Colorado PUC E-Filings System

Atmos Energy Colorado Natural Gas Market Potential Study – Clean Heat Plan

Submitted by Apex Analytics LLC with Brightline Group

December 29, 2023

Table of Contents

1. Introduction 1
Project Overview 1
Clean Heat Plan Incremental Energy Efficiency Potential 1
2. Creation of Clean Heat EE Portfolios 4
2.1 Approach 4
2.1.1 Development of Energy Efficiency Measures for Least Cost Portfolio 4
2.1.2 Development of Energy Efficiency Measures for Emissions Target Portfolio 5
2.1.3 Development of Energy Efficiency Measures for Preferred Portfolio 5
2.1.4 Development of Recovered Methane Resource Potential 6
2.2 Resulting Portfolio Costs and Savings of EE Measures 6
3. EE Pilot Program Descriptions and Assumptions 7
3.1 Pilot Development Rationale 7
3.2 Gas Heat Pumps 7
3.2.1 Opportunity Description 7
3.2.2 Barriers and Research Questions 8
3.2.3 Estimated Costs and Savings 9
3.3 Manufactured Housing Early Retirement 9
3.3.1 Opportunity Description 9
3.3.2 Barriers and Research Questions 10
3.3.3 Estimated Costs and Savings 10
4. Recovered Methane 11
Appendix 1: EE Potential Study Methods and Results 13
1. Potential Study Methodology 13
Study Approach 13
1.1 Overview 13
1.2 Customer Segmentation and Forecast Disaggregation 15
1.2.1 Customer Segmentation 15

1.3 Technical Potential 16
1.3.1 Measure Development 17
1.4 Economic Potential 19
1.5 Achievable Potential 20
1.5.1 Market Adoption Rates 21
2. Market Characterization & Baseline Forecast 21
3. Residential Sector Potential 23
3.1 Program Achievable Potential 23
3.2 Maximum Achievable Potential 27
3.3 Comparisons 30
4. Non-Residential Sector Potential 31
4.1 Program Achievable Potential 31
4.2 Maximum Achievable Potential 36
4.3 Comparisons 39
Appendix 2: Top Measures – Program Achievable 41
Appendix 3: Top Measures – Maximum Achievable 42

1. Introduction

Project Overview

Apex Analytics and its subcontractor Brightline Group (collectively, the "Apex Team" or the "Team") performed the attached market potential study to inform Atmos Energy's development of portfolios to fulfill the statutory requirements for a Clean Heat Plan ("CHP"). The Apex Team assessed the available technical, economic, and achievable energy savings potential from natural gas energy efficiency ("EE") measures and technologies both as part of, and incremental to, those contemplated in Atmos Energy's ongoing Demand-Side Management ("DSM") Strategic Issues proceeding (Proceeding No. 23A-0216G).

This 2023 CHP analysis version is based upon inputs and methodologies used in the 2022 market potential study analysis prepared by the Apex Team to inform Atmos Energy's DSM program in compliance with § 40-3.2-103, C.R.S. and related rules and orders promulgated by the Colorado Public Utilities Commission (the "Commission"). This 2023 CHP study considered alternative scenarios with additional cost-effectiveness screenings and incentive levels as compared to the 2022 DSM analysis.

Clean Heat Plan Incremental Energy Efficiency Potential

Energy savings potential within the CHP study horizon of 2023 through 2032 is significantly larger than historical Atmos Energy DSM program results due to several primary factors:

1. As with the 2022 market potential study, more measures (including building envelope measures) pass the MTRC based on the social cost of emissions benefits being included.
2. Higher CHP incentives and program budgets enable higher achievements.
3. Compared to the 2022 market potential study, additional measures pass the CHP MTRC cost-effectiveness test because the economic screen threshold was dropped to a Total Resource Cost ("TRC") benefit-cost ratio of 0.4 for program achievable and 0.01 for maximum achievable.

To calculate incremental EE amounts available for the CHP portfolios, the Apex Team used the technical, maximum achievable, and program achievable levels of EE from this CHP EE potential assessment and subtracted out Atmos Energy's existing DSM plans.

Table 1 summarizes annual incremental energy savings available for the CHP (the first year savings of incremental participants in a program) by potential level

(technical, maximum, and program achievable); Table 2 summarizes cumulative energy savings potential (savings from measures installed in previous years with lifetimes extending to that year plus the new savings for new participants in that year); and Figure 1 compares the CHP energy savings potential to forecasted energy sales.

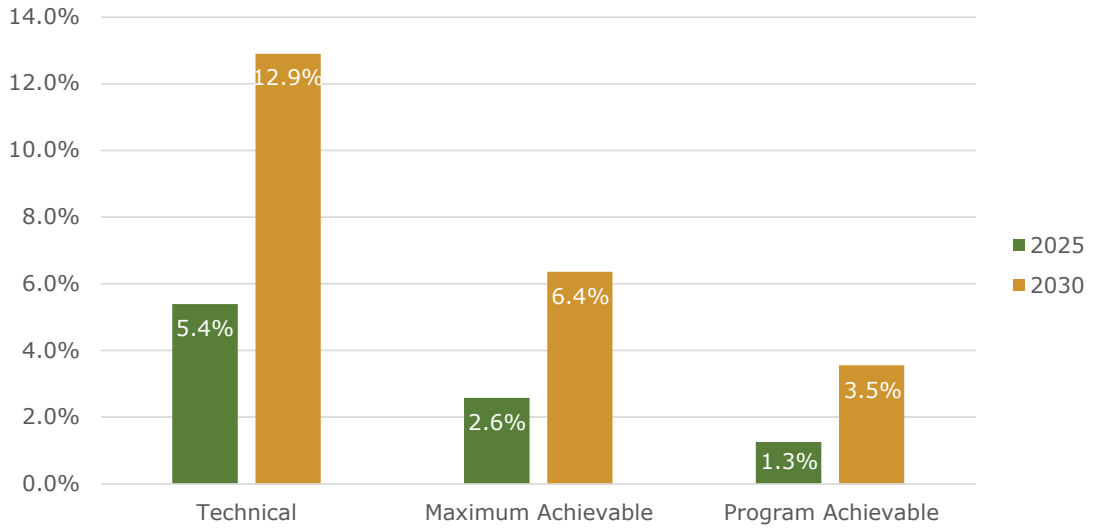
Table 1: Annual CHP Incremental Energy Savings Potential for EE Measures by Potential Level

Milestone Year	Technical	Maximum Achievable	Program Achievable
Annual Incremental Energy Savings (therms)			
2025	2,744,287	1,402,500	800,000
2030	2,956,421	1,714,696	1,060,044
Annual Budget ($ Millions)			
2025	n/a	$9.8	$3.8
2030	n/a	$11.6	$5.3

Table 2: Cumulative Energy Savings Potential by Potential Level

Time Horizon	Technical	Maximum Achievable	Program Achievable
Cumulative (therms)			
2023–2025	7,362,184	3,515,378	1,713,716
2023–2030	18,989,749	9,357,275	5,225,147

Figure 1: Cumulative Energy Savings Potential as a % of Total Sales Forecast



Using the approach described above from the maximum and program achievable potential, the Apex Team optimized the Clean Heat Plan additional EE resources as shown in Table 3.

Table 3: Clean Heat Portfolios

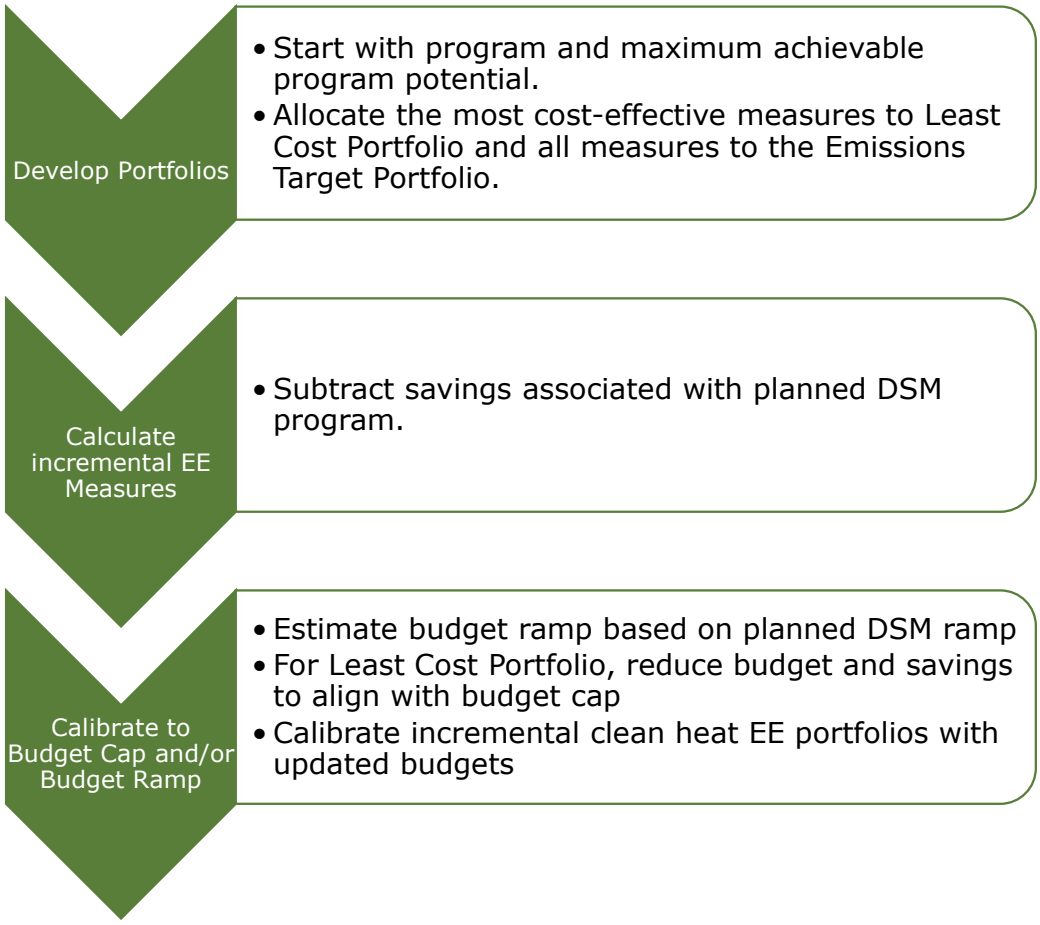
Year	Least Cost Portfolio Clean Heat Additional DSM Cumulative Savings (Therms)	Least Cost Portfolio Clean Heat Incremental DSM Budget ($Millions)	Emissions Target Portfolio Clean Heat Additional DSM Cumulative Savings (Therms)	Emissions Target Portfolio Clean Heat Incremental DSM Budget ($Millions)	Preferred Portfolio Clean Heat DSM Cumulative Savings (Therms)	Preferred Portfolio Clean Heat Incremental DSM Budget ($Millions)
2024	64,779	$0.5	87,221	$0.9	64,779	$0.5
2025	196,079	$1.1	288,290	$2.3	196,079	$1.1
2026	478,493	$2.7	643,561	$5.1	478,493	$2.7
2027	837,697	$3.2	1,205,946	$8.0	837,697	$3.2
2028	1,217,597	$3.4	1,830,566	$8.7	1,217,597	$3.4
2029	1,610,795	$3.4	2,521,476	$9.1	1,610,795	$3.4
2030	2,025,837	$3.4	3,270,054	$9.5	2,025,837	$3.4

2. Creation of Clean Heat EE Portfolios

2.1 Approach

Figure 2 summarizes the process for applying the potential estimates to support clean heat EE portfolios with savings and budgets.

Figure 2: Clean Heat Portfolio Development



2.1.1 Development of Energy Efficiency Measures for Least Cost Portfolio

To assess the incremental EE resource in the Least Cost Portfolio, the Apex Team targeted the most cost-effective measures above the planned DSM amounts of $2.1 million. This portfolio uses a mix of measures and assumptions from both the

maximum achievable potential and the program achievable potential. We optimized the measures assessed through the potential study to maximize GHG emissions savings per budget dollar by:

- Removing the measures with the lowest GHG emissions savings per budget dollar from the program achievable potential; and
- Assuming higher incentives and adoption of the most cost-effective measures within the maximum achievable potential.

Measures that were shifted to higher incentives and higher adoption included replace-on-burnout gas furnaces, gas boilers, and gas water heaters. We estimated new incremental EE for the Least Cost Portfolio by subtracting the budget associated with Atmos Energy's planned DSM Program from the total of the most cost-effective measures in the potential study. As a final step, we incorporated a ramp-up period to allow for the orderly expansion of EE budgets and savings considering the marketplace challenges such as contractor workforce and equipment availability to deliver the EE measures included in the Portfolio with over five times current DSM spending levels.

2.1.2 Development of Energy Efficiency Measures for Emissions Target Portfolio

In the Emissions Target Portfolio, the Apex Team developed a plan to maximize the total savings from EE measures by:

- Including every measure from the maximum achievable potential in the portfolio, regardless of its cost-effectiveness (using the MTRC); and
- Increasing the incentives for all measures to 100% of incremental cost.

We developed the Emissions Target Portfolio estimates by subtracting the planned DSM from a portfolio that includes all available measures to estimate the maximum amount of additional EE available. The Apex Team estimated budget and savings for the Emissions Target Portfolio by subtracting the existing DSM Program planned budget and savings from the total. As a final step, we incorporated a ramp-up period to allow for the orderly expansion of EE budgets and savings considering the marketplace challenges such as contractor workforce and equipment availability to deliver the EE measures included in the Portfolio with over ten times current DSM spending levels.

2.1.3 Development of Energy Efficiency Measures for Preferred Portfolio

At the direction of Atmos Energy, the Apex Team developed the Preferred Portfolio by:

- Applying a similar spending limit to the Least Cost Portfolio,
- Employing maximum incentives for the most cost-effective EE measures, and
- Decreased renewable natural gas ("RNG") targets.

2.1.4 Development of Recovered Methane Resource Potential

The Apex Team analyzed the responses to a joint Request for Information ("RFI") issued earlier in 2023 by Atmos Energy and other Colorado gas distribution companies related to RNG. The RFI requested costs and availability of RNG that meets the definition of recovered methane in the statute.

2.2 Resulting Portfolio Costs and Savings of EE Measures

Table 4 shows the therm savings and incremental budgets for the three Clean Heat Portfolios described above.

Table 4: Incremental DSM Portfolio Summary Costs and Therm Savings

Year	Least Cost Portfolio Additional DSM Cumulative Savings (therms)	Least Cost Portfolio Incremental DSM Budget ($Millions)	Emissions Target Portfolio Additional DSM Cumulative Savings (therms)	Emissions Target Portfolio Incremental DSM Budget ($Millions)	Preferred Portfolio Additional DSM Cumulative Savings (therms)	Preferred Portfolio Incremental DSM Budget ($Millions)
2024	64,779	$0.5	87,221	$0.9	64,779	$0.5
2025	196,079	$1.1	288,290	$2.3	196,079	$1.1
2026	478,493	$2.7	643,561	$5.1	478,493	$2.7
2027	837,697	$3.2	1,205,946	$8.0	837,697	$3.2
2028	1,217,597	$3.4	1,830,566	$8.7	1,217,597	$3.4
2029	1,610,795	$3.4	2,521,476	$9.1	1,610,795	$3.4
2030	2,025,837	$3.4	3,270,054	$9.5	2,025,837	$3.4

Table 5 shows the GHG savings and cost per metric ton ("MT") of GHG reductions for each Clean Heat Portfolio.

Table 5: Incremental DSM Portfolio GHG Savings and Cost per MT CO2

Year	Least Cost Portfolio Additional DSM CO2 Savings (MT CO2)	Least Cost Portfolio Cost per Ton ($/CO2)	Emissions Target Portfolio Additional DSM CO2 Savings (MT CO2)	Emissions Target Portfolio Cost per Ton ($/CO2)	Preferred Portfolio Additional DSM CO2 Savings (MT CO2)	Preferred Portfolio Cost per Ton ($/CO2)
2024	344	$145.4	463	$194.4	344	$145.4
2025	1,041	$157.9	1,530	$215.5	1,041	$157.9
2026	2,539	$180.1	3,415	$270.5	2,539	$180.1
2027	4,446	$167.9	6,400	$268.0	4,446	$167.9
2028	6,462	$168.6	9,715	$262.5	6,462	$168.6
2029	8,549	$162.9	13,382	$248.2	8,549	$162.9
2030	10,751	$154.4	17,354	$239.1	10,751	$154.4

3. EE Pilot Program Descriptions and Assumptions

3.1 Pilot Development Rationale

Atmos Energy asked the Apex Team to identify new and emerging opportunities in EE that go beyond what is typically offered around the country. The Apex Team identified two opportunities, gas heat pumps ("GHPs"), which represent an opportunity applicable to residential customers served by Atmos Energy, and manufactured housing early retirement, which specifically addresses a difficult to improve section of the built environment that is not currently readily served by existing programs.

3.2 Gas Heat Pumps

3.2.1 Opportunity Description

GHPs operate in a similar fashion to other heat pump technologies by moving heat from a source to a sink. GHPs are currently available in the commercial and industrial sector and residential appliances have recently begun to be manufactured, with availability expected in 2024. GHPs have the capability of space heating, space cooling, and water heating and are particularly well suited to colder and high-elevation climate applications, and in contrast to electric heat pumps, do not have challenges meeting the heating load in these climates.

Residential GHPs have the following potential benefits:

- GHPs are a proven and reliable technology.
- GHPs can operate efficiently in cold climates without the need for backup systems.
- GHPs operate at efficiencies over 100%, even at below zero-degree Fahrenheit temperatures. This saves significant carbon compared to baseline boilers or furnaces.
- GHPs use ammonia as a refrigerant, which has significantly lower global warming potential compared to hydrofluorocarbons.
- GHPs do not require electric panel upgrades, making for an easier retrofit than electric heat pump technologies.
- GHPs can readily replace boilers; replacement is often impractical with electric heat pump technologies that are currently available.
- GHPs technologies have the capability of utilizing recovered methane, further lowering their carbon impact.
- The operational cost to consumers is lower for both gas and water heating compared to electric products.

3.2.2 Barriers and Research Questions

While GHPs provide numerous benefits, there are currently barriers to adoption of the technology in the residential sector. First and foremost, there are not currently residential units available in the market. As an emerging technology, residential GHPs are expected to be more expensive than existing gas heating technologies until manufacturing can scale, contractor networks can be established, and consumer awareness can be increased.

Atmos Energy's proposed pilot could contribute data to help answer the following key research questions:

- What are the equipment and installation costs associated with GHPs?
- What is the operating efficiency of installed units?
- What are the customer barriers to adoption?
- What is the experience of customers who have installed units?
- What is the knowledge and perception of this technology in the existing contractor network?

3.2.3 Estimated Costs and Savings

This section describes the budget and savings associated with a single residential GHP unit. Currently, residential GHPs are not available in the market. There remains significant uncertainty around the equipment costs, installation costs, and savings associated with this measure. The pilot proposed by Atmos Energy intends to address many of the uncertainties that currently exist for this measure. To develop estimated costs and savings for a residential GHP unit, the Apex Team used the best information available to them including unpublished manufacture cost estimates, baseline data from the planned DSM resulting from the Strategic Issues docket, and expert judgement on efficient operating conditions. Table 6 shows the per-unit savings and costs associated with a typical GHP installation.

Table 6: Residential Gas Heat Pump Assumptions

Unit Cost ($)	Unit Annual Savings (Therms)	Unit Annual Emission Reduction (MT CO2)	Measure Lifetime (Years)
20,000	336	1.8	15

3.3 Manufactured Housing Early Retirement

3.3.1 Opportunity Description

Atmos Energy's service territory in Colorado contains a significant number of customers who meet requirements for income-qualified programs. In particular, per the Colorado Department of Public Health and Environment ("CDPHE") EnviroScreen mapping and health screening tool, the Greeley area in Weld County has a sizable low-income population, with multiple large communities having a median income less than 80% of the state median income. In addition, 7% of housing units in Weld County are manufactured homes, which provide one kind of affordable housing for Atmos Energy customers in these communities. Many manufactured homes built before 1995 have minimal insulation, are not well sealed, and have inefficient appliances. Lower EE standards before 1995 for manufactured homes means that there are many families living in inefficient homes and as such are subject to higher-than-average energy burdens. Retrofitting manufactured homes can be very challenging due to the cost, the physical condition of many older manufactured homes, and the difficulty in accessing the spaces where retrofit work would be performed. Replacing the entire home is an efficient, effective way to achieve all the upgrades associated with a highly efficient home that has significantly lower energy usage, resulting in lower monthly energy costs as well as lower GHG emissions.



Atmos Energy is proposing a pilot that would provide up to $30,000 in incentives to replace existing, pre-1995 manufactured homes with a new model that meets the ENERGY STAR® Manufactured New Homes Version 3 requirements. In order to obtain an ENERGY STAR certification and be eligible for the pilot incentives, new manufactured homes must meet certain envelope, HVAC, water heating, lighting, and appliance efficiency thresholds. Upgrading to an ENERGY STAR manufactured home can save customers up to 30% on heating bills[1]. Atmos Energy would collaborate with owners/managers of manufactured home communities and mobile home parks to identify appropriate candidates for this pilot. It may be especially beneficial to try to replace manufactured homes when a home is vacant during a sale, so planning and engaging park owners early will allow them to inform residents about this opportunity.

3.3.2 Barriers and Research Questions

Atmos Energy will use this pilot program as an opportunity to determine if it is feasible to scale this offering more broadly.

Specifically, Atmos Energy will be investigating the following research questions:

- What is the level of gas savings associated with this measure?
- What is the level of customer satisfaction with the pilot and its associated processes?
- When is the optimal time to replace/upgrade a manufactured home?
- Who are the key stakeholders that need to be influenced in order to make this offering successful? Homeowner? Park/community manager? Others?
- What are the other sources of funding that a customer could use in addition to the Atmos Energy incentive to make it feasible for a customer to replace their manufactured home?

3.3.3 Estimated Costs and Savings

Manufactured homes can last 50+ years and in many cases are used for 60–70 years or more. Accelerating the replacement of aging homes allows Atmos Energy to generate energy savings equal to the difference between the energy that an inefficient home would have used for the rest of its useful life had it not been replaced and what the new, more efficient unit uses. The analysis assumes the average remaining useful life is 15 years. Table 7 outlines the pilot's proposed

[1] https://www.crpud.net/ways-to-save/at-home/programs-for-new-homes/new-energy-star-manufactured-homes/

number of units installed, proposed incentives, and reduction in GHG emissions achieved through the pilot on an annual basis.

Table 7: Manufactured Home Pilot Assumptions

Number of Units	Incentive Level ($)	Unit Annual Savings (Therms)	Unit Annual Emission Reduction (MT CO2)	Measure Lifetime (Years)
2025: 5 2026: 10 2027: 10	30,000	600	3.2	15[2]

4. Recovered Methane

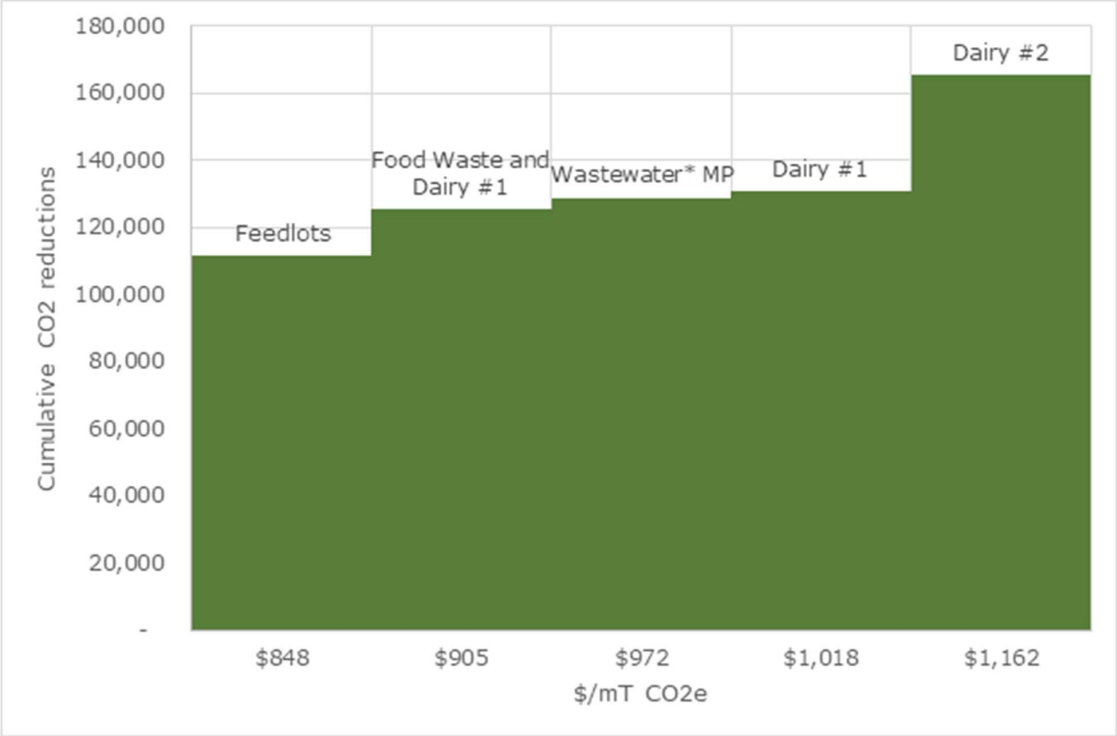
Atmos Energy provided the Apex Team with data from a recent RFI sent to suppliers through a joint industry group of gas distribution companies to estimate availability, costs, and savings associated with recovered methane to use in meeting Clean Heat Portfolio needs. To qualify as a Clean Heat Resource, recovered methane projects must be located in Colorado and meet a recovered methane protocol approved by the Air Quality Control Commission. Recovered methane resource types with an approved protocol include methane recovered from livestock manure management systems, methane derived from municipal solid waste (landfills) and wastewater treatment (agro-industrial or domestic), and methane from coal mines.

Apex converted the information from the RFI into supply curves based on projects provided in response to the RFI developed by Atmos Energy and others in a joint industry group in Fall 2023 to assess the availability and pricing of these resources. These project types include feedlot manure, dairy manure, wastewater, and food waste. Eight responses were received from the RFI representing ten sources, with eight of them including enough information to be analyzed. The projects offered listed had various dates of availability, terms, amounts and prices. Figure 3 summarizes the supply curve for recovered methane in the amounts offered and the costs in 2030.

For the Emissions Target portfolio where the amount of recovered methane needed is greater than the maximum amount in this supply curve, the Apex Team assumed additional sources would be available at the average of the prices from the RFI. To meet the Emissions Target in 2030, additional recovered methane beyond the quantities generated from the eight projects was required.

[2] The lifetime and savings shown are estimated for the remaining useful life of the retired manufactured home. Additional, smaller savings will accrue over the rest of the life of the new efficient manufactured home.

Figure 3: 2030 Recovered Methane Supply Curve



Appendix 1: EE Potential Study Methods and Results

1. Potential Study Methodology

Study Approach

The Apex Team used a bottom-up approach to estimate EE potential in the residential and commercial sectors. Bottom-up approaches begin by characterizing the eligible equipment stock, estimating savings and screening for cost-effectiveness at the measure level, then summing savings at the end-use, premise types, and customer sector levels.

In addition to technical potential estimates, the development of maximum achievable and program achievable potential estimates for a range of feasible measures is useful for program planning purposes. Unlike achievable and program potential estimates, technical potential estimates do not include customer acceptance considerations for measures, which are often among the most important factors when estimating the likely customer response to programs. For this study, the following estimates of EE potential were assessed:

- **Technical** potential with 100% customer adoption of highest energy savings measures with no measure cost-effectiveness screening.
- **Achievable** potential:
  - **Maximum** achievable potential with no measure cost-effectiveness screening, incentives established equal to 100% of the measure cost and aggressive program structures.
  - **Program** achievable potential with a modified total resource cost ("MTRC") test measure cost-effectiveness screening at 0.4 and incentives equal to approximately 50% of the measure cost.

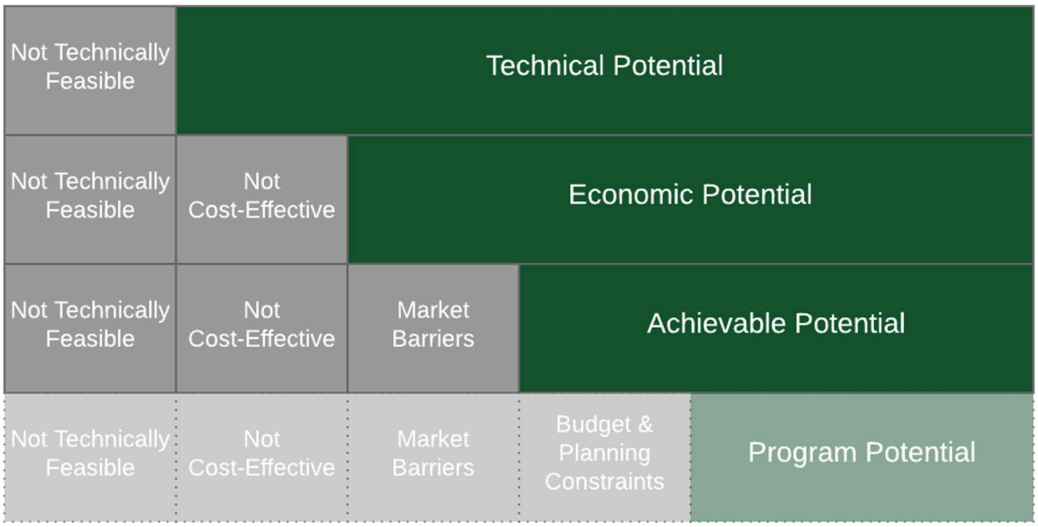
1.1 Overview

In accordance with standard industry practice for market potential studies, this study considers measures from the perspective of theoretical maximum savings and then accounts for barriers to estimate actual achievable savings.

Specifically, the study begins with technical potential, wherein all technically viable measures are included without regard to costs or other barriers. Economic potential is then assessed by estimating costs to implement measures and then applying economic benefit/cost criteria to the measures. Finally, achievable potential is calculated by considering non-economic factors affecting measure implementation, such as budgets and market barriers to customer adoption.

This analysis approach is based on standard perspectives of EE resource potential according to the National Action Plan for Energy Efficiency ("NAPEE")[3] as illustrated in Figure 4.

Figure 4: Conceptual Overview of Resource Potential Definitions



- **Technical Potential** is the theoretical maximum amount of energy that could be displaced by an efficient technology, regardless of cost and other barriers that may prevent the installation or adoption of a measure. Technical potential is only constrained by factors such as technical feasibility and applicability of measures.
- **Economic Potential** is the amount of energy that could be reduced by measures that pass a cost-effectiveness test. This analysis used the MTRC test, which estimates the measure costs to both the utility and its customers along with non-energy and social cost of emissions benefits. Economic potential is not reported in this study, as different cost-effectiveness thresholds are analyzed.
- **Achievable Potential** is the energy savings that can feasibly be achieved through program and policy interventions. Achievable potential accounts for barriers that hinder consumer adoption of EE measures such as financial, political, and regulatory barriers, and the capability of programs and administrators to ramp up activity over time.

[3] The U.S. Department of Energy and U.S. Environmental Protection Agency facilitated the work of a leadership group to develop the NAPEE "in pursuit of energy savings and environmental benefits through electric and natural gas energy efficiency. The NAPEE was published in July 2006 and may be found at www.energy.gov/sites/default/files/2023-10/napee_report_1.pdf.

- **Program Potential** reflects the realistic quantity of energy savings the utility can realize through programs during the horizon defined in the study. Potential delivered by programs is often less than achievable potential due to real-world constraints such as program budgets, effectiveness of outreach, and market delays. This study does not address program potential.

1.2 Customer Segmentation and Forecast Disaggregation

An accurate assessment of achievable savings potential requires a thorough characterization of the baseline energy usage. This characterization involves the following steps:

1. Determine the energy consumption per region, customer class, and segment in baseline year.
2. Disaggregate customer class loads into end-use loads, such as space heating, water heating, cooking, etc.
3. Analyze and calibrate data to 2021 energy sales.
4. Forecast the 10-year end-use energy consumption through 2032.

To complete these steps, the Team relied on a dataset outlined in section 1.2.1 consisting of:

- Historical loads and customers by sector.
- Market data, including fuel shares, equipment saturations, and structural characteristics.
- End uses, including energy use intensities and load shapes.
- Measure characteristics including technologies, costs, life, and savings.
- Expected new construction starts.

Data was largely drawn from secondary research. An overview of the activities involved in the characterization process follows. The findings of the market characterization are presented below.

1.2.1 Customer Segmentation

The Team determined energy and loads for the appropriate customer sectors, premise-type segments, vintages, and end uses as follows:

- Customer Sectors: Residential and Non-Residential
- Premise-Type Segments:
  - Residential: Single-Family and Low-Income

- Non-Residential: Master-metered Multi-Family, Commercial, and Industrial

- Vintages: Existing and New Construction
- End uses: Those shown by sector in Table 8

Table 8: End Uses by Customer Sector

Residential	Non-Residential
Space Heating – Gas Furnace	Space Heating – Gas Furnace
Space Heating – Gas Boiler	Space Heating – Gas Boiler
Gas Water Heating	Gas Water Heating
Miscellaneous	Cooking
	Snow-Melt
	Process Heating
	Process Industrial

The space heating end-use was segmented by gas boiler and gas furnace technologies to better align measure definitions with measure definitions, energy consumption, and efficiency shares.

The Team utilized secondary resources to complete the customer segmentation. Examples of these resources include:

- Atmos Energy Colorado DSM Portfolio Evaluation M&V Report 2020-2021,
- Energy Information Administration ("EIA") Residential Energy Consumption Survey ("RECS"),
- EIA Commercial Buildings Energy Consumption Survey ("CBECS"),
- 2016 NorthWestern Energy Montana End-Use and Load Profile study, among other references.

The important input parameters needed to model each end use are the total premise by sector count, fuel shares, end-use Unit Energy Consumption ("UEC"), and saturation.

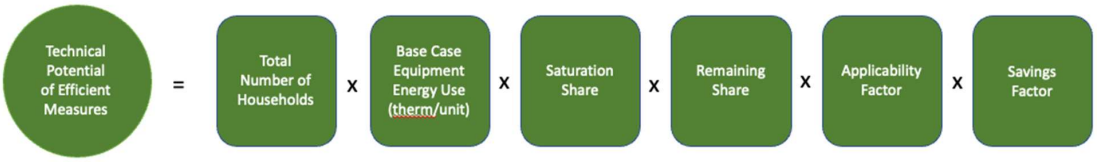
1.3 Technical Potential

Technical potential is the theoretical maximum amount of energy use that could be displaced by efficiency, disregarding all non-engineering constraints such as cost-effectiveness and the willingness of end users to adopt the efficiency measures. Technical potential is only constrained by factors such as technical feasibility of measures. The model applies the measure-level inputs to the disaggregated

baseline sales forecast to estimate technical savings and demand reduction potential over the planning horizon.

As an example, the core equation used in the residential sector EE technical potential analysis for each individual efficiency measure is shown in Equation 1.

Equation 1: Technical Potential General Algorithm



Where:

Total Number of Households = *Count of customer households in the subject region.*

Base Case Equipment Energy Use *= Natural gas used per customer per year by each base-case technology in each market segment. In other words, the base-case equipment energy-use is the consumption of the natural-gas-energy-using equipment that the efficient technology replaces or affects.*

Saturation Share = *Fraction of the end-use natural gas energy that is applicable for the efficient technology in a given market segment. For example, for residential water heating, the saturation share would be the fraction of all residential natural gas customers who have natural gas water heating in their household.*

Remaining Share = *Fraction of equipment that is not considered to already be energy efficient. To extend the example above, the fraction of natural gas water heaters that is not already energy efficient.*

Applicability Factor = *Fraction of the applicable units that is technically feasible for conversion to the most efficient available technology from an engineering perspective—i.e., it may not be possible to install a condensing water heater in all homes due to constraints.*

Savings Factor = *Percentage reduction in natural gas consumption resulting from the application of the efficient technology*.

1.3.1 Measure Development

Once the baseline forecast is disaggregated, the next step in assessing technical market potential is to accurately detail the universe of efficiency measures and their end-use-specific savings, costs, and lifetimes. Measures currently implemented in Atmos Energy and other Colorado DSM programs received careful consideration since these measures have a historical record and vendors have proven processes for implementation. Additionally, the Team compiled all measures available from such sources like technical reference manuals ("TRMs") from jurisdictions like the

states of Illinois and Vermont. The Team also leveraged measure data it has characterized in similar studies. From these regionally relevant databases, the Team selected measures that are commonly available, based on well-understood technology, and applicable to the buildings and end uses in Atmos Energy's Colorado service territory.

EE measures are characterized in three main vintages:

- **Replace on Burnout:** As equipment replacements are made normally in the market when a piece of equipment is at the end of its effective useful life (also referred to as "turnover").
- **Retrofit:** At any time in the life of the equipment or building.
- **New:** When a new home or building is constructed.

Upon finalizing the EE measure list, the Team collected data on energy savings, costs, lifetime, and applicability to determine potential measure impacts. This work involves a multi-step process described here.

Step 1: Define market classifications for application of measures.

The Team established market classifications as a framework for documenting applicability of each measure. These classifications were based on factors including region, fuel type, sector, market segment, and end use as defined in the disaggregated forecast (Section 1.2). Additionally, the Team further defined permutations for each measure based on the following parameters:

- **Measure Type**: Equipment vs. Non-equipment
- **Vintage**:
  - **Equipment:** Turnover, Retrofit, New
  - **Non-equipment:** Existing, New

Step 2: Screen sectors, segments, and end-uses for eligibility.

The Team screened market segments and end-uses for applicability of specific EE measures. For example, certain commercial end-uses, such as cooking, may not be appropriate for segments such as offices and warehouses and therefore were analyzed only in limited market segments. Technologies that switch the fuel source from natural gas to electricity or both fuels were not considered within this study.

Step 3: Develop base case impacts and costs.

The Team determined base case equipment and practices for each of the EE measures on the final list and developed a description and rationale for each. This included all base-case assumptions and data, such as building energy codes and federal standards. Base-case assumptions included known future adjustments, such as upcoming federal standards.

Step 4: Develop EE measure impacts and costs.

The Team developed a description of all EE (or "change case") measure equipment and practices, including all measure energy savings assumptions and calculation parameters, such as equivalent full load hours ("EFLH"). For each measure, the Team estimated energy savings as a percentage of base equipment and/or end-use consumption. In addition to energy savings, the Team collected incremental measure costs pertinent to Atmos Energy's service territory from appropriate TRM references and internet retailer data and researched measure life drawing on TRM documentation.

1.4 Economic Potential

Economic potential represents the savings possible given full adoption of all cost-effective efficiency measures. For this study, the Team utilized the MTRC, which is commonly considered the preferred test to assess measure benefits and costs from the perspective of the utility and society. Equation 2 presents the TRC ratio equation.

The benefits in the MTRC test in this case are the net present value ("NPV") of the lifetime avoided energy and emissions costs, plus non-energy benefits that accrue because of program interventions. The costs in this test are the NPV of the incremental measure costs.

Equation 2: MTRC Ratio

$$\textbf{TRC Ratio} = \textbf{NPV}(\textbf{Avoided Costs})/\textbf{NPV}(\textbf{Incremental Measure Costs})$$

Where*:*

$$\text{Avoided Cost} = \text{NPV}\left(\sum_{\text{year}=1}^{\text{measure life}}\left(\sum_{\text{i}=0}^{\text{i}=876}(\text{impact}_{\text{i}} \times \text{avoided cost}_{\text{i}})\right)\right)$$

The benefits include the NPV of the energy saved by the measures along with any significant benefits from other sources (water savings and a non-energy benefit adder to reflect other difficult-to-quantify benefits, as was used in developing the current programs). The forecast of avoided costs of energy is based on current avoided costs of gas escalated at the rate of inflation.

The costs are the NPV of all costs to implement those measures. These costs include full incremental costs (both utility and participant contributions), but no incentive payments that offset incremental costs to customers and no lost revenues. The full incremental costs include single upfront costs and operational & maintenance ("O&M") costs where applicable. Incentives are not included, because they occur within a transaction between the utility and its customers; thus, the costs and benefits negate each other. While non-incentive costs were not included in the measure-level screening of gas EE potential, they were included in further assessments of potential at the achievable potential level described below.

Additionally, the social cost of carbon at $68/metric ton of carbon dioxide equivalent was incorporated as an avoided benefit in the MTRC calculations. Non-energy benefits adders were used, consistent with current DSM plans, with 50% for low-income programs and 20% for non-low-income programs.

The measure screen from technical potential to program potential utilized a cost-effectiveness hurdle of 0.4 to reflect potential uncertainty in measure-level inputs and allow for programs to include packages of measures, wherein the overall cost-effectiveness of a group of measures is greater than the sum of its individual measures (e.g., combining insulation and air-sealing of building envelopes). This reduction in the screening threshold permits non-cost-effective measures into the portfolio so that a potential program intervention is more well-rounded and can include a limited number of non-cost-effective measures.

1.5 Achievable Potential

Finally, the assessment of program achievable EE potential required estimating, among other parameters, the rate at which cost-effective measures can be adopted over time. The Team incorporated individually developed sets of market penetration curves corresponding to implementation scenarios to account for the fact that program implementation scenarios have a direct influence over such market penetration rates.

The Team considered the following in determining achievable potential:

- **Benchmarking:** The amount of savings expected to be achievable through DSM programs was informed by the experience of utilities across the region and nation.
- **Customers' willingness to participate**: The likelihood that customers will participate in EE programs is a function of several factors, most notably incentive level.
- **Uncertainty:** Planning requirements often necessitate a point-estimate of potential; however, this is not an accurate reflection of the reality of DSM and EE programs. We prefer to think of achievable potential as a range, or probability distribution, where the point-estimate is the most likely outcome. This distribution defines the lower and upper bounds of expected savings, as well as the most likely value.

The team evaluated achievable potential EE impacts based on multiple incentive scenarios as a function of the cost-effectiveness (MTRC result) and incremental costs of efficiency measures:

- Program Achievable (MTRC greater than 0.4) with incentives established equal to 50% measure cost, except for measures in the low-income and small-commercial direct-install programs. The low-income program assumes an incentive equal to 100% of the incremental cost, and the small-

commercial direct-install program assumes an incentive equal to 75% of the incremental cost.

- Maximum Achievable (MTRC greater than 0.01) with incentives established equal to 100% of the measure cost and aggressive program models.

For instance, the program achievable level approximates the market adoption achievable by incentivizing 50% of the incremental cost of the measure. Results are presented from the perspective of the program achievable level unless otherwise specified.

1.5.1 Market Adoption Rates

In order to characterize the rate of market adoption for each of the specified potential levels, the Team developed a quantitative approach based on a Bass Diffusion Model. This method relies on scientific theory and historic program participation data based on Atmos Energy's experience and other DSM programs in North America.

The rate of adoption in a discrete period is determined by external influences on the market, internal market conditions, and the number of previous adopters.

- Initial Year Measure Adoption
  - First-year adoption levels were informed by recent Atmos Energy historical performance where possible.
- Long-Term Market Adoption Rates
  - The final adoption scores that resulted from willingness-to-pay surveys serve as the point-estimate for the long-term market adoption potential for the realistic achievable scenario.[4]

Unique end-use adoption curves were developed based on the following three parameters:

- Customer Sector: Residential and Non-Residential
- End-Use: Space Heating, Water Heating, etc.
- Incentive Level based on Achievable Scenario: 50%, etc.

2. Market Characterization & Baseline Forecast

The analysis of achievable savings potential requires a reasonably accurate characterization of the baseline energy usage and customer characterization. For

[4] Ameren Missouri 2020 DSM Market Potential Study by GDS Associates, Brightline Group, Opinion Dynamics, section 2.4
https://efis.psc.mo.gov/mpsc/commoncomponents/viewdocument.asp?DocId=936289645

the baseline, the Apex Team used data from calendar year 2021. In 2021, Atmos Energy had approximately 113,000 residential customers and 12,500 non-residential customers eligible for DSM or EE programs. Atmos Energy sold almost 13,000,000 MCF of natural gas in 2021 in Colorado with 61.4% for residential customers and 38.6% for non-residential customers. Figure 5 and Figure 6 illustrate energy consumption for each end use for the residential and non-residential sectors, respectively. Space heating followed by water heating are the predominate end uses for both customer sectors.

Figure 5: Residential Baseline Energy Consumption by End Use

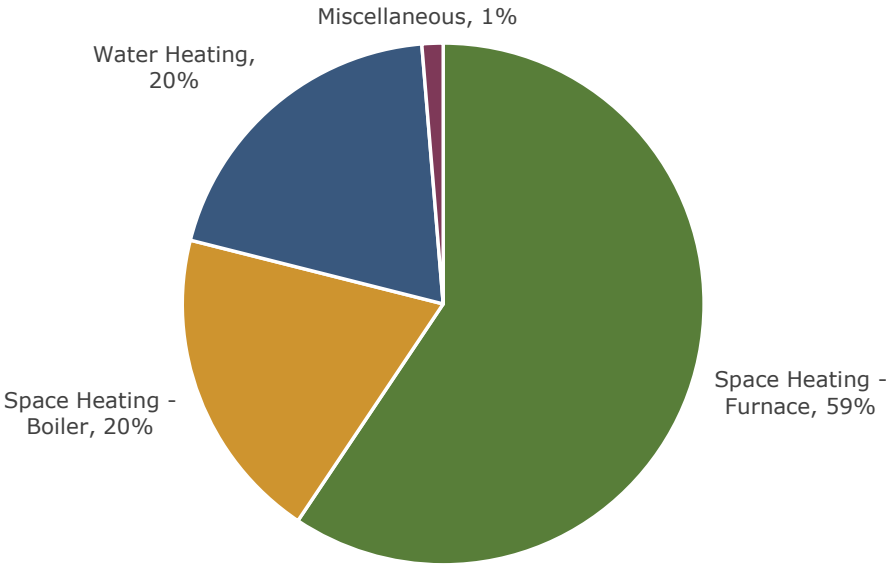
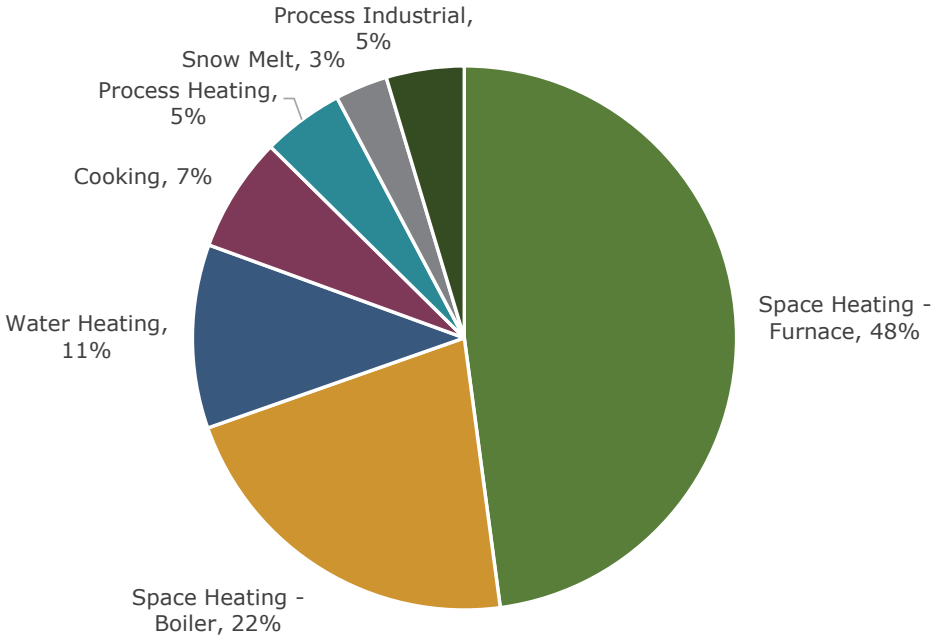


Figure 6: Non-Residential Baseline Energy Consumption by End Use[5]



3. Residential Sector Potential

3.1 Program Achievable Potential

The largest EE opportunities are within the residential sector. Table 9 summarizes energy savings potential and budgets to achieve the program achievable potential for each program for the reference years.

[5] Throughout the report, percentages may not add to 100% due to rounding

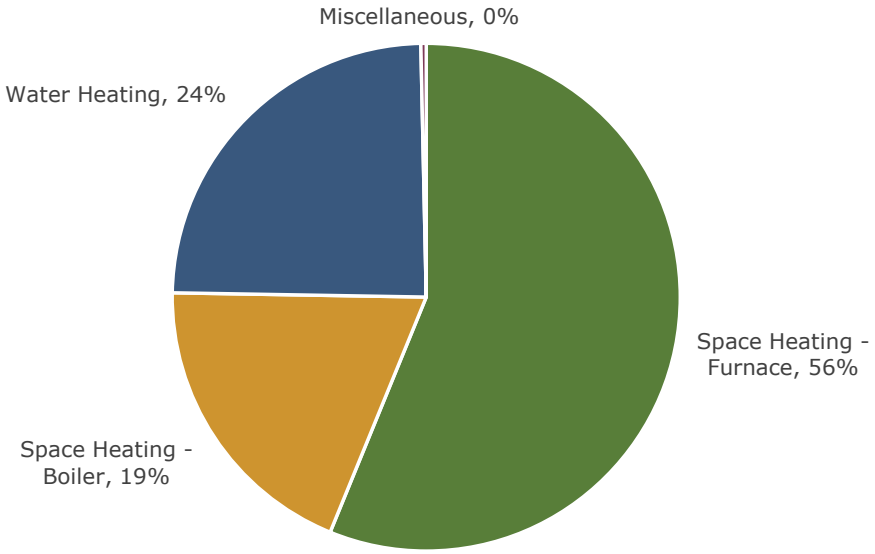
Table 9: Residential Sector Energy Savings Potential and Budget by Program (Program Potential – Clean Heat)[6]

Milestone Year	2025	2030
Annual Incremental (therms)		
Home Energy Reports (HER) Behavioral Program	141,342	152,266
Low-income	157,765	209,845
Rebate	83,125	97,732
Equipment	122,665	213,355
Envelope	27,754	49,409
New Construction	22,672	38,552
Total	**555,322**	**761,158**
Annual Budget ($ Millions)		
Home Energy Reports (HER) Behavioral Program	$84,805	$91,360
Low-income	$1,414,087	$1,915,819
Rebate	$261,870	$313,329
Equipment	$600,162	$1,043,457
Envelope	$156,743	$279,538
New Construction	$54,749	$93,151
Total	**$2,572,415**	**$3,736,653**

As shown in Figure 7, the largest residential end-use opportunity exists for space heating, in particular natural gas furnaces.

[6] Throughout the report, totals may differ from sums slightly due to rounding.

Figure 7: Annual Incremental Residential Savings Potential by End Use (2025) (Program Potential – Clean Heat)



As shown in Figure 8, the largest residential program opportunity is for home energy reports ("HER") and low-income direct-install programs. New program opportunities exist for new construction, envelope measures, and additional equipment measures that would normally be offered through a rebate program.

Figure 8: Annual Incremental Residential Savings Potential by Program Type (2025)
(Program Potential – Clean Heat)

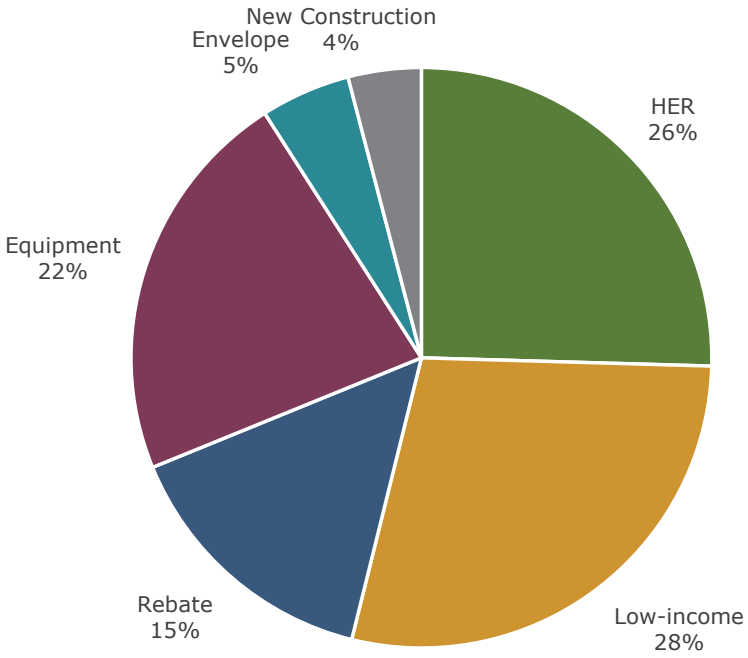
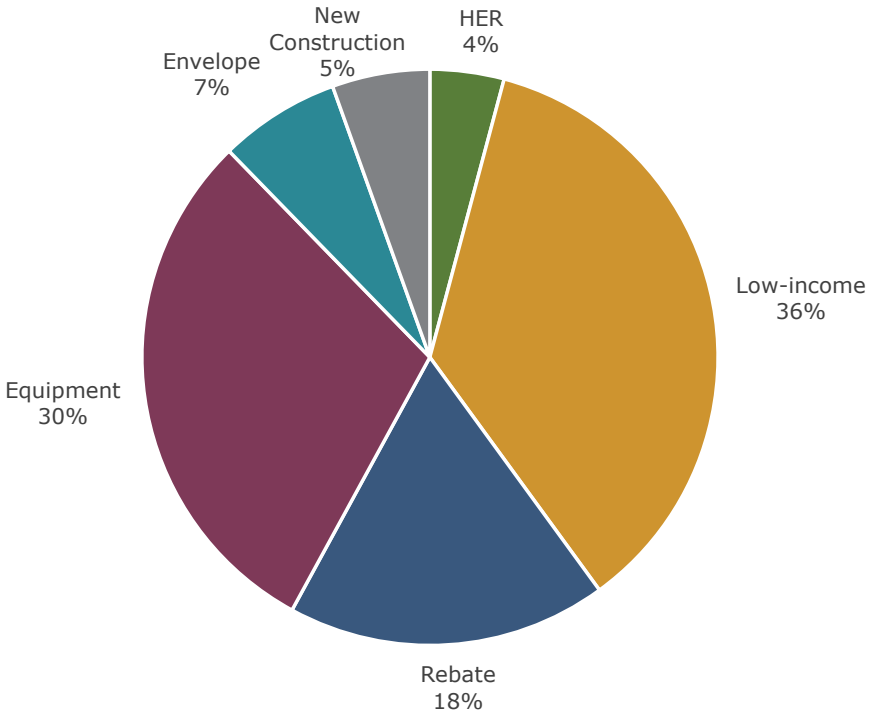


Figure 9 indicates how energy savings shares would change if energy savings measures were measured on a cumulative (lifetime) basis through 2025 as compared to an annual incremental metric. HERs have a measure life of one year; consequently, on a cumulative basis energy savings, HER measures have a much smaller impact when considering the lifetime benefits of all measures.

Figure 9: Cumulative Residential Savings Potential by Program Type (2025) (Program Potential – Clean Heat)



3.2 Maximum Achievable Potential

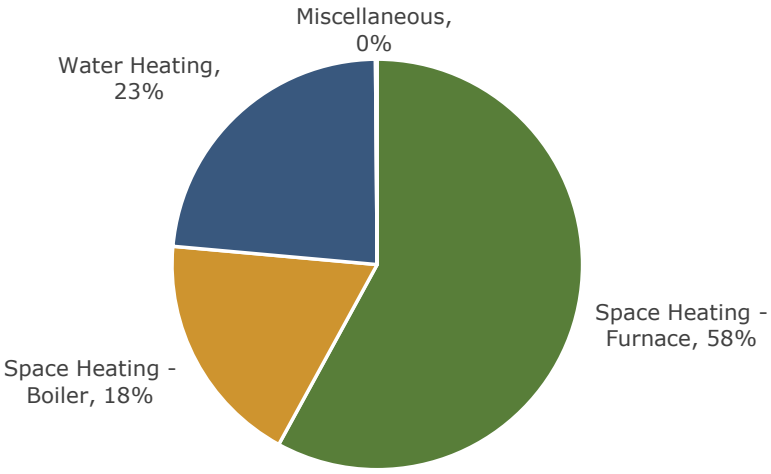
The maximum achievable potential analysis includes any measure, regardless of its cost-effectiveness. Additionally, customer incentives are increased to equal the incremental measure cost, making it free for the customer to upgrade to the efficient option. Table 10 summarizes energy savings potential and budgets to achieve the full achievable potential for each program for the reference years. The largest increase from the program potential is in the low-income with a 121% increase in budget and a 63% increase in energy savings.

Table 10: Residential Sector Energy Savings Potential and Budget by Program (Maximum Potential – Clean Heat)

Milestone Year	2025	2030
Annual Incremental (therms)		
Home Energy Reports (HER) Behavioral Program	176,677	190,333
Low-income	256,008	317,018
Rebate	155,928	167,980
Equipment	226,453	361,108
Envelope	91,444	98,512
New Construction	42,722	65,662
Total	**949,232**	**1,200,612**
Annual Budget ($ Millions)		
Home Energy Reports (HER) Behavioral Program	$106,006	$114,200
Low-income	$3,129,471	$3,778,902
Rebate	$779,856	$840,132
Equipment	$463,017	$737,309
Envelope	$798,113	$859,800
New Construction	$161,648	$244,884
Total	**$5,438,111**	**$6,575,226**

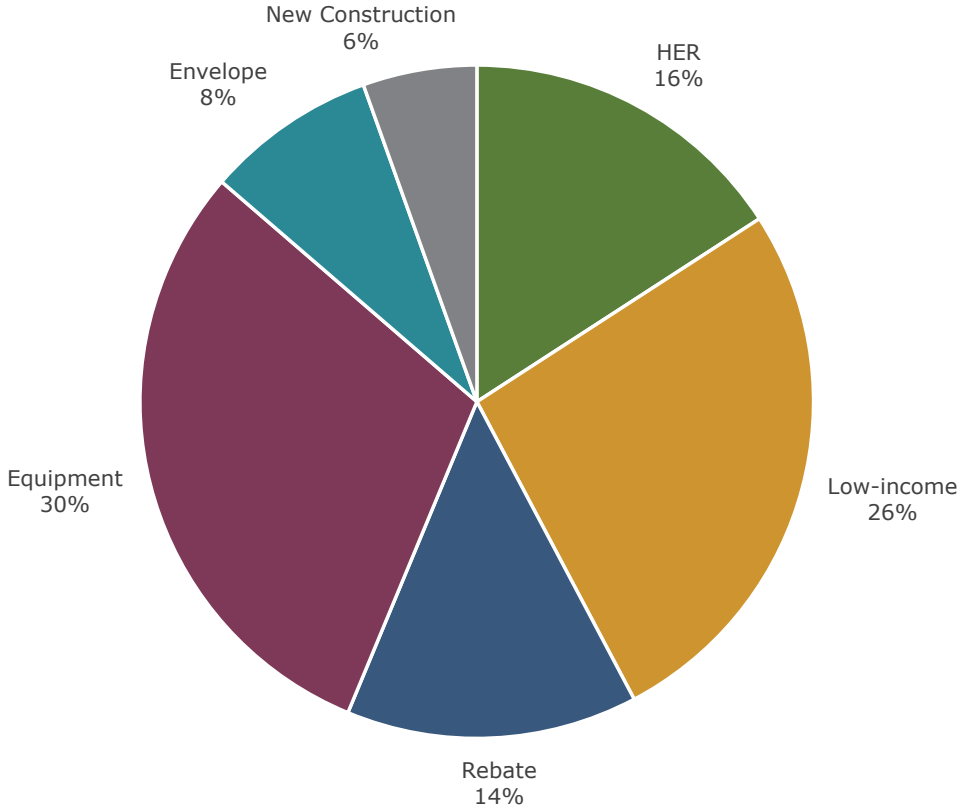
As shown in Figure 10, the largest residential end-use opportunity remains for space heating, in particular natural gas furnaces.

Figure 10: Annual Incremental Residential Savings Potential by End Use (2025) (Maximum Potential – Clean Heat)



As shown in Figure 11, the largest residential program opportunity is for equipment and low-income direct-install programs. The HER program budget and savings remains largely unchanged from the program potential scenario as the opportunity is largely maximized in the program potential model assumptions.

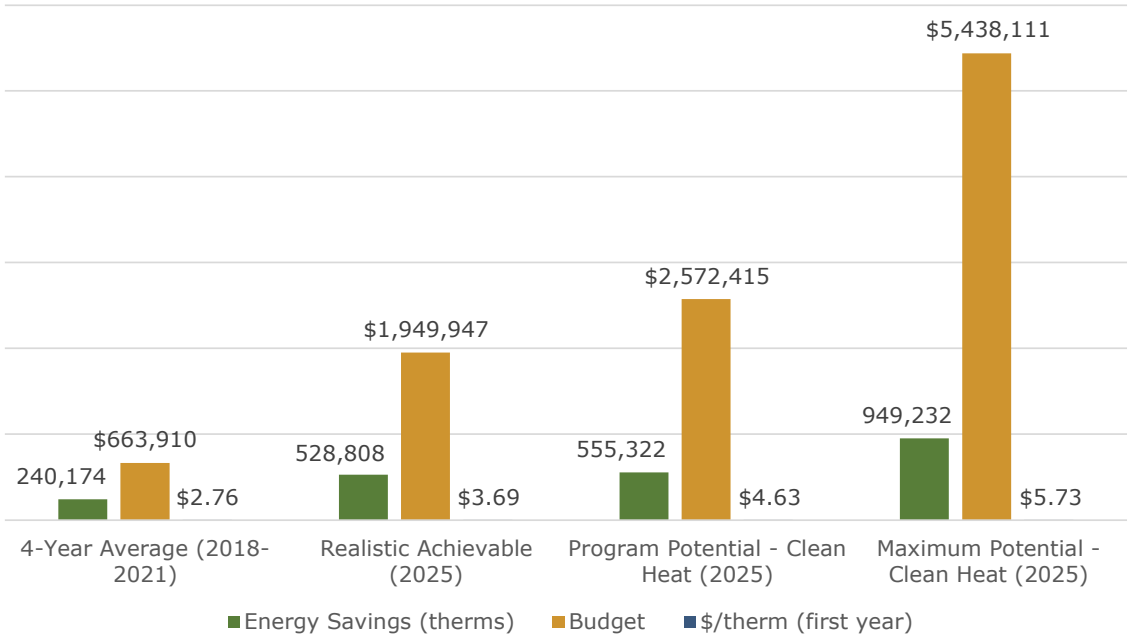
Figure 11: Annual Incremental Residential Savings Potential by Program Type (2025)
(Maximum Potential – Clean Heat)



3.3 Comparisons

Figure 12 provides a comparison benchmark of maximum and program potential savings and budgets in the year 2025 as compared to Atmos Energy's actual DSM program accomplishments and budgets average from 2018 through 2021, in addition to realistic potential estimated in the 2022 market potential study. It is important to note that the first-year savings per program budget dollar ($/therm (first year)) is increasing for each scenario. As the measure cost-effectiveness is reduced, the program budget is less effective in saving energy as non-cost-effective measures are pursued.

Figure 12: Comparison of 2025 Achievable Potential to Historical Residential Program Participation



4. Non-Residential Sector Potential

4.1 Program Achievable Potential

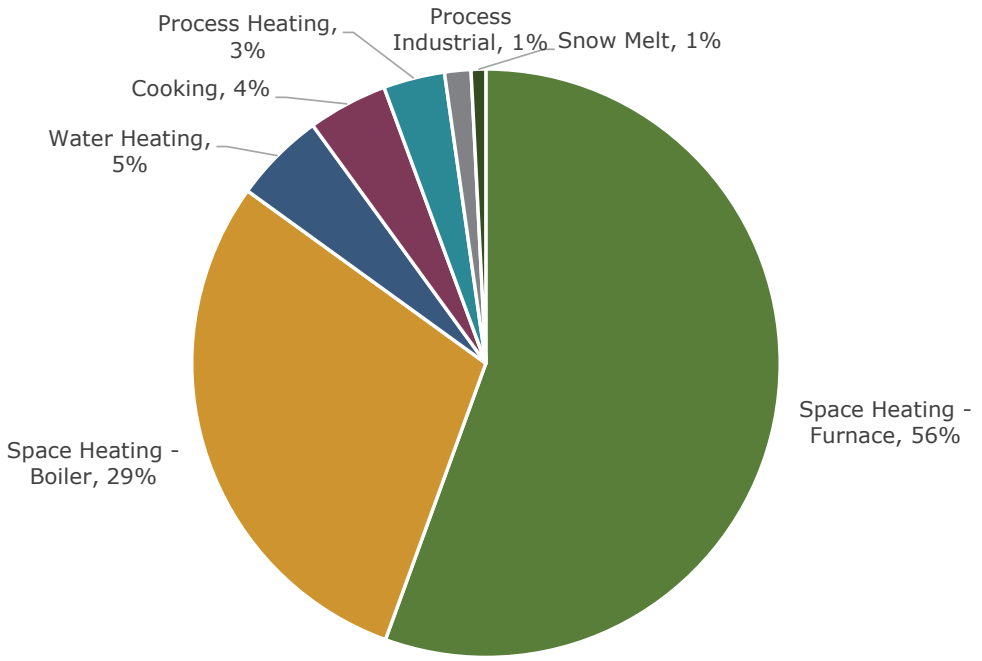
There is an opportunity for EE programs within the non-residential sector. Table 11 summarizes energy savings potential and budgets to achieve the achievable potential for each potential level for the reference years.

Table 11: Non-Residential Energy Savings Program Potential by Program

Milestone Year	2025	2030
Annual Incremental (therms)		
Custom	41,203	52,248
Small Commercial	67,227	73,637
Equipment	52,223	64,939
New Construction	20,582	22,885
Appliances	10,375	12,771
Tune-up	31,557	42,489
Total	**223,166**	**268,970**
Annual Budget ($ Millions)		
Custom	$318,990	$406,963
Small Commercial	$264,677	$289,849
Equipment	$307,065	$381,600
New Construction	$89,105	$95,570
Appliances	$32,597	$40,104
Tune-up	$138,571	$186,577
Total	**$1,151,006**	**$1,400,662**

Similar to the residential sector, the largest non-residential end-use opportunity exists for space heating, in particular natural gas furnaces or gas-fired rooftop units, as shown in Figure 13.

Figure 13: Annual Incremental Non-Residential Savings Potential by End Use (2025)



As shown in Figure 14, there are many non-residential program opportunities beyond the current program in Atmos Energy's existing DSM program in Colorado. New program opportunities exist focused on small commercial premises, new construction, prescriptive measures, and cooking equipment. Additional opportunities exist to tune up existing natural gas equipment and corresponding control systems. However, developing a cost-effective tune-up program may be challenging for a smaller utility.

Figure 14: Annual Incremental Non-Residential Savings Potential by Program Type (2025)

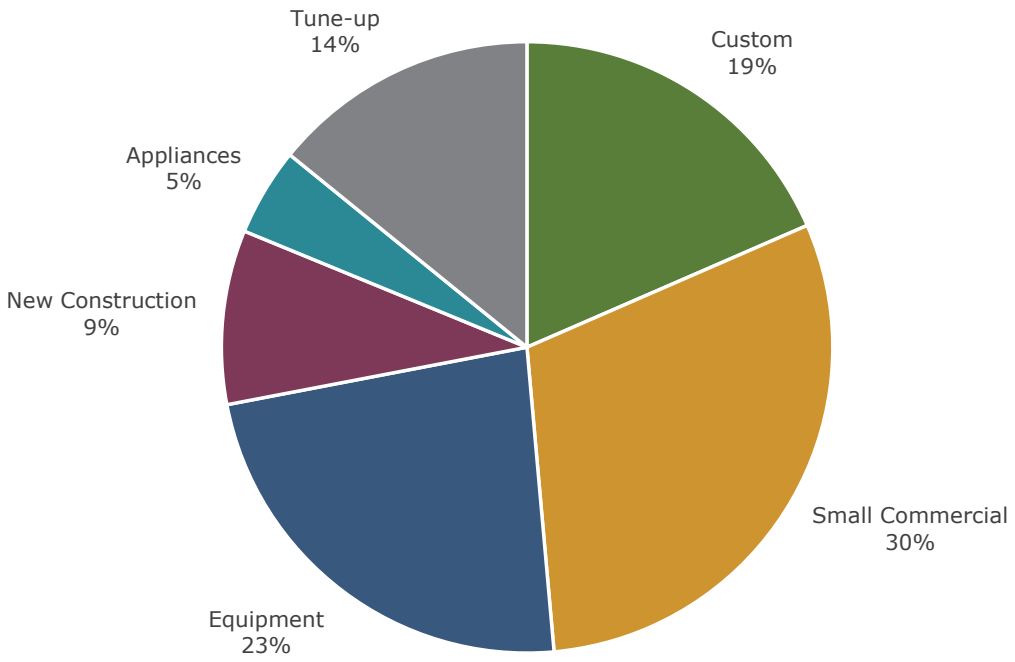
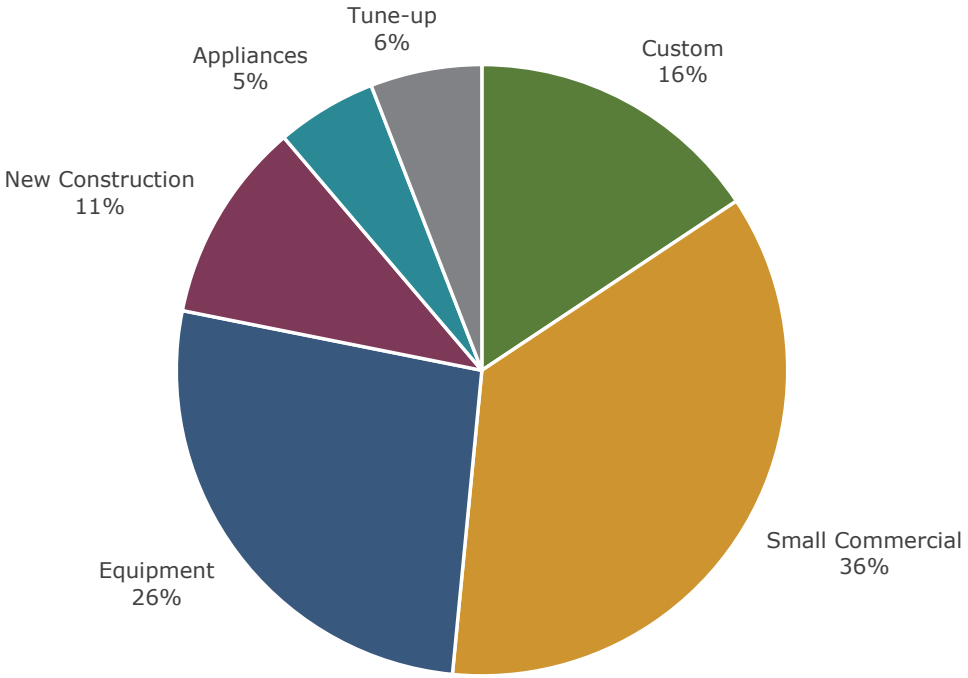


Figure 15 indicates how energy savings shares would change if energy savings measures were measured on a cumulative (lifetime) basis through 2025 as compared to an annual incremental metric. Different than the residential sector, all of the cost-effective measures have a measure life greater than 10 years. Consequently, shares of achievable potential are not very different when considering annual incremental versus cumulative energy savings metrics.

Figure 15: Cumulative Non-Residential Savings Potential by Program Type



(2025)

4.2 Maximum Achievable Potential

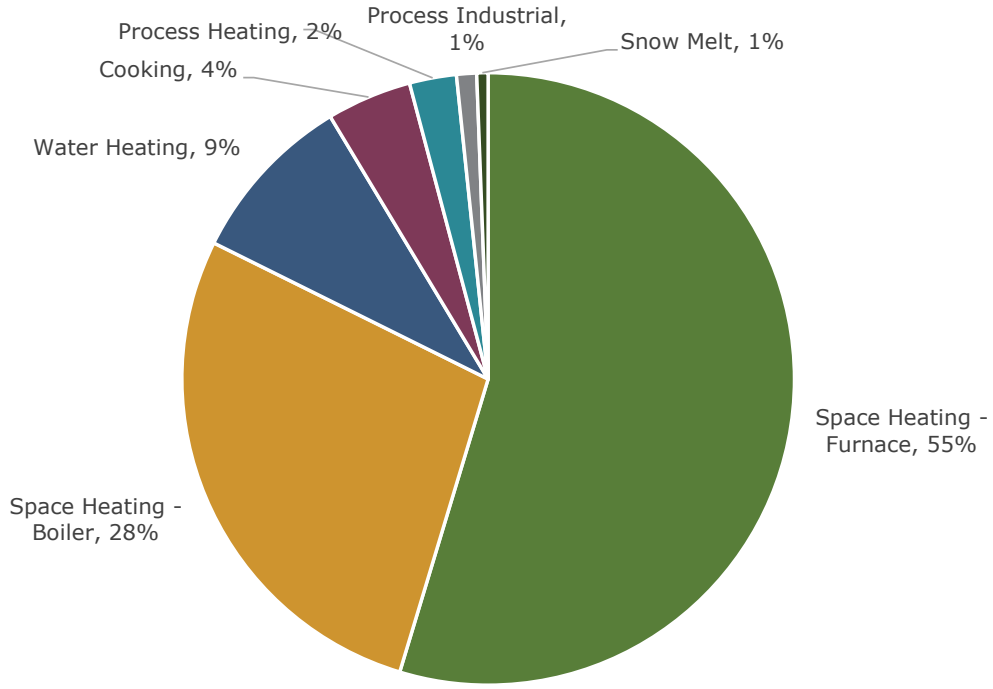
The maximum achievable potential analysis includes any measure, regardless of its cost-effectiveness. Additionally, customer incentives are increased to equal the incremental measure cost, making it free for the customer to upgrade to the efficient option. There is an opportunity for expanded EE incentives within the non-residential sector. Table 12 summarizes energy savings potential and budgets to achieve the full achievable potential for each program for the reference years.

Table 12: Non-Residential Sector Energy Savings Maximum Potential and Budget by Program

Milestone Year	2025	2030
Annual Incremental (therms)		
Custom	118,618	127,685
Small Commercial	67,281	73,679
Equipment	86,547	111,480
New Construction	26,991	33,305
Appliances	15,910	19,348
Tune-up	60,352	65,020
Total	**375,698**	**430,518**
Annual Budget ($ Millions)		
Custom	$2,201,824	$2,367,986
Small Commercial	$221,196	$242,039
Equipment	$1,242,757	$1,595,566
New Construction	$173,503	$221,009
Appliances	$72,777	$88,406
Tune-up	$225,172	$242,593
Total	**$4,137,228**	**$4,757,598**

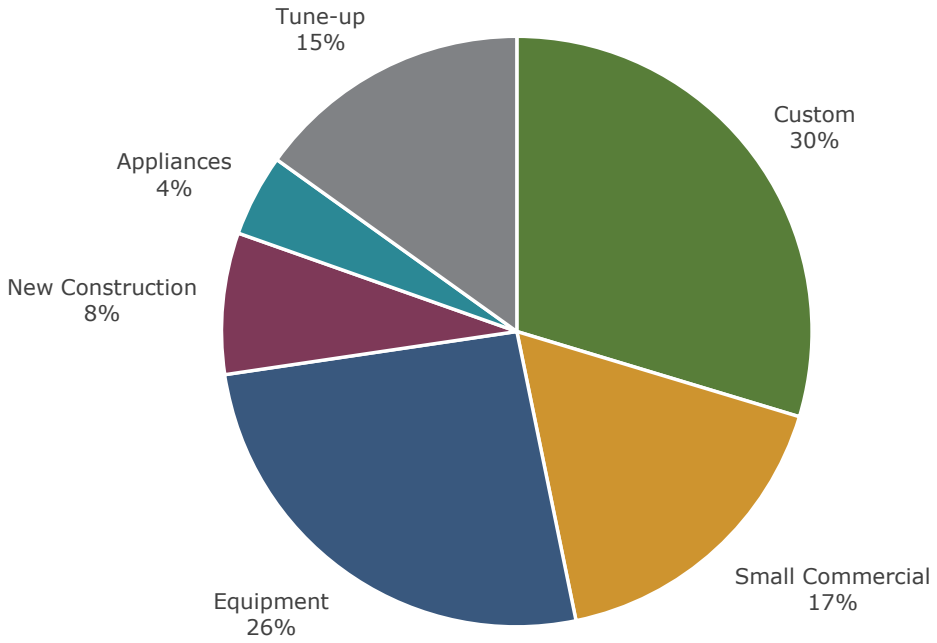
Similar to the residential sector, the largest non-residential end-use opportunity exists for space heating, in particular natural gas furnaces or gas-fire rooftop units, as shown in Figure 16.

Figure 16: Annual Incremental Non-Residential Savings Potential by End Use (2025)



As shown in Figure 17, there are many non-residential program opportunities beyond the current program that Atmos Energy implements in its existing DSM program in Colorado. New program opportunities exist for small commercial premises, new construction, prescriptive measures, and cooking equipment. Additional opportunities exist to tune up existing natural gas equipment and corresponding control systems. Consideration should be given to developing a cost-effective tune-up program, as challenges many exist for a small utility.

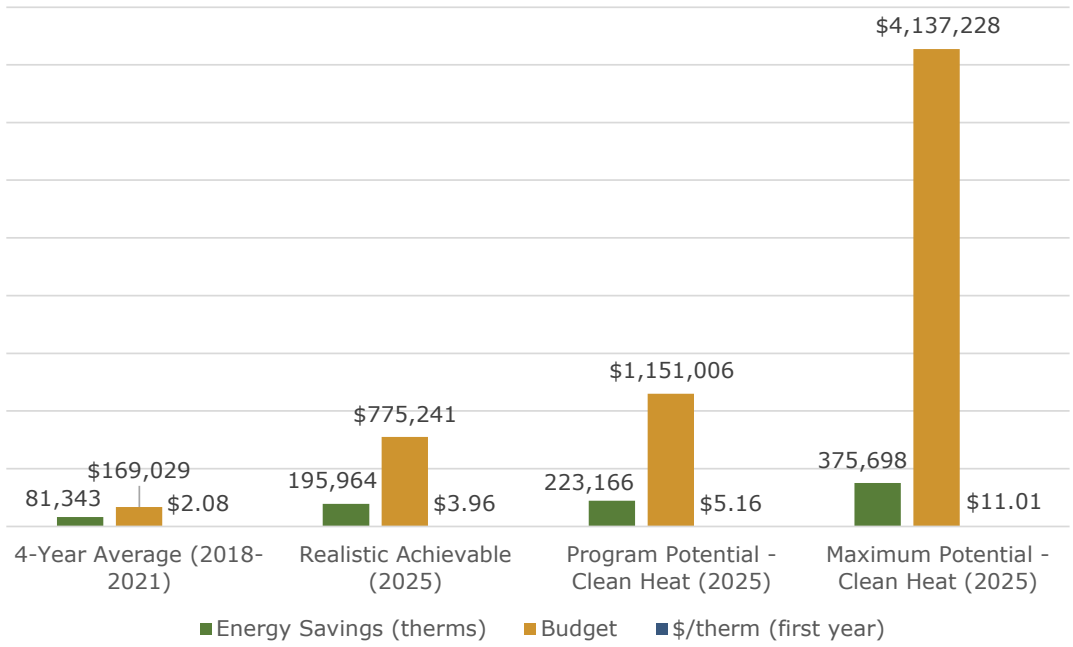
Figure 17: Annual Incremental Non-Residential Savings Potential by Program Type (2025)



4.3 Comparisons

Figure 18 provides a comparison benchmark of maximum and program potential savings and budgets in the year 2025 as compared to Atmos Energy's actual DSM program accomplishments and budgets average from 2018 through 2021, in addition to realistic potential estimated in the 2022 market potential study. It is important to note that the $/therm (first year) is increasing for each portfolio. As the measure cost-effectiveness is reduced, the program budget is less effective in saving energy as non-cost-effective measures are pursued.

Figure 18: Comparison of 2025 Achievable Potential to Historical Non-Residential Program Participation



Appendix 2: Top Measures – Program Achievable

Measures	Sectors	% of Annual Incremental Opportunity
Home Energy Reports	Residential	19.5%
Advanced Thermostat	Both	17.6%
Gas Furnace	Both	8.9%
Gas Water Heater – Standalone	Residential	7.6%
Gas-Fired Rooftop Units	Non-Residential	4.5%
High Efficiency Gas Boilers	Both	3.7%
Insulation - Attic	Residential	3.6%
High Efficiency New Construction	Residential	3.1%
Gas Water Heater - Tankless	Residential	2.8%
Insulation - Wall	Both	2.4%
Combination Boiler/DWH	Residential	2.3%
Insulation - Ceiling	Residential	2.0%
Tune-up – Gas Furnace Maintenance	Both	1.9%
Envelope Air Sealing	Residential	1.8%
Insulation - Basement	Residential	1.4%
Insulation - Floor over crawlspace	Residential	1.3%
Strategic Energy Management (SEM)	Non-Residential	1.3%
Duct Sealing	Residential	1.3%
Tune-up – Gas Boiler Maintenance	Non-Residential	1.2%
Insulation - Floor (non-slab)	Non-Residential	1.1%
Gas Boiler Controls	Non-Residential	1.0%
Low-Flow Showerhead	Residential	1.0%
Gas Water Heater > 55 Gal - Tankless	Non-Residential	0.8%
Windows	Both	0.7%
Gas Boiler reset controls	Non-Residential	0.7%
Infiltration Reduction	Residential	0.6%
Gas Water Heater Setback	Residential	0.6%

Appendix 3: Top Measures – Maximum Achievable

Measures	Sectors	% of Annual Incremental Opportunity
Home Energy Reports	Residential	19.5%
Advanced Thermostat	Both	17.6%
Gas Furnace	Both	8.9%
Gas Water Heater - Standalone	Residential	7.6%
Gas-Fired Rooftop Units	Non-Residential	4.5%
High Efficiency Gas Boilers	Both	3.7%
Insulation - Attic	Residential	3.6%
High Efficiency New Construction	Residential	3.1%
Gas Water Heater - Tankless	Residential	2.8%
Insulation - Wall	Both	2.4%
Combination Boiler/DWH	Residential	2.3%
Insulation - Ceiling	Residential	2.0%
Tune-up – Gas Furnace Maintenance	Both	1.9%
Envelope Air Sealing	Residential	1.8%
Insulation - Basement	Residential	1.4%
Insulation - Floor over crawlspace	Residential	1.3%
Strategic Energy Management (SEM)	Non-Residential	1.3%
Duct Sealing	Residential	1.3%
Tune-up – Gas Boiler Maintenance	Non-Residential	1.2%
Insulation - Floor (non-slab)	Non-Residential	1.1%
Gas Boiler Controls	Non-Residential	1.0%
Low-Flow Showerhead	Residential	1.0%
Gas Water Heater > 55 Gal - Tankless	Non-Residential	0.8%
Windows	Both	0.7%
Gas Boiler reset controls	Non-Residential	0.7%
Infiltration Reduction	Residential	0.6%
Gas Water Heater Setback	Residential	0.6%