,685,5883,690,323</u>	<u>\$13,625,9034,693,226</u>	<u>\$22,918,2728,246,078</u>	<u>\$5,499,3592,179,5</u>
Non-Measure Costs		<u>\$824,226484,717</u>			<u>\$824,226484,7</u>
Total Measure Costs	<u>\$23,311,4918,383,549</u>	<u>\$8,861,3613,205,607</u>	<u>\$14,450,1295,177,942</u>	<u>\$22,918,2728,246,078</u>	<u>\$4,675,1321,694,8</u>
Online Audit Kit Program					
Program Total	<u>\$4,264,8822,472,719</u>	<u>\$986,750695,683</u>	<u>\$3,278,1321,777,035</u>	<u>\$2,669,5061,548,703</u>	<u>\$986,750695,6</u>
Non-Measure Costs		<u>\$768,332568,515</u>			<u>\$768,332568,5</u>
Total Measure Costs	<u>\$4,264,8822,472,719</u>	<u>\$218,418127,168</u>	<u>\$4,046,4642,345,551</u>	<u>\$2,669,5061,548,703</u>	<u>\$218,418127,1</u>
Portfolio Wide Costs					
Program Total	-	\$738,970	\$(738,970)	-	\$738,9
Non-Measure Costs		\$738,970			\$738,9
Total Measure Costs	-	-	-	-	-

3.4 Technical Reference Manual (TRM)

CERTIFICATE OF SERVICE

I hereby certify that true and correct copies of the foregoing have been served upon the following persons, in the manner indicated, in accordance with the requirements of § 1.54 (relating to service by a participant).

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