Colorado PUC E-Filings System







The Mountain Energy Project: Non-Pipeline Alternative Report

Prepared for Public Service Company, Xcel Energy

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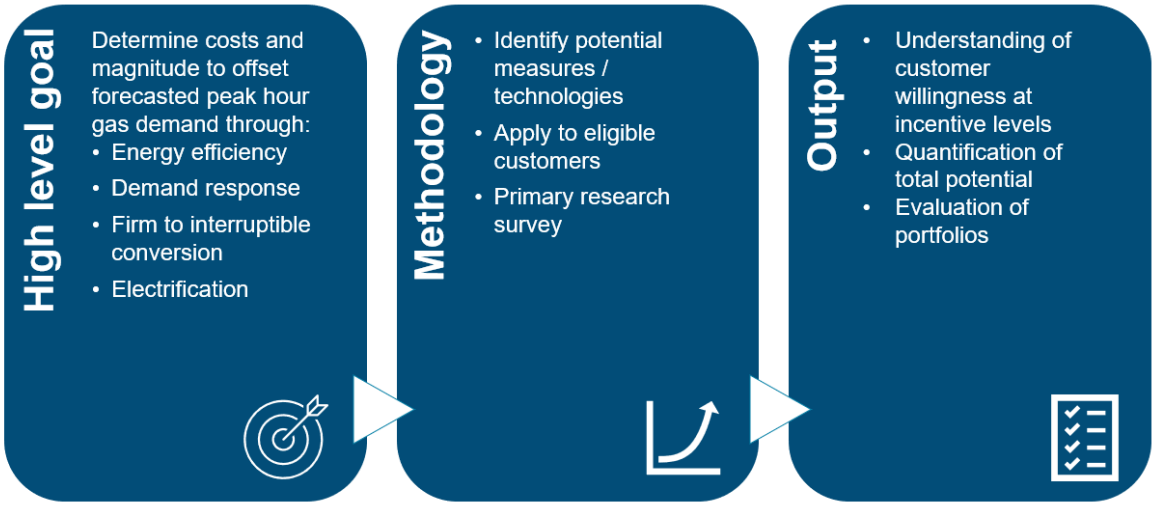
1 Executive Summary

Public Service Company of Colorado (the Company), a subsidiary of Xcel Energy, is now in the midst of the Gas Infrastructure Plan (GIP) paradigm, having completed its initial GIP proceeding in 2023, with the first litigated GIP to be filed in 2025. The initial GIP filing focused on providing transparency into the processes for how the Company evaluates investments to ensure safety and reliability of the gas system and identified several projects needed to address the Company's System Safety & Integrity, Capacity Expansion, New Business, and Mandatory Relocation requirements. The Company was given authority in that case, and its follow-on Clean Heat Plan proceeding, to pursue two smaller non-pipeline alternative (NPA) solutions to avoid gas infrastructure; Pearl Street Mall and the F-3 Reinforcement projects.

Now, the Company has taken another step forward with its NPA Analysis process that continues to evolve. In this report, we describe how the Company is planning for the energy future of Colorado mountain communities by using its NPA Analysis process, designed to identify a cost-effective solution to address an urgent capacity constraint, which the Company has identified in its Eastern Mountain Gas System[1].

The Company collaborated with PA Consulting, APEX Analytics and Jacobs (the PA team) to perform the NPA Analysis, leveraging their industry insights and expertise in areas such as natural gas strategic planning, natural gas energy efficiency (EE) and other demand side management (DSM) modeling, and gas infrastructure engineering. As an integral part of the Company's collaboration with the PA team, the Company worked with stakeholders, integrated stakeholder comments, especially when measuring and screening NPA measures for consideration. The PA team developed primary research surveys to further understand customer and stakeholder needs and expectations of the NPA Analysis, importantly including information around incentive levels to combat the diverse ownership of customers in the mountain region.

Figure 1-1: The Company's NPA Analysis Process



The PA team began with a primary research study in the Company's Eastern Mountain Gas System service territory, followed by the development of a series of potential alternative portfolios, which were composed primarily of natural gas DSM measures, including gas EE and beneficial electrification (BE), as well as other Design Day peak hour gas capacity reduction tools. The alternative portfolios were informed by stakeholder feedback and information gained from primary research. The alternative portfolios were then optimized for cost and greenhouse gas (GHG) emissions reduction objectives, while meeting operational requirements. The portfolio development process considered three high-level alternative portfolio types, each of which was projected to have the ability to mitigate the identified capacity constraint in the Eastern Mountain Gas System:

[1] The Southern and Western Gas Systems will remain largely unaffected by the implementation of the NPA Portfolio

- **Electric Portfolio** – a portfolio composed of only customer side solutions. Includes gas DR, electrification, shell measures, and firm to interruptible service conversion, excluding gas consuming appliance incentives;
- **NPA-Only Portfolios** – two portfolios comprised of only customer side solutions. Includes gas DR, electrification, shell measures, firm to interruptible service conversion, and gas consuming appliance incentives;
- **Hybrid Portfolios** – two portfolios comprised of solutions optimized for least cost among all achievable potential solutions, utilizing a combination of gas infrastructure reinforcements (including modular liquified natural gas (LNG) and compressed natural gas (CNG) supplemental supply), and NPA measures and technologies.

The Company provided a Gas-Only Portfolio to serve as a baseline of comparison for analysis. The alternative portfolios were then qualitatively and quantitatively evaluated and analyzed to identify the appropriate portfolio for use in mitigating the need for a new traditional natural gas infrastructure project in the Eastern Mountain Gas System. Following the development and analysis of these alternative portfolios, the analysis presented in this report and the associated cost-benefit analysis modelling tool supported the recommendation of Hybrid Portfolio 2 as the preferred alternative portfolio.

Hybrid Portfolio 2 is projected to solve the capacity constraint, and best balances cost with supporting reduced reliance on gas infrastructure, focusing on the use of NPAs to drive the Company's customers toward end-use decarbonization, and reducing Design Day peak demand on the gas system. Hybrid Portfolio 2 combines many DSM and other conservation and BE measures and programs with a reduced amount of natural gas infrastructure, including one modular LNG site and one CNG site to support system reliability. Hybrid Portfolio 2 reflects the least cost option identified through the cost-benefit analysis framework as compared to the baseline gas infrastructure solution.

2 Review of Scope

In June 2023, the Company and the PA team began to collaborate on the Mountain Gas System NPA Analysis. The objective of NPA Analysis was to identify a cost-effective solution to address an urgent capacity constraint, which the Company had identified in its Eastern Mountain Gas System.

2.1 Scope of Work Overview

To address the capacity constraint identified by the Company in the Eastern Mountain Gas System, the PA team took a multistep collaborative approach. The PA team worked closely with the Company to provide an overview of the gas system, working with the Company to review their planning process, and identify and understand the capacity constraint. The PA team worked with the Company's customers and stakeholders, informed by primary research, to develop a custom list of potential NPA measures and technologies. The NPA Analysis process included primary research into the Company's Eastern Mountain Gas System customers' knowledge of and preferences for various DSM and other conservation measures and programs. The PA team assessed the potential of the NPA measures and technologies, and lastly, developed and evaluated alternative portfolios to cost-effectively alleviate the capacity constraint in the Eastern Mountain Gas System. Additionally, the NPA Analysis included an assessment of the impacts to the Mountain Electric System of increased electrification measures.

The Mountain Gas System NPA Analysis scope of work included the development and evaluation of alternative portfolios, comprised of a variety of NPA measures and technologies, to potentially offset the need for the baseline gas infrastructure project proposed in the long-term plan for the Eastern Mountain Gas System. The capacity constraint in the Eastern Mountain Gas System could prohibit reliability and growth in sales to existing customers, new customers, structures, and facilities if not alleviated through a combination of measures. Specifically, the NPA Analysis presented in this report provides an assessment of the opportunity to utilize NPAs to avoid, defer, or potentially reduce a planned gas infrastructure project to alleviate the capacity constraint in the Eastern Mountain Gas System.

2.2 Overview of Mountain Energy NPA Analysis

The core deliverables expected of the PA team as a product of the Mountain Gas System NPA Analysis included alternative portfolio development, comparative analysis and reporting, and stakeholder engagement. This report functions as a technical appendix to Company testimony, providing further details to the NPA Analysis and Potential Study. This report includes an expert review of the Company's system planning, including an overview of sales and peak day demand, customer counts, and use per customer (UPC) trends.

The report details the NPA DSM Solution Development Study, or Potential Study, that assessed the diversity and end-use of gas customers in the Eastern Mountain Gas System to inform the potential and feasibility for NPA measures and technologies in the various geographies of the area. This work included extensive residential and commercial customer surveys and primary research collection to develop a bespoke list of NPA measures that could be feasible for alleviating the capacity constraint.

Lastly, the report details the development of five alternative portfolios, representing a combination of NPA measures and technologies, and determines the viability of each for alleviating the capacity constraint. If the capacity constraint could be alleviated, the alternative portfolios were tested for cost-effectiveness using a cost-benefit analysis framework. This report concludes with a recommendation of Hybrid Portfolio 2, as this portfolio successfully alleviates the capacity constraint in the Eastern Mountain Gas System, aligns with the Company's emission reduction goals, and proves to be cost-effective.

3 Review of Planning Processes and the Need for an NPA Analysis

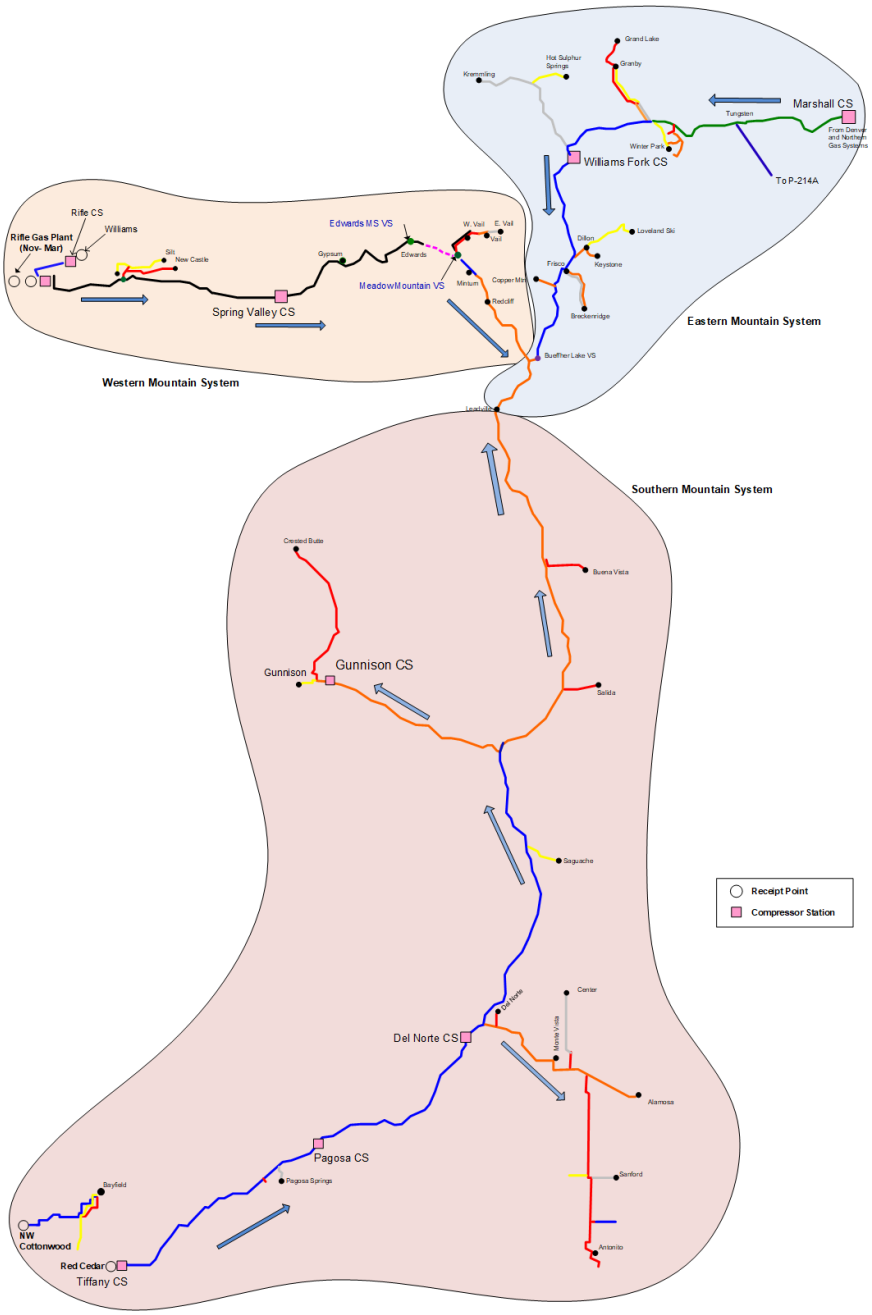
The Company's Eastern Mountain Gas System is experiencing an existing and forecasted capacity constraint, where customers are at risk of an outage during cold weather events such as Design Day conditions due to insufficient system pressure caused by customer gas demand growth and limited supply (capacity constraint). To resolve this capacity constraint, the peak demand requirements must be addressed. The Mountain Energy NPA Analysis, completed through collaboration between the PA team and the Company, aimed to alleviate the capacity constraint in the Eastern Mountain Gas System.

To achieve this goal, the PA team worked with the Company to review key planning processes and further understand the capacity constraint in the region and understand the diversity of end-users effected by the capacity constraint.

3.1 Mountain Gas System Overview

The Mountain Gas System serves 65,000 customers and three gas local distribution companies (LDCs). The system stretches from Boulder, Colorado to approximately Durango, Colorado and includes approximately 975 miles of transmission mains and eight compressor stations. The Company's Mountain Gas System covers much of the mountainous terrain in Colorado. The system is composed of various pipelines, facilities, and appurtenances to transport gas throughout the Mountain System to supply the customers' demand load. The Mountain Gas System is generally composed of three hydraulically separate systems on Design Day – the Western, Eastern, and Southern Mountain Gas System. The Eastern Mountain Gas System was the focus of the Mountain Energy NPA Analysis. Below, Figure 3-1 provides a map of the entire Mountain Gas System with directional gas flows into the Mountain Gas System from the major supply points.

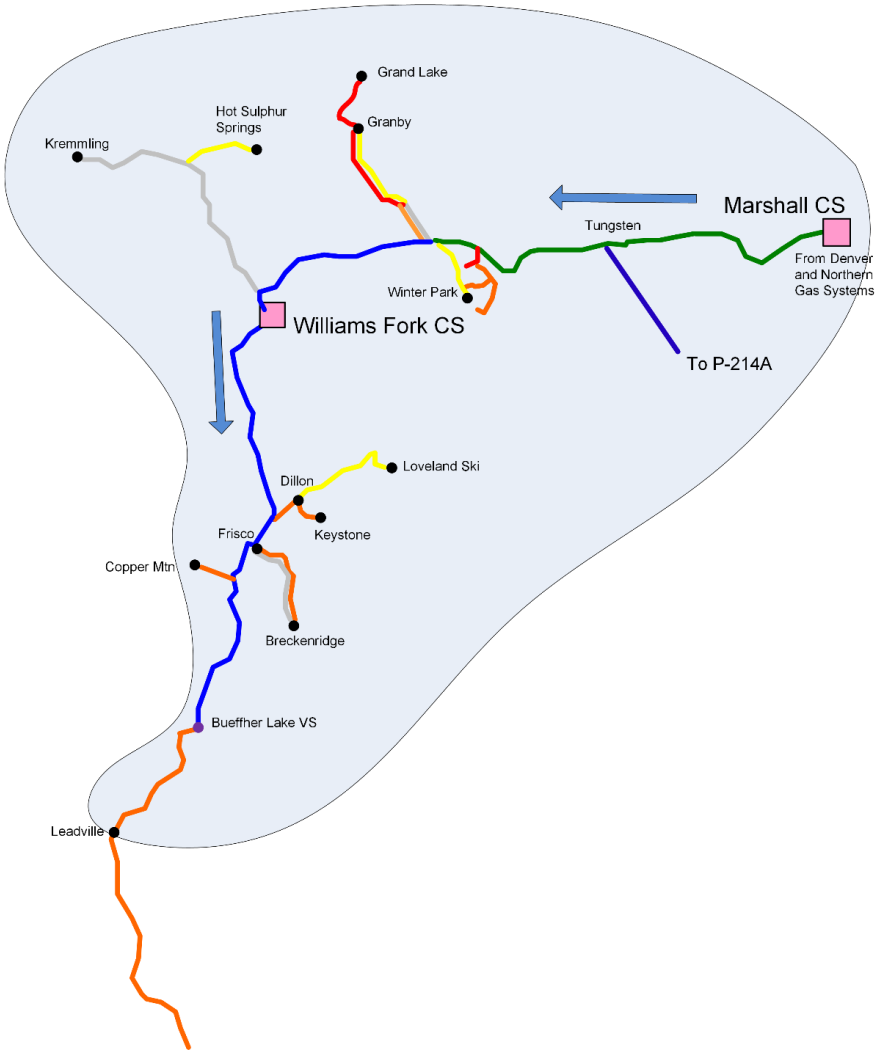
Figure 3-1: Mountain Gas System Map



The system is subdivided into three systems, Marshall Compressor Station (CS) Supply (red), Rifle CS Supply (green), and Tiffany CS Supply (cyan). These systems are interconnected, but during loading conditions, operate generally as three separate systems. The point of demarcation, or null point, is located just north of Leadville, CO.

The NPA Analysis presented in this report focuses on the Eastern Mountain Gas System, as demonstrated in Figure 3-2: Eastern Mountain Gas System.

Figure 3-2: Eastern Mountain Gas System

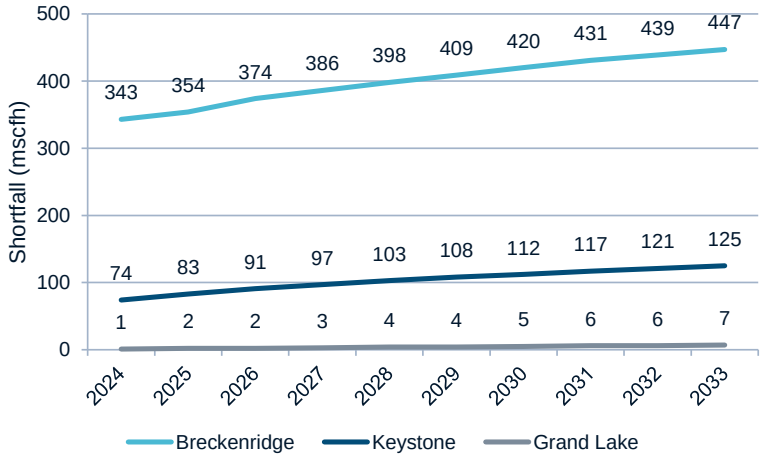


This area is also served by the Company's Mountain Electric Distribution System, which includes eight distribution substations, twenty-five distribution feeders and two medium voltage classes (13.2kV and 24.9 kV).

3.2 System Constraints – the Need for an NPA Analysis

The Company determined the Eastern Mountain Gas System cannot support the peak demand load on colder than Design Day conditions. The capacity shortfall is forecasted to increase approximately 0.9% through the 2033-2034 heating season and reach approximately 579 mscfh by 2033, as detailed in Figure 3-3.

Figure 3-3: Forecasted Supply Shortfall



The Company utilized the concept of a Design Day to ensure that its existing gas infrastructure and assets can handle firm customer load during an extreme cold weather day, when demands on the system are greatest. Design Day is determined based on the concept of a peak-day, which refers to a probabilistic occurrence of a temperature occurring over a given heating season. A capacity shortfall occurs when Design Day peak hour gas demand exceeds supply and/or available system capacity for the project area. The capacity shortfall may increase each heating season dependent on the level of forecasted growth.

The Company provided details to the PA team explaining the capacity shortfall of the Eastern Mountain Gas System, describing that the Eastern Mountain Gas System has an existing Design Day capacity shortfall and increasing levels of peak demand are expected. For the Mountain Energy NPA Analysis, Breckenridge, Keystone, and Grand Lake were considered to have capacity shortfalls that must be eliminated.

3.2.1 Sales and Peak Day Demand

When evaluating whether an alternative portfolio can delay, reduce the scope of, or avoid the proposed gas infrastructure project, determining the required reduction in Design Day peak hour gas demand by heating season, the capacity constraint, is critical. The PA team conducted an independent assessment of sales, including throughput and peak demand, to determine if the Company's outlook on the nature, timing and magnitude of Eastern Mountain Gas System customer count, UPC, and peak day demand was reasonable. The PA team did not evaluate the Company's Design Day methodology. The results of this evaluation are described within the following sub-sections.

Overall, the PA team concluded that residential customer class represented the largest customer count, had the highest annual energy consumption (aside from the LDCs), and had the second highest peak day consumption and peak hour consumption demands, second to the LDCs.

3.2.2 Customer Count and UPC

The PA team used customer annual usage data along with monthly billing data, provided by the Company, to characterize customer gas energy consumption, peak hour consumption, and peak daily consumption. The PA team received growth rates from the Company as an input for this assessment. For this analysis, customers were segmented by sector, building group, and geography. This segmentation scheme allowed the PA team to characterize sector specific measures, run analyses that either include or exclude transport

customers[2], and analyze gas system constraint impacts, which are dependent on the location of buildings participating in the NPA offerings.

Table 3-1 shows the customer counts, annual energy consumption, peak day consumption, and peak hour consumption for each sector and building group with the ***entire*** Mountain Gas System. LDCs are included as they impact the total load on the system, but the team did not analyze building level data for these customers, and they were not included in the NPA Analysis. Results from Table 3-1 were used to inform the development of NPA measures and technologies that could be tailored to the specific customer groups and demands across the system.

Table 3-1: Mountain System Customer Counts and Usage by Sector and Building Group

Sector	Building Group	Customer Count	Annual Energy Consumption (mcf)	Peak Day Consumption (mcfd)	Peak Hour Consumption (mscfh)
Residential	Single Family	44,388	5,048,875	48,635	2,702
	Multifamily	11,097	1,262,219	12,159	675
Commercial	Commercial	5,249	2,500,850	19,283	1,071
	Multifamily	918	496,915	3,696	205
Transport	Multifamily Transport	312	1,033,946	7,615	423
	Transport	618	3,049,678	20,883	1,160
LDC	LDC	N/A	6,220,000	49,733	2,763
Total	**Total**	62,582	19,612,483	162,044	8,999

3.3 Review of the Company's Planning and Processes

The Company's Gas Planning Process was reviewed in detail through a combination of workshops and data review.

The Company is performing the analysis of the Mountain System using the Unsteady State Gas modeling approach, using the Synergi Gas platform. For the Company's gas system, this is the best approach to truly study the impact of a multi-day weather event. The modeling process was reviewed in several workshops that included model setup, calibration, load development and final outcomes. Each of these steps and outcomes is of key importance to overall model quality and confidence in the results obtained.

The Company is utilizing a planning process that is robust and complete. They are following industry best practices, and no exceptions were noted. The model outcomes allowed the detailed load shedding analysis to be completed.

3.3.1 Build of GIS Data to System Data

The Company builds the background system file for their planning software using their proprietary geographical information system (GIS) data to populate position and metadata into the Mountain System gas model. Parts of the metadata are assigned values for characteristics like roughness, internal diameter, etc. from the GIS data load. The overall system connectivity is checked to ensure it matches the physical system prior to any loading to ensure that all nodes are connected. Various load centers and system configurations are also added (supply points, regulator stations, compressor stations, etc.) to simulate the full system configuration.

[2] Only firm transport customer loads were included in the analysis. Interruptible loads were not included. Whenever transport customers are referred to in this report, they refer to firm transport customers.

Factors that Impact Model Accuracy:

- Updating the Model for System Changes (Map Posting Backlog) – This is defined as the period it takes to update the GIS system from actual in-service dates to being reflected into the system model. Examples of facilities included in the updates range from new customer loads to large capital improvements to the system. The Company currently evaluates the model and manually adds projects quickly that could materially impact the model to the system configuration. By completing this manual process, the model reflects the most current system configuration at any time it is run. This is a best practice and ensures accurate outcomes. They also complete an annual update cycle for modelling geospatial data that would incorporate system changes and additions not previously added manually.
- Connectivity Once Imported – The modeling team does a continuity check while running baseline cases to ensure the system model is connected as the system is in the field. Connectivity is critical to ensure that the actual digital model matches the physical system. Model calibration confirms the configuration and was done extensively.

As reviewers, the PA team did not have access to the model directly, but observed and studied the steps used to build and validate the model. Items such as update cycles, model inputs, and model connectivity that can impact model completeness were discussed and verified. Overall, the process observed for data model building appears to be complete and mature.

3.3.2 Model Development and Calibration

The Mountain System is a complex system with inputs, loads and various system restraints. The unsteady state modeling approach simulates a three-day period of loading and the related flows and pressures. Below are some of the steps taken to complete the analysis process for the Mountain System. Please note this is a high-level summary of steps taken to complete the analysis process. Overall, this portion of the process was executed thoughtfully and thoroughly.

- Once the geospatial and load data were completed in the model software, the model was run using the software processes. Various checks were made, any errors resolved, and the model was ready for running various scenarios. These processes took place prior to the PA team's confirmation but were explored during joint workshops and the overall results confirmed via historical simulations and actual field pressure/volume data.
- Model calibration was performed by matching the simulations to actual pressure/volume data recorded in the Company SCADA system. Loads were increased or decreased to match the actual conditions noted at a known design temperature. This could be done on the entire model, or specific areas depending on the outcomes. For the Mountain System model, this was done by the area, to ensure overall outcomes match real data. This becomes the baseline model or base case model. This data was verified and observed via curves showing SCADA data to model outcomes. The curves validated the model calibration was complete and within reasonable tolerances.
- After the model is calibrated, the added growth is placed into the model. This is completed by adding load nodes in the areas where growth is expected to simulate future growth. And the model is run up to the full load profile (as detailed above). The Company performed these steps after determining the best growth approach based on study of growth data.

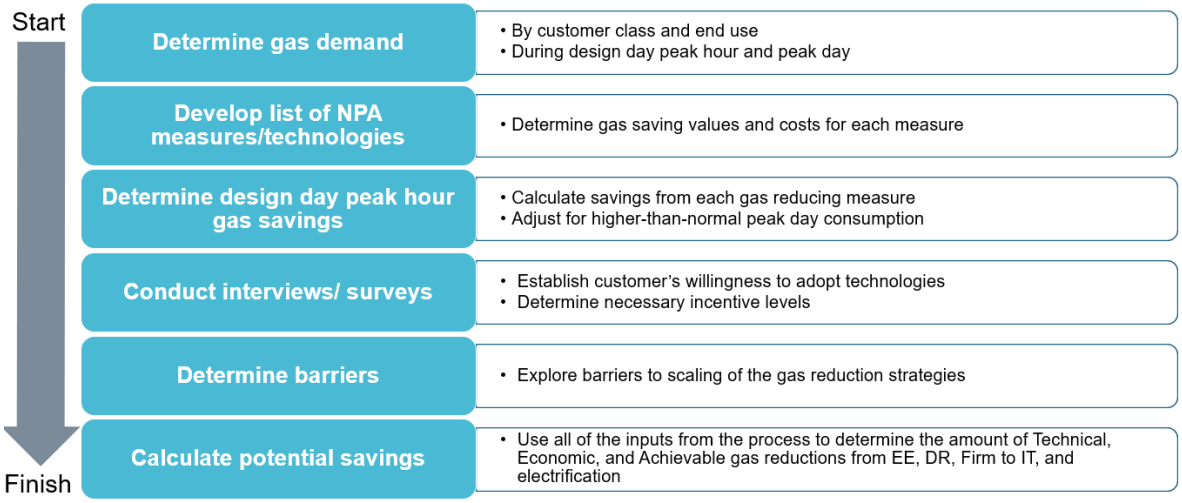
Once all calibration and the baseline model are completed, the planning software then allows analysis to begin.

4 NPA DSM Solution Development

The PA team was retained by the Company to complete an assessment of a variety of NPA measures and technologies to understand their potential to alleviate the capacity constraint in the Eastern Mountain Gas System. In the Colorado Public Utilities Commission's (PUC) Rules Regulating Gas Utilities, an NPA is defined as "programs, equipment, or actions that avoid, reduce, or delay the need for investment in certain types of new gas infrastructure and may include EE, demand response (DR), and beneficial electrification".[3] As part of the Mountain Energy NPA Analysis, the PA team worked to complete the NPA potential study, described in this section, meant to inform an integral element of the Company's planning process for supplying safe, clean, and reliable energy to the Eastern Mountain Gas System.

To address the Eastern Mountain Gas System capacity constraint, the PA team developed NPA DSM solutions and estimated their potential for alleviating the constraint. The PA team conducted primary research in the Eastern Mountain Gas System to better understand specific characteristics of the region, assess barriers to NPA implementation, understand trade partners' readiness to support electrification, understand customer's interest in participating in potential Company programs, and assess interest at different incentive levels to inform the achievable potential for NPA measures. Figure 4-1 below shows the methodology for developing and evaluating a set of NPA measures and technologies that could be efficient in helping alleviate the current gas system capacity constraint in the Eastern Mountain Gas System.

Figure 4-1: Approach to Estimating Potential



The steps from the figure are further explained in this list:

1. **Determine gas demand**: The PA team assessed current and projected gas demand by customer class and end use, accounting for Design Day peak hour and peak day, informed by data provided by the Company.[4]
2. **Identify potential NPA measures/technologies**: The PA team developed a list of 70+ potential NPA measures and technologies to evaluate for effectiveness in the Eastern Mountain Gas System, shown in Table 4-7 and Table 4-8, later in this section. The potential measures include EE, DR, and electrification measure types. Additionally, the PA team determined the gas saving values and costs associated with each identified measure. The team consulted the Company's most recent potential

[3] Colorado Department of Regulatory Agencies, Public Utilities Commission, 4 Code of Colorado Regulations 723-4.

[4] The team included a demolition rate of 1% per year for residential and 2% per year for commercial. The Company provided slightly lower demolition rates but the PA team assumed a higher demolition and rebuild rate in the mountain service territories.

study, the technical reference manual (TRM), scanned for national NPA measures, and accumulated stakeholder feedback to develop the initial measure list.

3. **NPA measure qualitative screening process**: Each NPA measure was processed through a series of screens to make it to the next step.
    a. **Determine Design Day peak hour gas savings**: The PA team assessed if the measure/technology had measurable impact to the peak hour gas demand.
    b. **Relative peak hour/peak day gas demand impact**: The PA team assessed the relative magnitude of peak hour/peak day gas demand impact from the NPA measure/technology on a scale of 1-5. A NPA measure/technology had to score higher than 1 to pass.
    c. **Qualitative screen**: The NPA measure/technology was scored form 1-5 on each of the following criteria: 1) commercial availability of measure; 2) customer acceptance of solution; 3) availability of contractors; 4) ease of implementation; and 5) GHG impacts. A weighted score was then determined.
4. **Conduct interviews/surveys**: The PA team established customer willingness to adopt NPA measures and technologies and determined the necessary incentive levels required to increase likelihood of customer adoption.
5. **Quantitative Measure Characterization:** For all measures passing the qualitative screen, the PA team developed a full set of quantitative inputs for estimating peak hour impacts and cost-effectiveness of each measure/technology in each geographic area under consideration. Where possible, savings, costs, and lifetimes were aligned with current Company DSM TRM assumptions. The team deviated from the TRM in three important ways. First, all measures in the study were defined at the premise level, rather than some other unit for ease of application. This is especially impactful in the commercial area, where building sizes vary tremendously. Second, for measures not included in the current Company DSM TRM, the PA team relied on secondary sources of estimates of savings from other jurisdictions. Third, for measures covering end uses with significantly different baseline premise-level consumption in the Eastern Mountain Gas System, the algorithms from the TRM were used, with usage variables updated to match premise-level usage in the Eastern Mountain Gas System, which accounts for differences in climate and building size between the TRM (generalized across Xcel territory) and the Eastern Mountain Gas System. Savings estimates were then calibrated to actual premise-level consumption and peak hour usage in each geographic area to calculate area-specific estimates of impacts. The peak hour estimates are based on the calibrated gas model from the Company, as mentioned earlier, and are based on gas planning design temperatures ranging from -42 to -33 degrees F, which are significantly lower than ASHRAE design temperatures used in the latest TRM. All of the impact estimates are effectively scaled to the average size premise within each area and building segment. Market adoption curves were developed based on current participation rates and expected market growth based on customer surveys and contractor interviews. Quantitative inputs included:
    a. Annual throughput savings (therms/year)
    b. Peak hour gas demand impacts (peak hour mscfh)
    c. Lifetime (years)
    d. Incremental Cost (dollars)
    e. Adoption curves
    f. Electricity throughput impacts (kWh)
    g. Electricity summer and winter peak demand impacts (kW)
6. **Modeling of NPA measures/technologies**: The PA team modeled 54 measures across each of the nine geographies. The PA team assessed the potential of each NPA measure/technology in three categories:
    a. ***Technical potential –*** the theoretical maximum amount of energy use that could be displaced, disregarding all non-engineering constraints such as cost effectiveness and the willingness of end users to adopt the EE measures.

b. ***Economic potential –*** subset of technical potential that is economically cost effective.

c. ***Achievable potential –*** subset of economic potential that further limits potential by taking into consideration market of programmatic barriers or constraints such as program budget caps or implementation issues.

7. **Calculate potential savings**: the PA team used all the inputs from the process to determine the amount of technical, economic, and achievable potential gas reductions from EE, DR, firm to interruptible service, and electrification.

4.1 Building Type and End-Use Disaggregation

The PA team used load disaggregation to calibrate all NPA measures/technologies impact assumptions using baseline estimates of annual throughput and peak day gas demand usage by building type and geography.

First, the PA team disaggregated the annual throughput and peak hour impacts by building type and customer type for the entire mountain region (e.g. residential, commercial, commercial transport, and LDC), as shown in Figure 4-2 and Figure 4-3 below. The results show that single family residential makes up the largest portion of non-LDC, non-transport annual throughput and peak hour usage. As a result, **single family residential solutions were identified as the most important building type** to focus on in development of NPA DSM solutions, with **master-metered multifamily and lodging the most important commercial areas for commercial solutions**.

Figure 4-2: Mountain System Throughput by Building Type and Customer Type

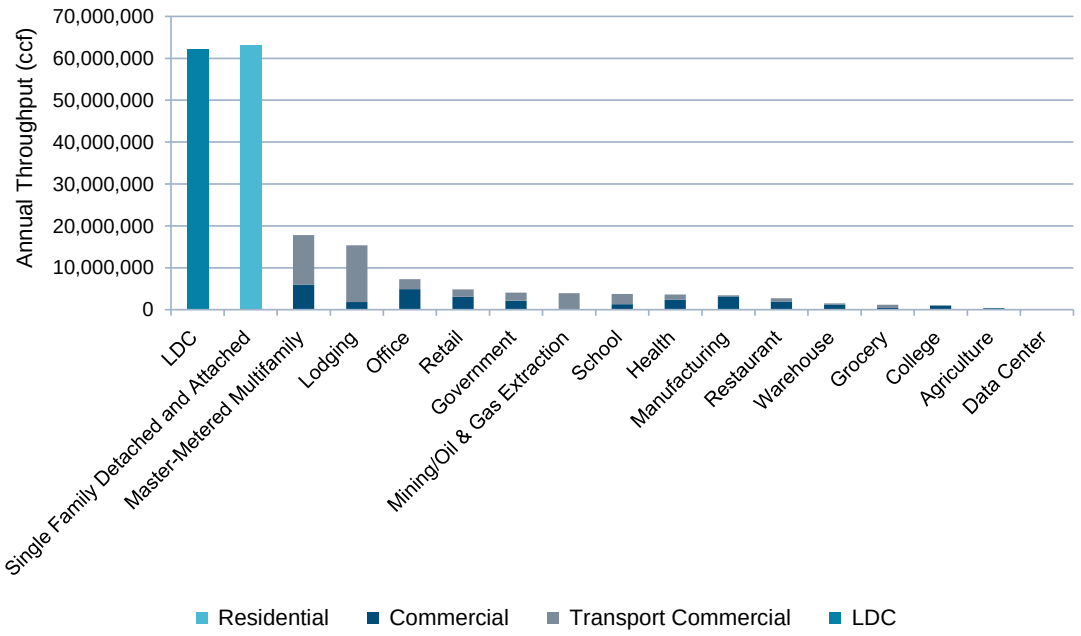
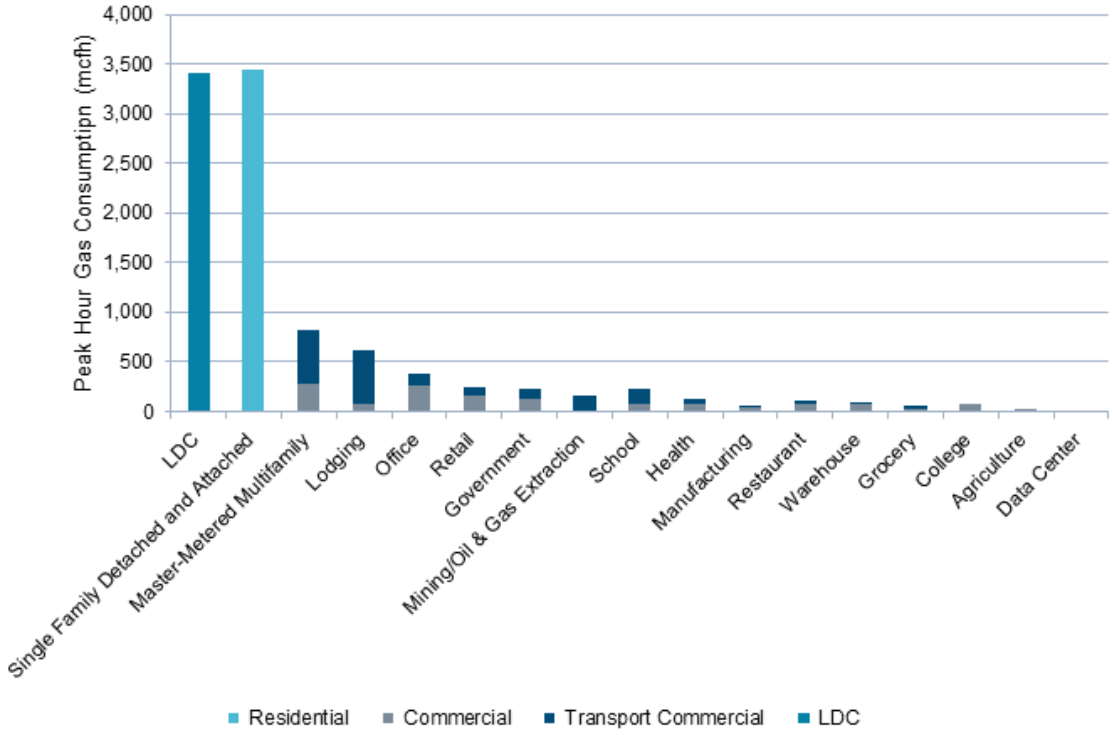


Figure 4-3: Mountain System Peak Hour Gas Consumption by Building Type and Customer Type



By understanding the building type and end-use disaggregation, the PA team was able to identify that single family residential makes up the largest portion of non-LDC, non-transport annual throughput and peak hour usage. Practical NPA measures and technologies were informed by narrowing in on a specific customer class and end use.

4.2 End Use Disaggregation

The PA team disaggregated monthly consumption (throughput) data from the Company into heating and non-heating by premise for all premises in the Mountain System. The heating and non-heating loads were then disaggregated further using a combination of results from the residential energy consumption survey (RECS)[5], the commercial building energy consumption survey (CBECS)[6], and their professional judgement, to apply estimated breakdowns of heating and non-heating by building type.

Next, the PA team disaggregated the peak hour data from the Company. The PA team began this process by assessing the verified Design Day as-is gas model estimates of peak heating and non-heating. The PA team could then disaggregate peak heating and non-heating further using information from throughput disaggregation and assumed load shapes. As shown in Figure 4-4 below, space heating was found to be the largest end use for annual throughput, followed by water heating and commercial cooking.

[5] Residential Energy Consumption Survey (RECS) - Energy Information Administration (eia.gov)
[6] Energy Information Administration (EIA)- Commercial Buildings Energy Consumption Survey (CBECS)

Figure 4-4: Mountain System End Use Disaggregation of Annual Throughput

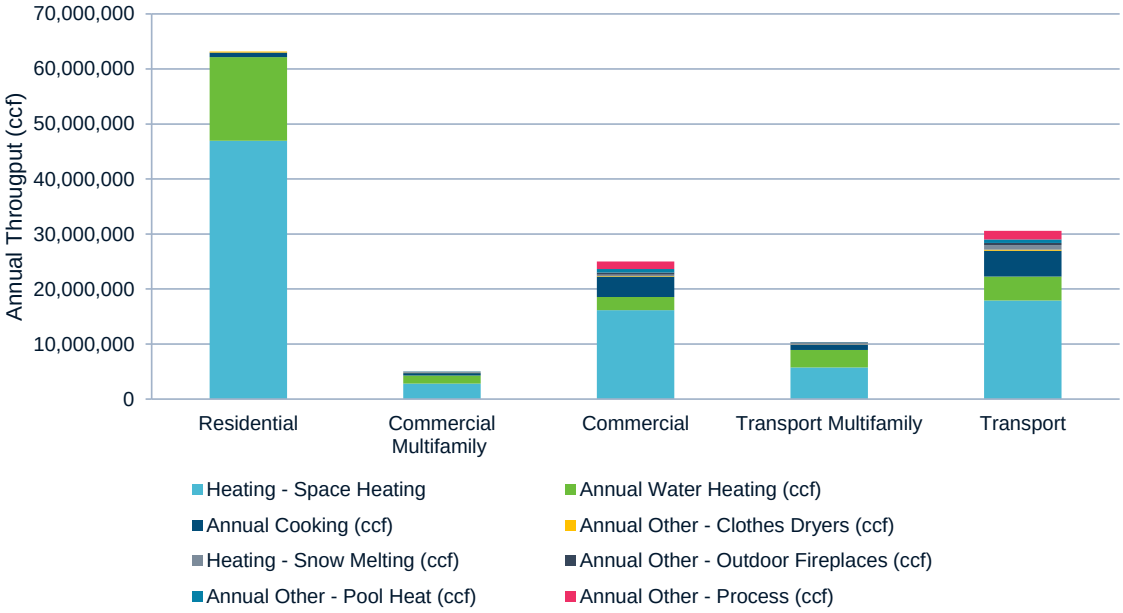


Table 4-1 below shows the annual throughput end use breakdown per premise for the Mountain System. Customers in the Mountain System have significantly higher usage than customers on the Front Range.

Table 4-1: Mountain System Annual Consumption per Premise by Customer Type

End Use	Annual Consumption per Premise (ccf)				
	Residential	Commercial Multifamily	Commercial	Transport Multifamily	Transport
Heating – Space Heating	846	3,058	3,079	18,468	28,959
Annual Water Heating	274	1,608	456	10,066	7,048
Annual Cooking	15	487	703	3,049	7,643
Annual Other - Clothes Dryers	3	30	23	189	319
Heating - Snow Melting	-	161	46	972	1,282
Annual Other - Outdoor Fireplaces	-	30	74	189	679
Annual Other - Pool Heat	-	30	118	189	1,041
Annual Other - Process	-	-	266	-	2,531
Total	**1,137**	**5,413**	**4,764**	**33,139**	**49,348**

On peak days, the heating load spikes much higher, while all other loads stay the same. **This results in space heating being, by far, the largest contributor to peak hour consumption**, as shown in Figure 4-5. As a result, **space heating became the focus of NPA DSM solution development efforts for inclusion in a portfolio focused on reducing peak hour gas consumption, with a particular focus on residential space heating**.

Figure 4-5: Mountain System End Use Disaggregation of Peak Hour Consumption

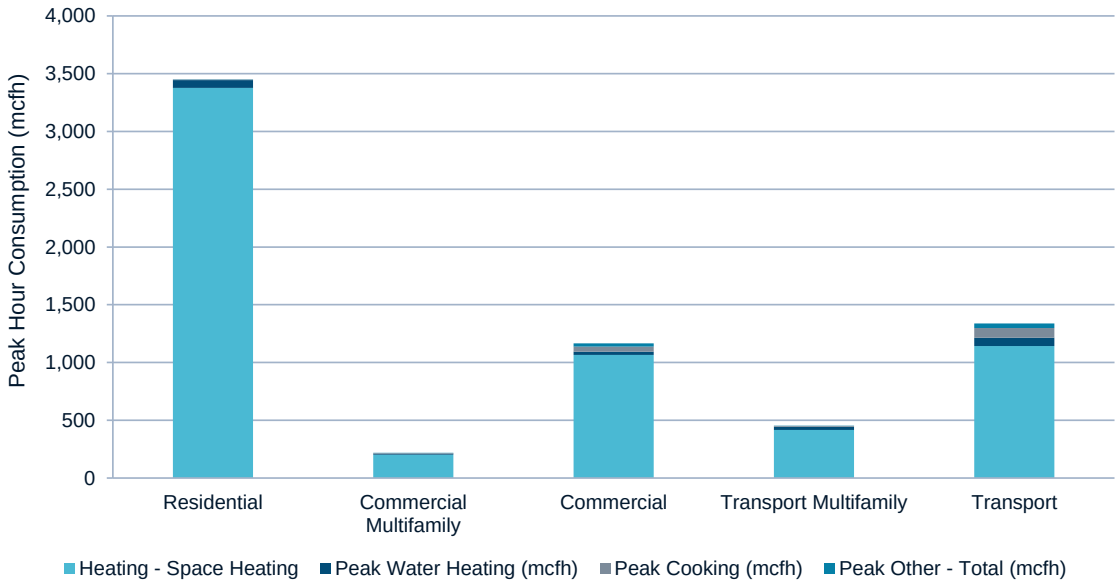


Table 4-2 below shows the peak hour gas end use breakdown per premise for the Mountain System.

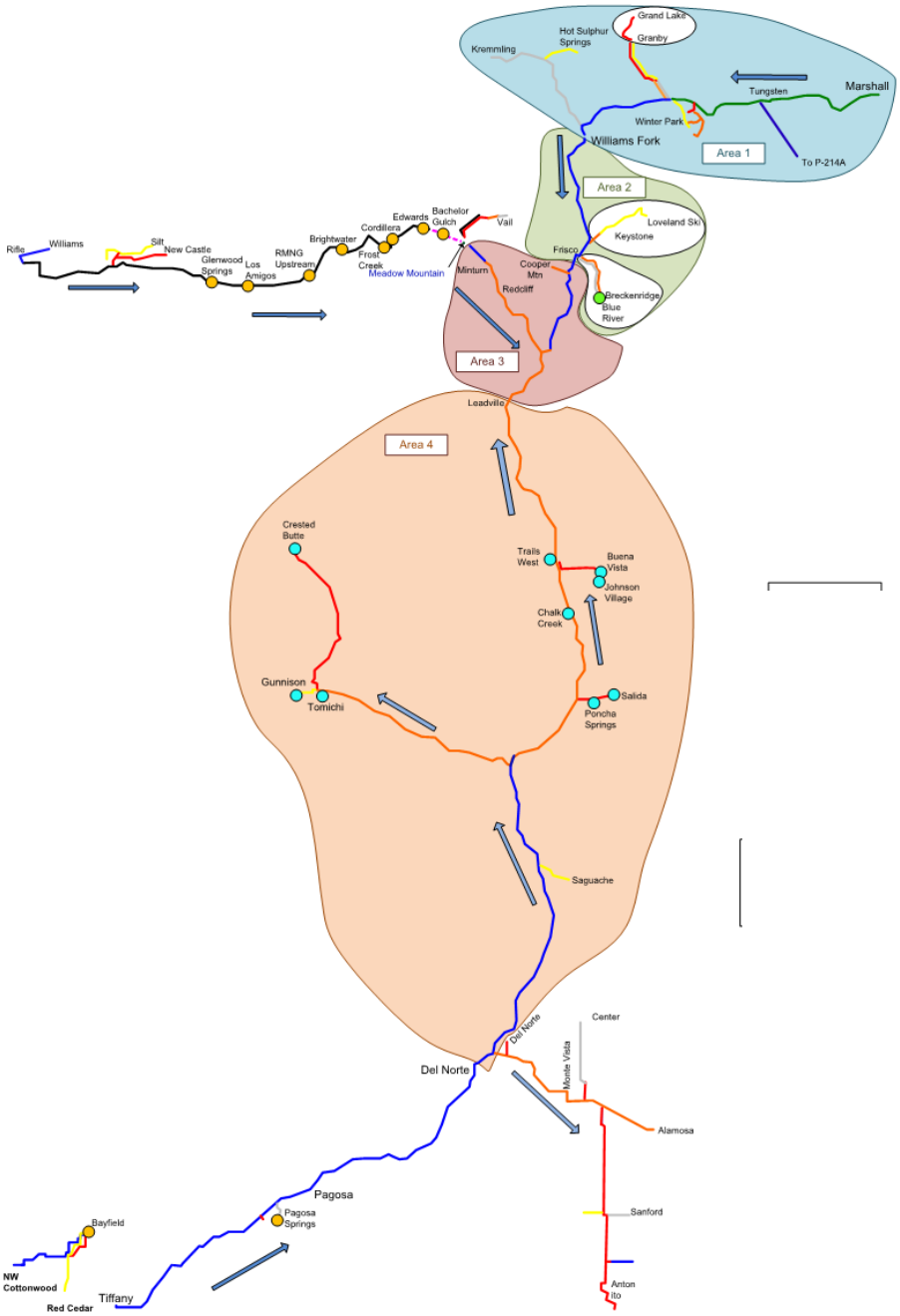
Table 4-2: Mountain System Peak Hour Gas Usage per Premise by Customer Type

End Use	Peak Hour Gas Usage per Premise (mscfh)				
	Residential	Commercial Multifamily	Commercial	Transport Multifamily	Transport
Peak Heating – Space Heating	0.061	0.220	0.203	1.334	1.849
Peak Water Heating	0.001	0.011	0.005	0.087	0.117
Peak Cooking	0.000	0.003	0.009	0.026	0.134
Peak Other - Clothes Dryers	0.000	0.000	0.000	0.002	0.006
Peak Heating - Snow Melting	-	0.004	0.001	0.022	0.028
Peak Other - Outdoor Fireplaces	-	0.000	0.001	0.002	0.009
Peak Other - Pool Heat	-	0.000	0.001	0.002	0.014
Peak Other - Process	-	-	0.004	-	0.035
Total	**0.062**	**0.239**	**0.223**	**1.474**	**2.192**

4.3 Geographic Area Analysis

Customers were segmented into different areas based on their relative location to the constrained area. This was done because each geographic area provides varying levels of per unit Design Day peak hour gas reductions for each constraint point. A map of the geographic areas of interest is displayed in Figure 4-6.

Figure 4-6: Map of Modeled Target NPA Potential Geographic Areas



As displayed in the map above, Area 1 (light blue) consists of Marshall CS to Williams Fork CS, which includes the Grand Lake area. Grand Lake Area (dark blue) includes Granby and Grand Lake Top considers Grand Lake Only. Area 2 (green) is defined as Williams Fork CS to Frisco and includes the Breckenridge (yellow) and Keystone (purple) areas. Area 3 (red) is defined as Frisco to Leadville and Area 4 (orange) is defined as Leadville to Del Norte, plus the upper Gunnison Valley.

Table 4-3 and Table 4-4 show the customer counts, annual energy consumption, peak day consumption, and peak hour consumption by geography for residential and commercial customers respectively. Data from these tables were used to inform an understanding of customer geographical spread, annual consumption by geography, and peak consumption by geography.

Table 4-3: Residential Customer Counts and Usage by Geography

Geography	Customer Count	Annual Energy Consumption (mcf)	Peak Day Consumption (mcfd)	Peak Hour Consumption (mscfh)
Area 1 - Grand Lake Top Portion	2,066	179,186	1,638	91
Area 1 – Other Grand Lake Area	3,048	300,904	2,949	164
Other Area 1	5,709	538,930	5,263	292
Area 2 - Breckenridge	8,188	1,130,644	10,010	556
Area 2 - Keystone	4,526	501,849	4,755	264
Other Area 2	2,850	363,991	3,386	188
Area 3	3,447	348,255	3,088	172
Area 4	448	35,092	335	19
None[7]	25,203	2,912,243	30,625	1,701
Total Mountain System	**55,485**	**6,311,094**	**60,794**	**3,377**

Table 4-4: Commercial non-Transport Customer Counts and Usage by Geography

Geography	Customer Count	Annual Energy Consumption (mcf)	Peak Day Consumption (mcfd)	Peak Hour Consumption (mscfh)
Area 1 - Grand Lake Top Portion	136	34,501	244	14
Area 1 – Other Grand Lake	384	121,016	976	54
Other Area 1	590	268,915	2,369	132
Area 2 - Breckenridge	911	418,027	3,225	179
Area 2 - Keystone	646	287,356	2,515	140
Other Area 2	36	24,736	219	12
Area 3	372	137,719	1,104	61
Area 4	72	24,569	217	12

[7] The “None” geography is defined as the area that has minimal impact on the system constraint, generally inclusive of the western Mountain System north and west of Meadow Mountain and southern Mountain System south of Del Norte.

Geography	Customer Count	Annual Energy Consumption (mcf)	Peak Day Consumption (mcfd)	Peak Hour Consumption (mscfh)
None	3,020	1,680,926	14,147	786
Total Mountain System	**6,167**	**2,997,765**	**22,979**	**1,276**

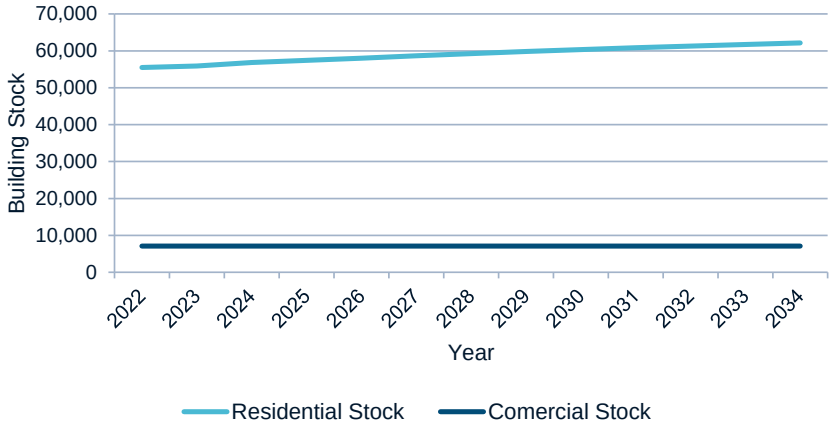
Table 4-5 shows the customer counts, annual energy consumption, peak day consumption, and peak hour consumption by geography for commercial transport customers. Results from this table were used to inform commercial transport customer dynamics and appropriate NPA measures and technologies.

Table 4-5: Commercial Transport Customer Counts and Usage by Geography

Geography	Customer Count	Annual Energy Consumption (mcf)	Peak Day Consumption (mcfd)	Peak Hour Consumption (mscfh)
Area 1 - Grand Lake Top Portion	7	12,552	96	5
Area 1 – Other Grand Lake	23	71,461	569	32
Other Area 1	64	235,315	1,950	108
Area 2 - Breckenridge	184	804,165	6,358	353
Area 2 - Keystone	200	473,443	3,700	206
Other Area 2	58	260,966	2,783	155
Area 3	67	473,108	3,805	211
Area 4	0	0	0	0
None	327	1,752,614	13,401	745
Total Mountain System	**930**	**4,083,624**	**28,498**	**1,583**

The PA team used data from the Company for the residential and commercial customer count and load growth in the region over the timeline of the study (through winter of 2033-34). For commercial, it was forecast that the number of new construction buildings was equal to the demolition rate. For residential, the total number of buildings assumption increases by roughly 1% per year, as seen in Figure 4-7.

Figure 4-74: Residential and Commercial Building Stock Count



Results from this figure were used to inform residential and commercial demand and end-use through the 10-year forecasted capacity constraint timeline. In general, a customer that is closer on the pipeline distribution network to a constraint point delivers a higher fraction of premise peak gas savings to that constraint point. The Company's gas modeling team used Synergi gas hydraulic modeling software to model the average impact of customer demand reduction in each of the nine geographies for each of the three constraint points, which allows more precise impacts of measures installed in different areas to be calculated for each of the different constraint points. The areas modeled and the constraint points are shown in Figure 4-6 above.

With the geographic areas of interest informing the PA team's analysis, Table 4-6 shows the impact of peak hour reduction for all geographies at each constraint point. **Area 2, including Breckenridge, Keystone, and other parts of Area 2, delivers the highest fraction of peak hour reductions to Breckenridge and Keystone. The immediate area around Grand Lake ("Grand Lake Top") is the only area that can deliver peak hour reductions to the Grand Lake constraint.**

Table 4-6: Ratio of Peak Hour Reduction to Capacity Delivered

Geography	RB-4 (Breckenridge)	RX-7 (Keystone)	RG-12 (Upper Grand Lake)
Other Area 1	0.37	0.14	0.00
Area 1 – Other Grand Lake	0.49	0.18	0.00
Area 1 - Grand Lake Top	0.42	0.16	0.65
Other Area 2	0.65	0.27	0.00
Area 2 - Breckenridge	0.98	0.05	0.00
Area 2 - Keystone	0.46	0.74	0.00
Area 3	0.75	0.24	0.00
Area 4	0.31	0.10	0.00
None	0.00	0.00	0.00

4.4 Measure Characterization

The PA team started measure development by compiling a list of current gas DSM measures included in the DSM technical resource manual and then conducted a national review of available measures and technologies to consider for inclusion in the portfolio. The initial list was provided to stakeholders for comment and

stakeholders provided additional measures to add to the initial measure list for screening. The PA team then performed a qualitative and quantitative screen of NPA measures and technologies. This screening was intended to streamline the overall analysis by excluding measures expected to have minimal impact on potential.

Qualitative Measure Characterization

NPA measure qualitative screening process: each measure was processed through a series of screens to make it to the next step.

1. **Determine Design Day peak hour gas savings**: the PA team assessed if the measure/technology had measurable impact to the peak hour gas demand.
2. **Relative peak hour/peak day gas demand impact**: the PA team assessed the relative magnitude of peak hour/peak day gas demand impact from the NPA measure/technology on a scale of 1-5. A NPA measure/technology had to score higher than 1 to pass.
3. **Qualitative screen**: the NPA measure/technology was scored form 1-5 on each of the following criteria: 1) commercial availability of measure; 2) customer acceptance of solution; 3) availability of contractors; 4) ease of implementation; and 5) GHG impacts. A weighted score was then determined.

Excluded measures will not necessarily be eliminated from consideration for future program offerings, but they are not included in quantitative estimates of potential. Table 4-7 and Table 4-8 show residential and commercial (including transport) qualitative screening results, including measures that passed screening (included measures) and those that failed screening (excluded measures). Each excluded measure has a reason for exclusion listed.

Table 4-7: Residential Qualitative Measure Screening Results

Measure Type	Measure	Inclusion Status/ Reason for Exclusion
DR	Behavioral Messaging DR	Included
DR	Thermostat DR/DLC	Included
Behavior	Home Energy Reports	Included
EE	Windows	Included
EE	Infiltration Reduction	Included
EE	Insulation	Included
EE	Low Flow Faucet Aerator	Excluded / Minimal Peak Hour Savings
EE	Low Flow Showerheads	Excluded / Minimal Peak Hour Savings
Gas Equipment	Gas Furnace Replacement	Included
Gas Equipment	High Efficiency Boiler Replacement	Included
Gas Equipment	Efficient Storage and Tankless Water Heaters	Included
Gas Equipment	Gas Furnace Tune-Up	Included
EE	Building Codes	Excluded / Out of Program Scope
EE	Energy Star Home/Efficient Home	Included
BE	Heat Pump Water Heater	Included

Measure Type	Measure	Inclusion Status/ Reason for Exclusion
BE	Heat Pump Full Electrification	Included
BE	Ground Source Heat Pumps (Specific Location)	Included
BE	All Electric New Construction	Included
BE	Dual Fuel Heat Pump	Excluded / Minimal Peak Hour Savings
DR	Tech Agnostic, Whole Home DR Measured at Meter	Excluded / Low Market Availability
DR	DHW DLC	Excluded / Low Market Availability
DR	HVAC DLC - switch	Excluded / Low Market Availability
Gas Equipment	High Efficiency Fireplaces	Excluded / Low Market Availability
Gas Equipment	Water Heater Tank Insulation	Excluded / Minimal Peak Hour Savings
EE	Water Heater Pipe Insulation	Excluded / Minimal Peak Hour Savings
BE	Integrated Controls for MSHPs	Excluded / Minimal Peak Hour Savings
Gas Equipment	Ranges	Excluded / Minimal Peak Hour Savings
BE	Electric Resistance Water Heater	Excluded / Minimal Peak Hour Savings
BE	Furnace/Boiler Supplements (i.e. Pellet Stoves)	Excluded / Low Market Acceptance
Gas Equipment	Pool Heaters	Excluded / Minimal Applicability
EE	Snowmelt	Excluded / Minimal Applicability
Gas Equipment	Clothes Dryers	Excluded / Minimal Peak Hour Savings
BE	Ground Source Heat Pumps (Snow Melt)	Excluded / Minimal Applicability
EE	Smart Thermostat	Excluded / Negative Peak Hour Savings

Table 4-8: Commercial and Industrial Qualitative Measure Screening Results

Measure Type	Measure	Inclusion Status/ Reason for Exclusion
DR	Tech Agnostic, Whole Facility DR Measured at Meter	Included
BE	All Electric New Construction	Included
EE	Infiltration Reduction	Included
EE	Windows	Included
EE	Insulation	Included

Measure Type	Measure	Inclusion Status/ Reason for Exclusion
Gas Equipment	Gas Condensing Boiler	Included
Gas Equipment	Gas Storage and Tankless Water Heater	Included
EE	Guest Room Energy Management	Excluded / Minimal Peak Hour Savings
Gas Equipment	Gas Furnace - High Efficiency	Included
EE	Energy Efficient New Construction	Included
Gas Equipment	Condensing Boiler - Process	Included
BE	Cooking Electrification	Included
BE	Ground Source Heat Pumps (Specific Location)	Included
BE	VRF Heat pumps (large or boiler/chiller)	Included
BE	Heat pump water heaters	Included
BE	ASHP replace Rooftop (baseline rooftop)	Included
BE	Snowmelt Electrification	Excluded / Low Market Availability
DR	Snowmelt DR	Included in Whole Facility DR
EE	Building Codes	Excluded / Out of Program Scope
DR	Thermostat DR/DLC	Included in Whole Facility DR
DR	Forced Whole Facility DLC w/incentives	Excluded / Low Market Acceptance
BE	Fuel Switching for Dual Fuel Customers	Excluded / Minimal Applicability
Gas Equipment	Combination Ovens	Excluded / Minimal Peak Hour Impacts
EE	Pre-Rinse Spray Valves	Excluded / Minimal Peak Hour Impacts
EE	Demand Control Ventilation	Excluded / Minimal Peak Hour Impacts
EE	HVAC Heat Recovery/ Energy Recovery Ventilator	Excluded / Low Impacts
EE	Snowmelt EE	Excluded / Minimal Peak Hour Impacts
Gas Equipment	Hot Water Boiler Tune-Up	Excluded / Low Impacts
Gas Equipment	High Efficiency Ovens & Dryers	Excluded / Minimal Peak Hour Impacts
EE	Steam Trap Replacement	Excluded / Minimal Applicability
BE	Dual Fuel Heat Pumps (gas backup)	Excluded / Minimal Peak Hour Impacts
BE	Commercial Boiler - Solar Hot Water	Excluded / Minimal Peak Hour Impacts
BE	Ground Source Heat Pumps (Snow Melt)	Excluded / Low Impacts

Measure Type	Measure	Inclusion Status/ Reason for Exclusion
EE	C&I Process	Excluded / Minimal Applicability
DR	Outdoor fireplace DR	Included in Whole Facility DR
BE	Ground Source Network Loop	Excluded / Low Market Availability

Quantitative Measure Characterization

The measures that passed qualitative screening then received further quantitative measure characterization, including all inputs necessary to estimate cost-effectiveness and peak hour impacts. Savings were estimated using TRM where available, calibrated to actual consumption and peak data for the mountain region. Residential and commercial (including transport) measures and their key measure characteristics are shown in Appendix 6. While the actual analysis used geography and building group, the savings values in these tables reflect the weighted average values across all geographies and building types, assuming the weights from the achievable potential. Table 4-9 below shows the residential savings adjustment multipliers by geographic area and building type. These multipliers represent the ratio in consumption and savings between the building type and geographic area combination and the base assumptions based on the TRM with peak hour factors applied. They were derived using the premise-level disaggregated end-use peak usage by geographic area and building type. These multipliers reflect differences in weather and building size and characteristics that drive differences in per premise consumption across the population. The savings adjustments are multiplied by the generic savings to estimate geography and building type-specific results.

Table 4-9: Residential Measure Savings Adjustments by Geographic Area and Building Type

Geographic Area	Building Type	Heating	Non-Heating
1 - Breck	SF	1.21	1.40
1 - Breck	MF	0.92	1.06
2 - None	SF	1.04	1.09
2 - None	MF	0.79	0.83
3 - Area3	SF	0.91	0.94
3 - Area3	MF	0.69	0.72
4 - Area4	SF	0.70	0.74
4 - Area4	MF	0.53	0.56
5 - Keystone	SF	0.99	1.05
5 - Keystone	MF	0.76	0.80
6 – Upper Grand Lake	SF	0.82	0.67
6 – Upper Grand Lake	MF	0.63	0.51
7 – Grand Lake	SF	0.93	0.79
7 – Grand Lake	MF	0.71	0.60
8 - OtherArea1	SF	0.89	0.76
8 - OtherArea1	MF	0.68	0.58
9 - OtherArea2	SF	1.13	1.24
9 - OtherArea2	MF	0.86	0.94

Table 4-10 below shows the commercial measure adjustment multipliers (including transport).

Table 4-10. Commercial and Transport Measure Adjustment Multipliers

Geographic Area	Building Type	Heating	Non-Heating
1 - Breck	Commercial	0.98	1.01
1 - Breck	Multifamily Commercial	1.09	1.34
1 - Breck	Multifamily Transport	10.07	9.17
1 - Breck	Transport	9.08	10.93
2 - None	Commercial	1.32	1.11
2 - None	Multifamily Commercial	1.37	1.66
2 - None	Multifamily Transport	7.76	8.30
2 - None	Transport	14.17	14.41
3 - Area3	Commercial	0.91	0.66
3 - Area3	Multifamily Commercial	1.13	0.89
3 - Area3	Multifamily Transport	6.35	11.51
3 - Area3	Transport	20.74	15.84
4 - Area4	Commercial	0.85	0.53
4 - Area4	Multifamily Commercial	4.18	3.97
4 - Area4	Multifamily Transport	NA	NA
4 - Area4	Transport	NA	NA
5 - Keystone	Commercial	0.98	1.00
5 - Keystone	Multifamily Commercial	0.96	1.31
5 - Keystone	Multifamily Transport	3.51	5.46
5 - Keystone	Transport	4.88	6.88
6 – Upper Grand Lake	Commercial	0.70	0.37
6 – Upper Grand Lake	Multifamily Commercial	0.70	0.34
6 – Upper Grand Lake	Multifamily Transport	NA	NA
6 – Upper Grand Lake	Transport	2.43	6.84
7 – Grand Lake	Commercial	0.79	0.65
7 – Grand Lake	Multifamily Commercial	0.63	0.64
7 – Grand Lake	Multifamily Transport	5.80	13.52
7 – Grand Lake	Transport	6.27	4.16
8 - OtherArea1	Commercial	1.06	0.94
8 - OtherArea1	Multifamily Commercial	1.11	1.05

Geographic Area	Building Type	Heating	Non-Heating
8 - OtherArea1	Multifamily Transport	8.62	13.24
8 - OtherArea1	Transport	7.50	7.79
9 - OtherArea2	Commercial	1.73	0.93
9 - OtherArea2	Multifamily Commercial	1.70	1.73
9 - OtherArea2	Multifamily Transport	2.86	5.12
9 - OtherArea2	Transport	17.23	25.62

4.5 Primary Research

To inform the NPA Potential Study, the PA team conducted primary research to assess customer characteristics and interest in energy efficient and electrification upgrades along with trade partner knowledge and interest in promoting and installing electrification equipment. The PA team used the information from these surveys and interviews to inform estimates and ramp up time for market adoption, the level of incentives needed to achieve the NPA goals, and the amount of workforce development needed to support any program.

The PA team conducted primary research among three groups of interviewees, with the respective survey and interview topics as follows:

- **Residential Customer Survey**
  - Gas equipment saturation
  - Demographic information
  - Willingness to participate in gas equipment or building shell efficiency upgrades, conversions of gas equipment to electricity, and load management programs
- **Contractor / Builder Interviews**
  - Experience and awareness of the Company's programs
  - Experience in recommending or installing heat pumps
  - Need for additional training
  - Recommendations for marketing
- **Commercial Customer Survey**
  - Gas equipment saturation
  - Building characteristics
  - Willingness to participate in converting gas equipment to electricity, shell upgrades and load management programs

4.5.1 Residential Customer Survey

The PA team conducted a survey of a random sample of the Company's residential gas customers in the affected mountain areas, intended to capture customer demographics in the Eastern Mountain Gas System. For comparison purposes, a sample of customers located on the front range of the Company's service territory. The PA team offered the survey in both English and Spanish, recruited customers over email, and offered a $10 gift card incentive for completing the survey. Response rates and survey confidence and precision for front range and mountain areas are shown in Table 4-11. The survey questionnaire is attached in Appendix 6.2.

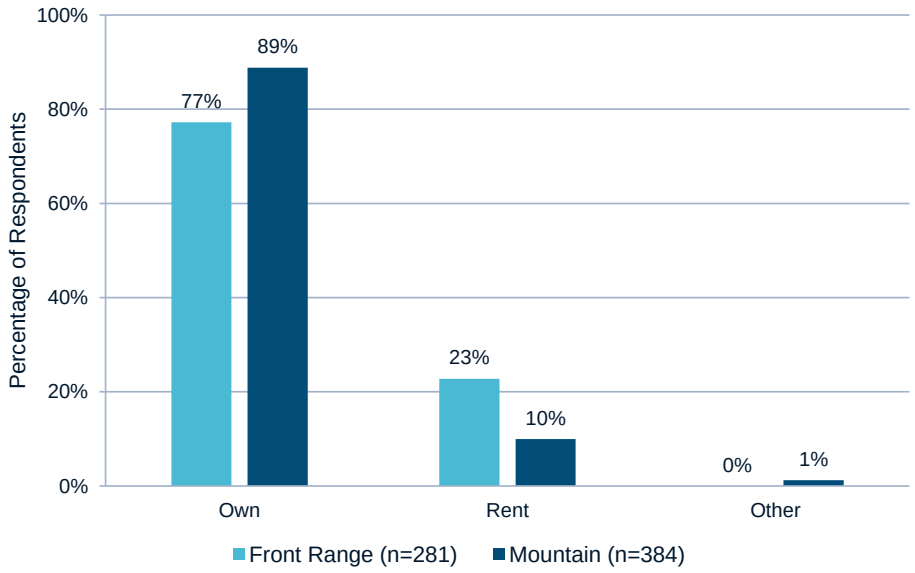
Table 4-11: Residential Survey Response Rates

Area	Customers Surveyed	Completed Surveys	Response Rate	Spanish Respondents	Confidence and precision
Front Range	4,600	295	6.4%	9	90% +/- 4.7%
Mountain	4,599	400	8.5%	9	90% +/- 4%

4.5.2Residential Customer Survey Results

Since customers that own their own homes are more likely to invest in upgrades than renters, the survey first asked about home ownership. For those customers responding to the survey, home ownership rates are higher in the mountain areas than on the front range (Figure 4-8) which improves the opportunity to participate.

Figure 4-8: Home Ownership Rates



For customers identifying as renters, the PA team asked whether the respondents would have the ability to influence equipment decisions in the homes they reside, and used this information to screen out those survey respondents that would be unable to answer later program interest questions. As shown in Figure 4-9, the level of influence was spread across the four choices; only those indicating some or a lot of influence received later survey questions about program interest. Renter respondents that self-report as influential were included in our assessments for the NPA potential.

Figure 4-9: Influence as a Renter on Equipment Decisions

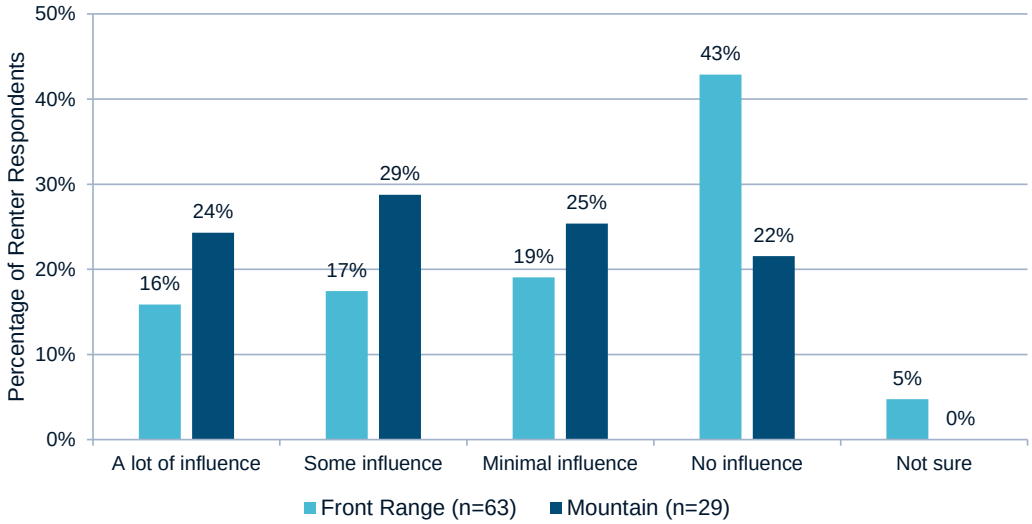


Figure 4-10 describes how energy bills are paid for those customers that rent their home. Those customers that pay their own energy bills are more likely to be interested in program participation. Results show that mountain area customers more often pay their bill directly.

Figure 4-10: How Bills are Paid

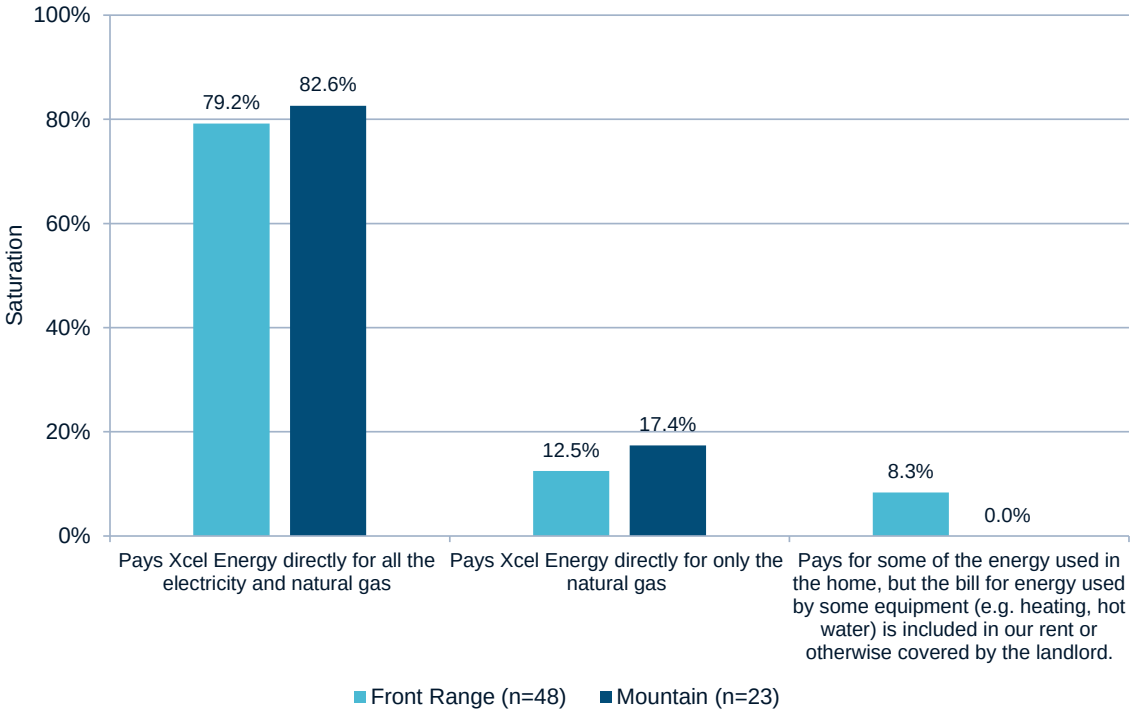


Figure 4-11 shows the shares of respondents that rent their homes to others. The higher percentage of Mountain customers renting their homes to others indicates a unique characteristic of Mountain area

customers due to the resort nature which may make participating more challenging due to homeowners being absent part or all the time.

Figure 4-11: Do You Rent This Home to Others?

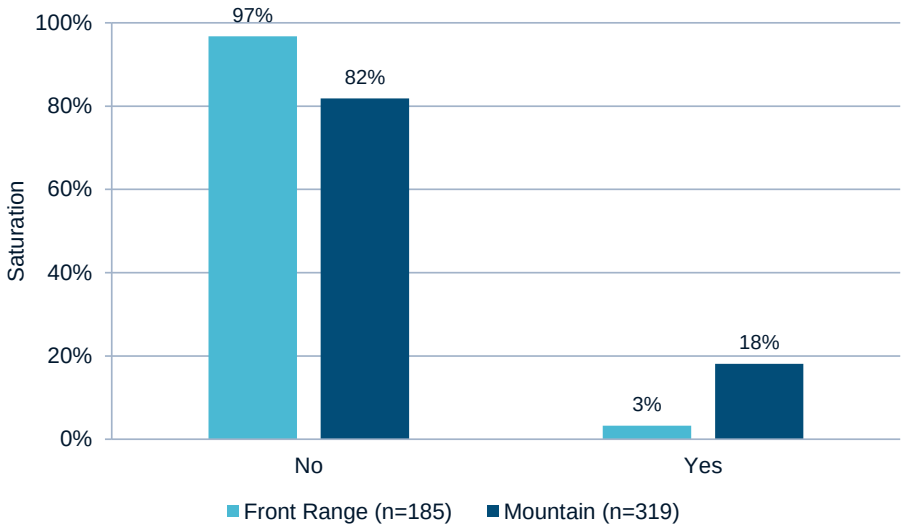


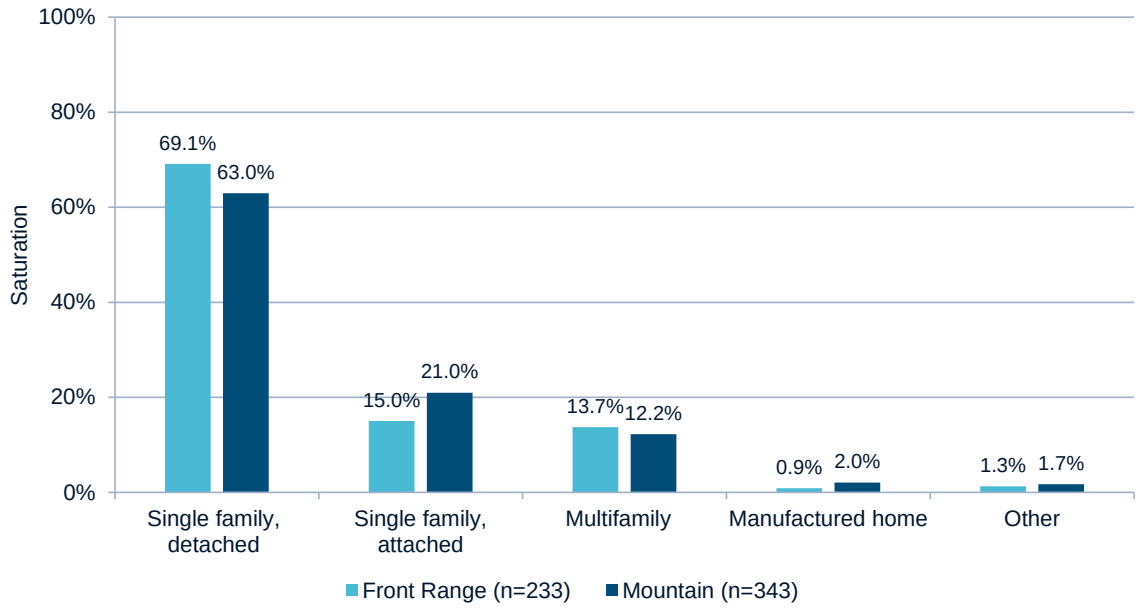
Table 4-12 shows the percentage of time the home is occupied by different parties or vacant. The responses to the question showing higher vacancies also illustrate the unique characteristics of mountain area customers due to absent owners which may make it more difficult be aware of and participate in a program.

Table 4-12: Occupancy

Occupants	Front Range (2% Eligible)	Mountain (14% Eligible)
You or your family members	40.0%	27.2%
Others outside of your family	58.4%	47.6%
Vacant	1.6%	25.8%
Total	100.0%	100.5%

Figure 4-12 describes the breakdown of home types in the front range and mountain areas. Homes that are not single family, detached, and owner-occupied may have barriers to participation. Mountain area homes are slightly less likely to be single family and detached.

Figure 4-12: Home Description



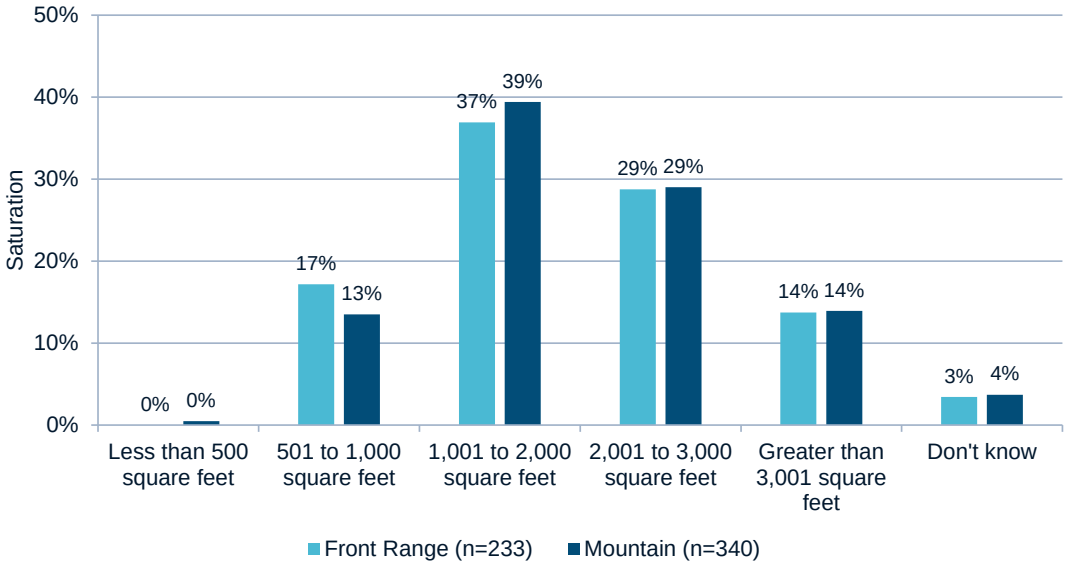
As part of understanding how mountain area properties differ from the Company's broader customer base, we asked about number of units in multifamily properties. Table 4-13 describes the average number of units in for those in a multifamily property which are less in the mountain areas compared to front range.

Table 4-13: Average Number of Units

Area	Average Units
Front Range	29
Mountain	12

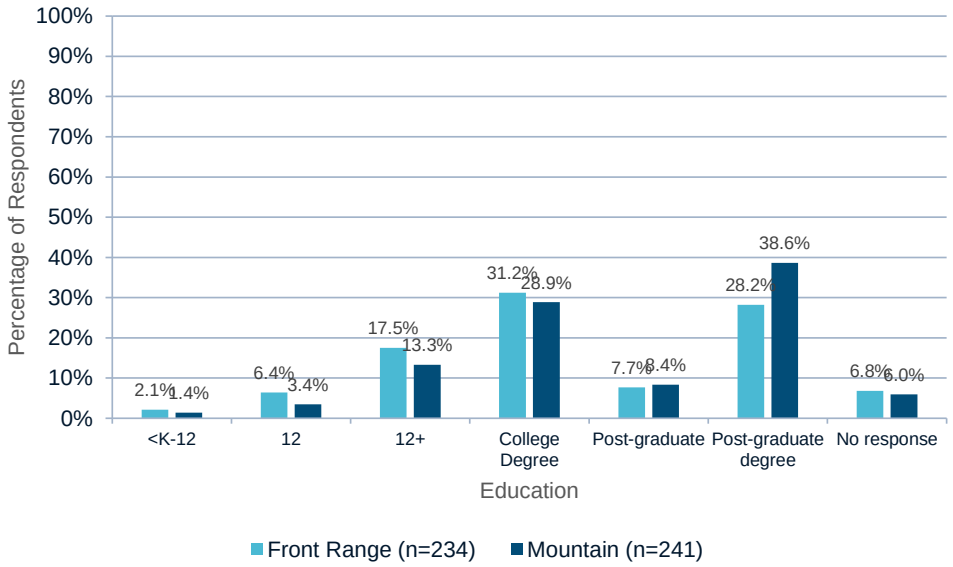
We asked questions about home size to determine whether the distribution is significantly different in the mountain area compared to the rest of the Company's service territory. As shown in Figure 4-13, the distribution of home sizes is fairly similar between the two areas.

Figure 4-13: Home Size



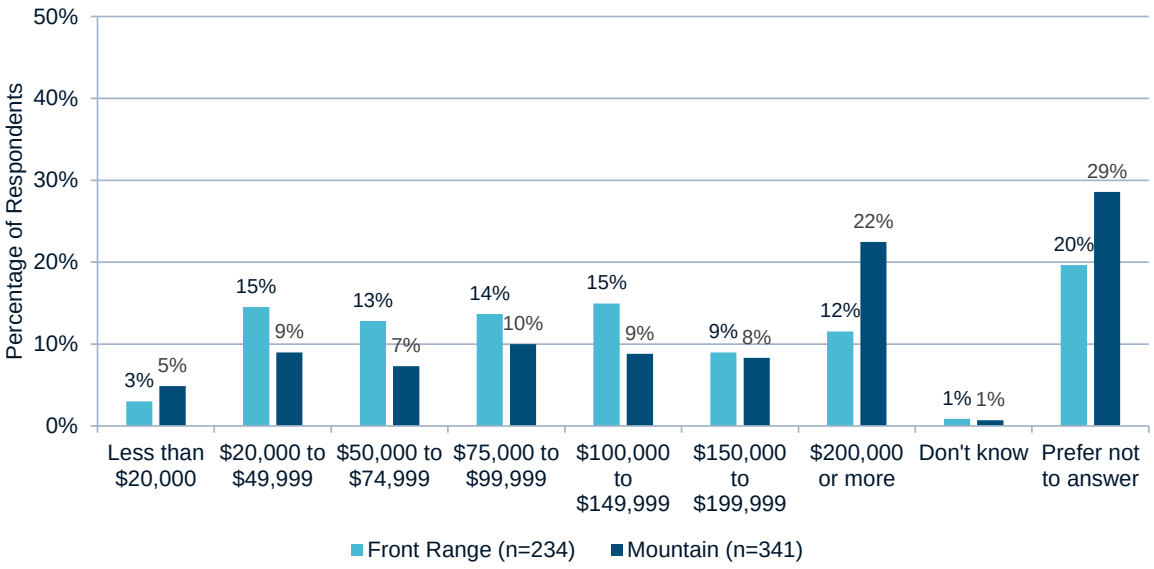
Across a wide variety of programs and jurisdictions, we have found that program participation is typically higher among more educated populations. We surveyed customers to assess their education levels. Figure 4-14 shows the distribution of respondent's education level. The Company's mountain area customers have slightly higher education levels than the rest of the territory.

Figure 4-14: Education Level



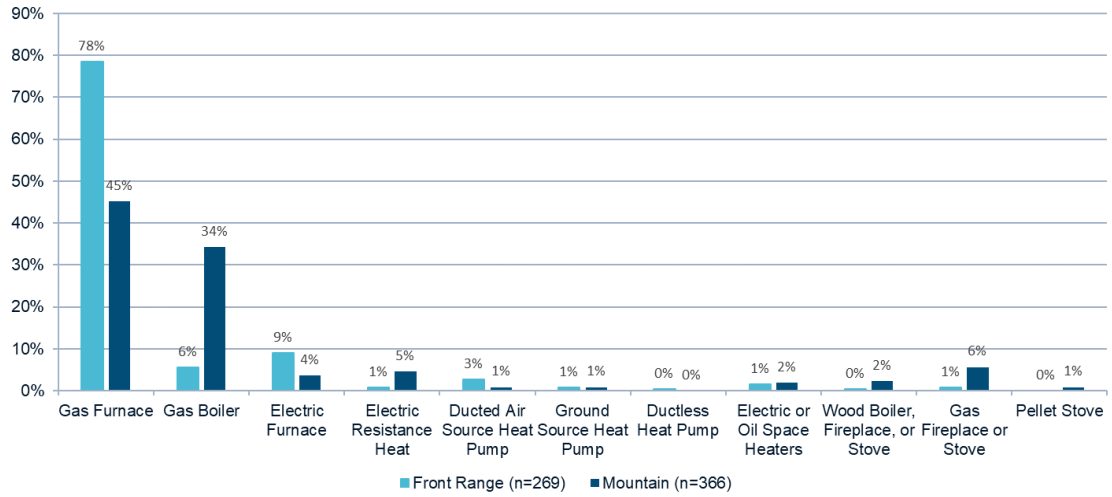
Program participation also tends to be higher among those with higher incomes. We surveyed customers to assess income levels in the mountain areas compared to the rest of the Company's service territory. Figure 4-15 shows the distribution of household income among respondents indicating higher levels of income among mountain area customers.

Figure 4-15: Household Income



As the most significant NPA potential comes from heating system upgrades, all respondents were asked to identify their primary heat source. As shown in Figure 4-16, most heating systems are gas in both mountain and front range areas. In both cases, the share of furnaces is higher than boilers, however mountain areas have a higher share of customers using gas boilers (34%) than front range (6%).

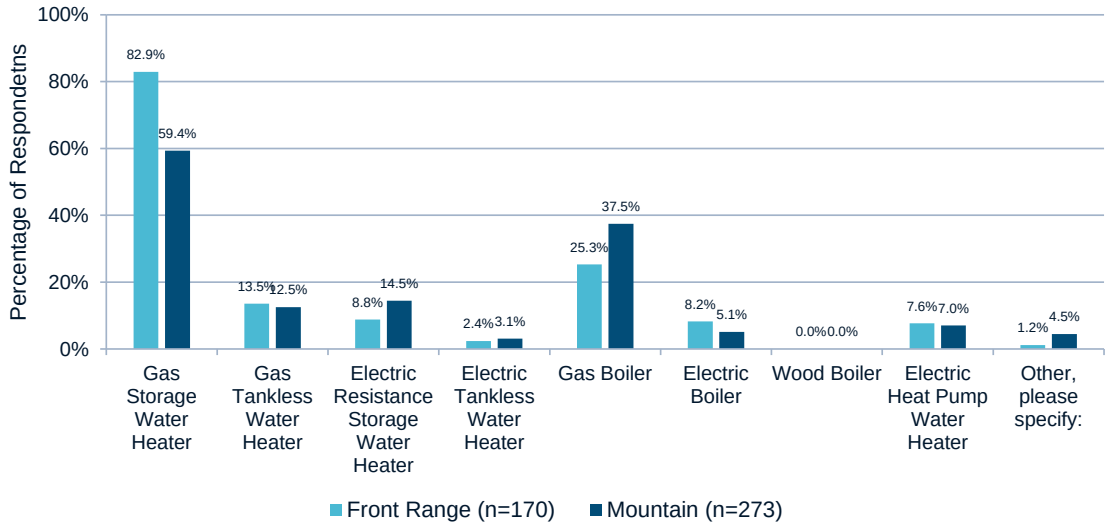
Figure 4-16: Primary Heat Source



Water heating is also a significant home appliance that may use gas, and therefore the survey asked about types of water heaters in respondent homes. Figure 4-17 shows that gas water heaters make up the majority

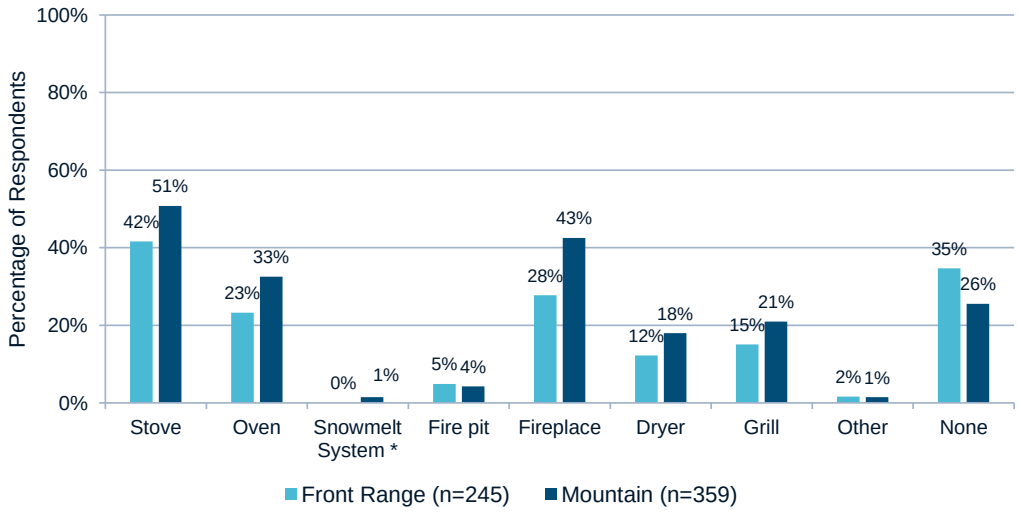
in both mountain and front range, although mountain area customers have a higher share of gas boilers used for water heating than in the front range.

Figure 4-17: Types of Water Heating



To assess whether there are other natural gas fueled appliances that may contribute to peak gas use, the survey asked about other equipment. Figure 4-18 shows the shares of other appliances and equipment fueled by natural gas. Gas stoves were the most common (42% front range and 51% mountain), followed by fireplaces (28% front range and 43% mountain). Seven mountain respondents have a snowmelt system at their home.

Figure 4-18: Other Natural Gas Fueled Equipment[8]

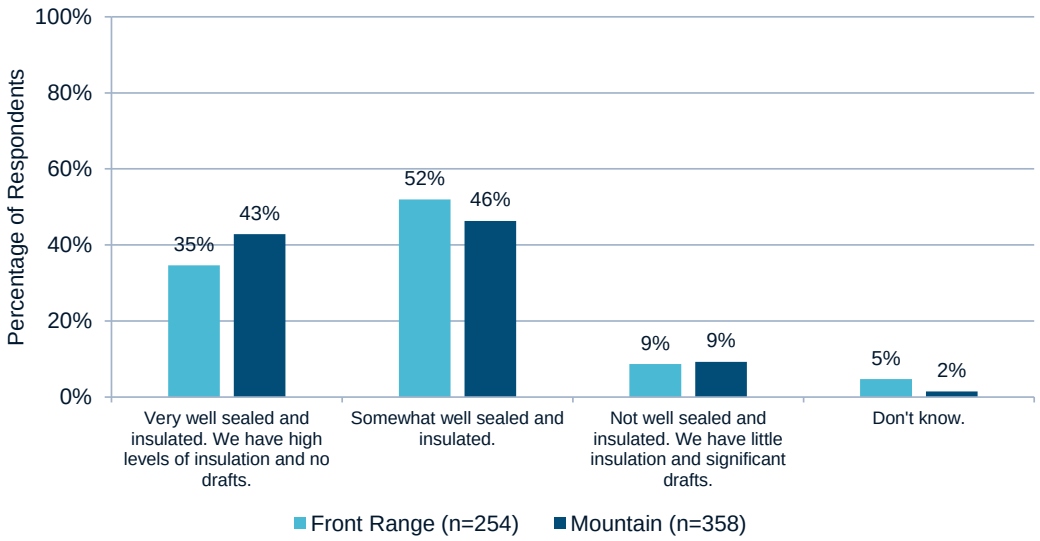


As weatherization could be a significant natural gas savings opportunity, customers were asked about their perceptions of how well sealed and insulated their homes were. Only a small percentage (9% in both areas)

[8] 7 Mountain customers reported a snowmelt system.

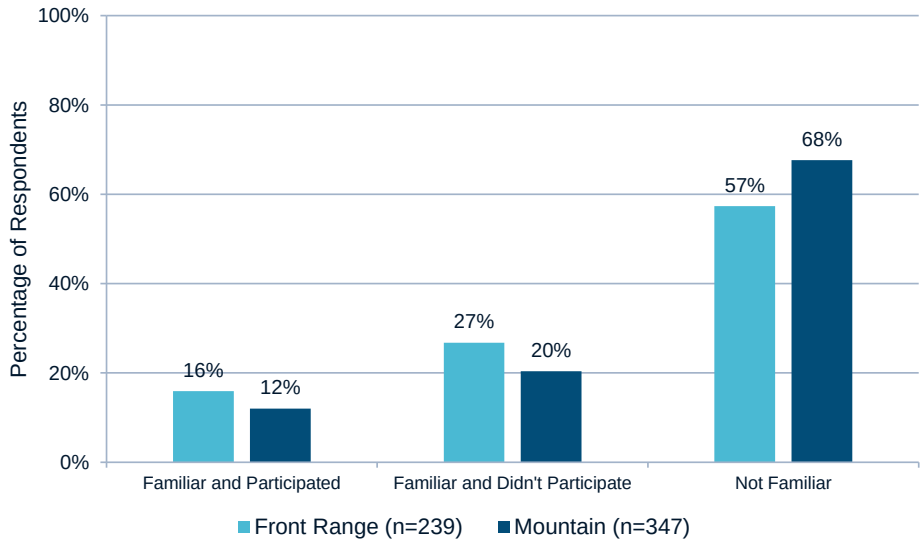
felt like their homes were not at all well sealed and insulated, while 35% in the front range and 43% in the mountain areas felt their homes were very well sealed and insulated (Figure 4-19).

Figure 4-19: Insulation and Sealing



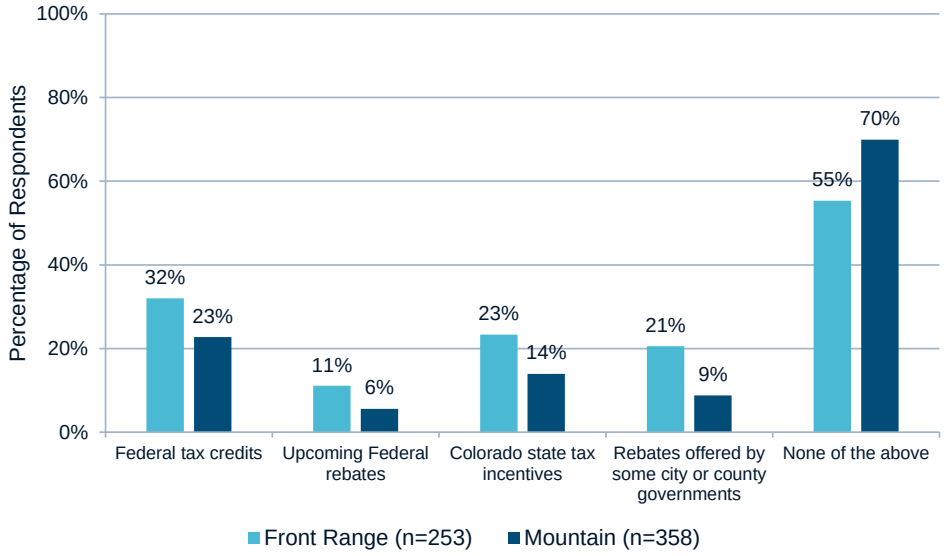
The survey asked about current understanding of the Company's programs and past participation, to assess the amount of education that will be needed when offering an NPA Program in the mountain area. As shown in Figure 4-20, familiarity and past participation in the Company's programs lagged in the mountain region (12% familiar and participated) compared to the front range (16% familiar and participated).

Figure 4-20: Company Program Familiarity and Participation



The survey also asked about their familiarity with other incentives such as federal, state, or local rebates or incentives to understand customers' understanding of existing programs and incentives. Customers in the mountain areas lagged those located in the front range (Figure 4-21).

Figure 4-21: Familiarity with Incentives



The next set of questions were asked to assess customers' general interest or willingness to interact with a program that saves natural gas. Figure 4-22 shows responses to the question "Xcel Energy offers multiple programs to save natural gas. Please indicate your level of willingness to participate in each of the types of savings opportunities listed below." For this question, renters with some or a lot of influence were included and asked to respond on behalf of their landlord. The highest interest in both areas was for adding insulation and air sealing, followed by adjusting thermostats.

Figure 4-22: Interest in Upgrades

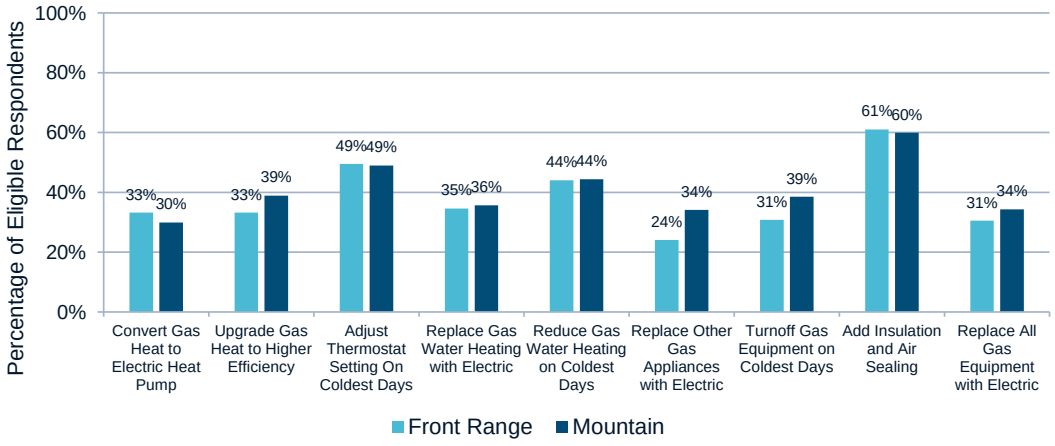
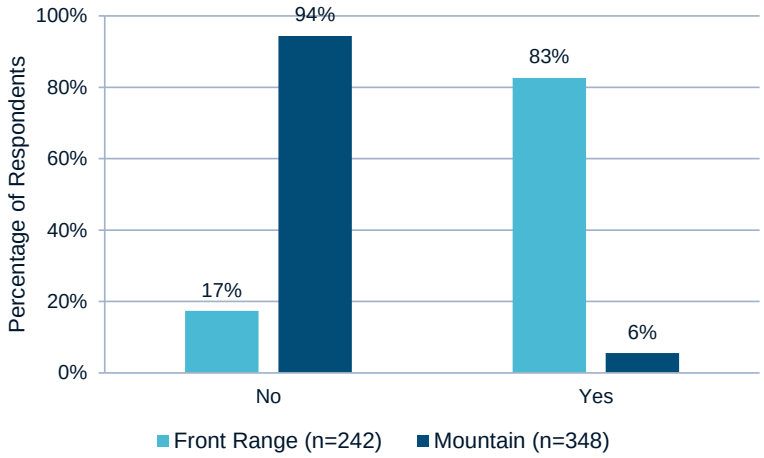


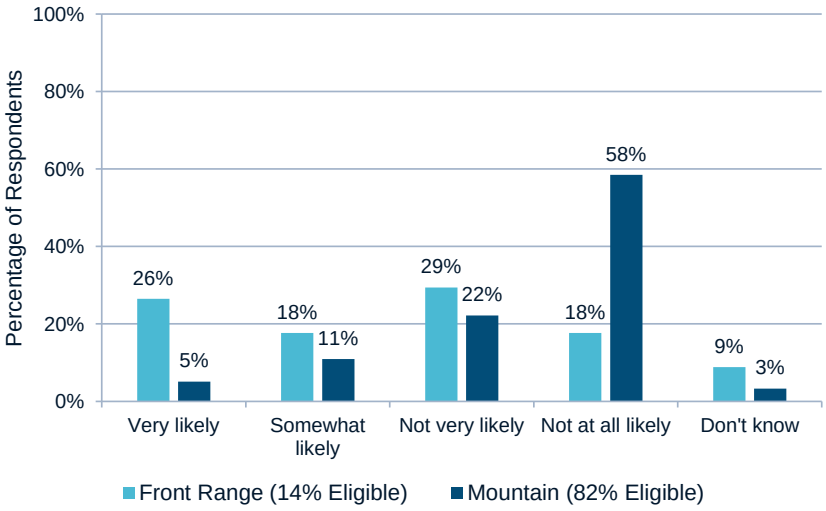
Figure 4-23 shows the percentage of customers in each area that have an air conditioning system. Because of milder summer temperatures, mountain area customers have a much lower saturation of air conditioners (6%) than front range customers (83%).

Figure 4-23: Air Conditioner Ownership



Because a selling point of heat pumps is they provide both air conditioning and heating, the survey asked customers not having air conditioning about the likelihood of adding air conditioning if they were to upgrade their heating system. The share of mountain customers very or somewhat likely to add (16%) was lower than the front range customers (44%).

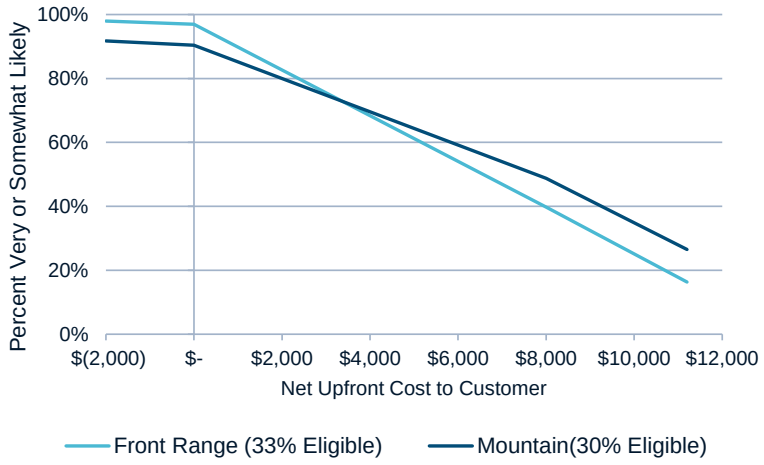
Figure 4-24: Likelihood of Adding Air Conditioning



The survey next asked customers that indicated they were very or possibly interested in a particular upgrade about different price levels at which they would likely to participate in an incentive program. The following figures contain these results. For these questions, the survey tested different levels of incentives to assess how participation would be impacted at different incentive levels. In each case we provided survey respondents with estimated costs and possible incentives in dollars to give customers a sense of the magnitude of the purchase price while assessing a range of incentives between 30% and 100% of the cost. We also adjusted the dollar amounts to be round numbers to simplify the questions where possible. In cases where operating costs have the potential to be higher (such as fuel conversions), we also tested interest with incentives that were greater than full replacement costs in case uncertainty around operating costs could be overcome with greater incentives up front.

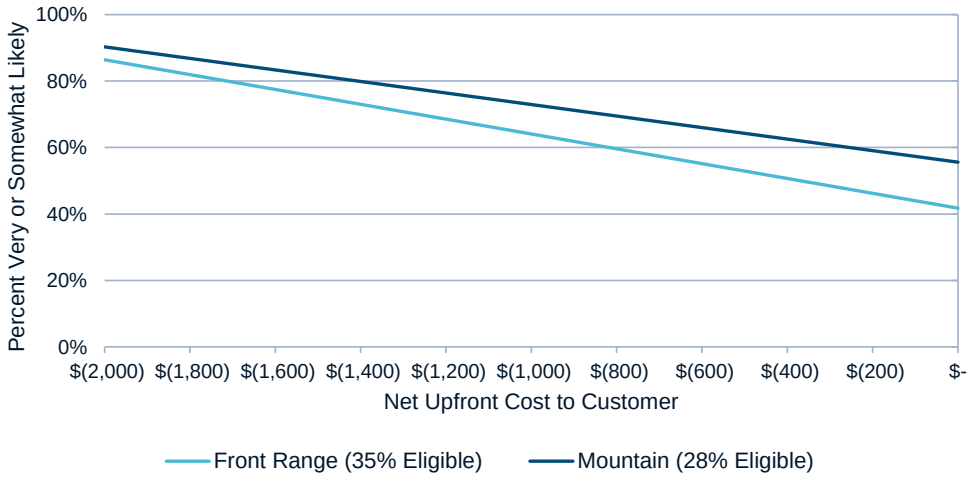
Because heat pumps could be an important contributor to reducing peak heating load, we tested four levels of incentives ranging from 30% of expected cost to 112.5% of the expected costs. Over 90% of interested and eligible customers in both front range and mountain areas indicate a likelihood of participating in a program to convert their gas heating system to a heat pump assuming the same operating costs, if the incentive covered the full cost of converting or more. Interest in participating dropped consistently with a drop in the incentive levels such that less than 30% of those eligible were interested at incentive levels equal to 30% of the expected costs.

Figure 4-25: Likelihood to Convert to Heat Pump with Same Operating Cost



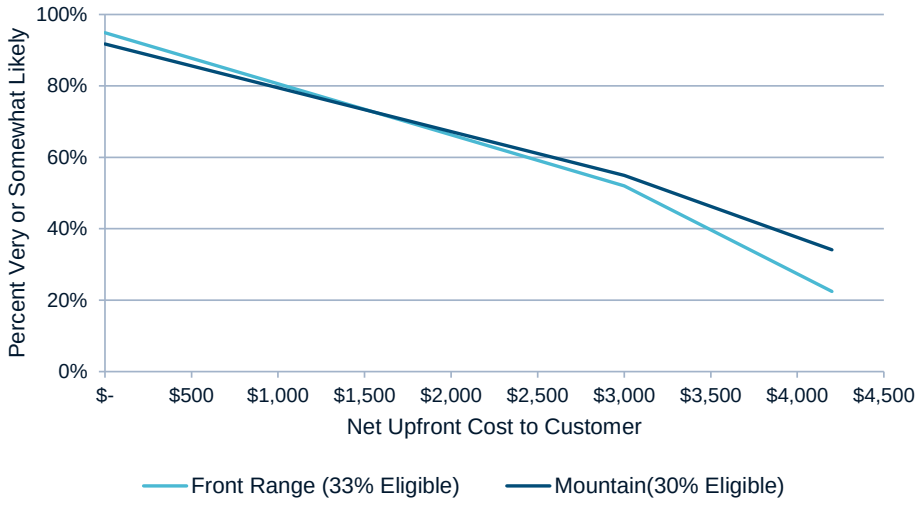
One consideration of converting a gas heating system to heat pump is how operating costs could change. Operating costs will depend on actual operation as well as the actual difference between electricity and gas volumetric rates that can vary during any month. Figure 4-26 shows the results when operating costs are assumed to be $1,000 more annually for the heat pump. In this case we only asked about incentives equal to the full cost of conversion or more since we expected that customers would not pay any incremental cost for a new system that costs more to operate. Interestingly, close to half of respondents indicate interest in participating if the full cost is paid even if operating costs increase, with mountain respondents having slightly higher interest than front range respondents.

Figure 4-26: Likelihood to Convert to Heat Pump with $1,000 Increase in Operating Cost



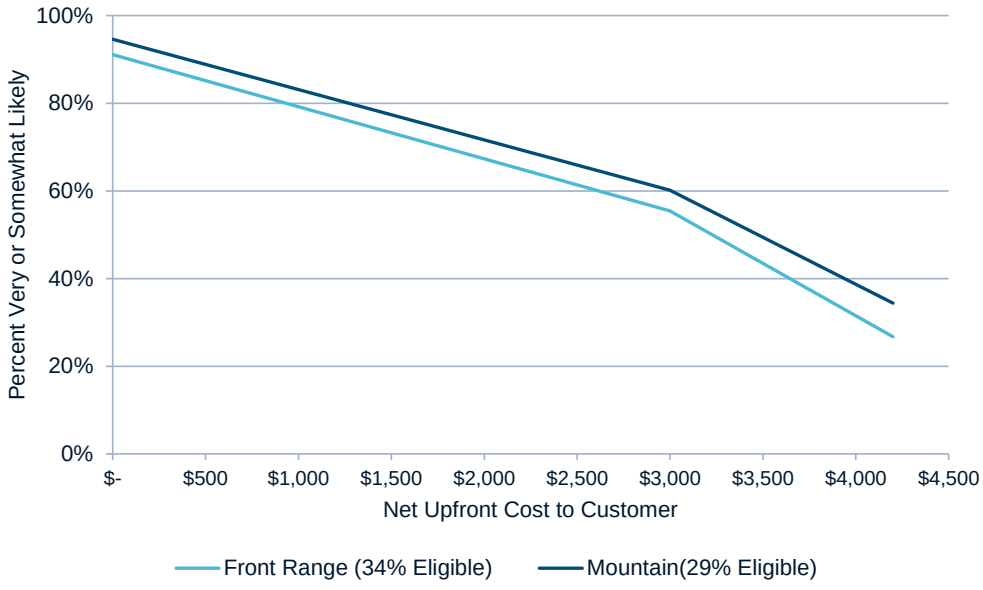
When asking about upgrading existing gas heating systems to a higher efficiency gas heating system, we tested three incentive levels ranging from 50% to 100% of costs. Figure 4-27 shows the likelihood of upgrading a heating system to a higher efficiency version assuming savings of $250 per year on the gas bill with nearly 100% interested at 100% incentives and under 40% interested at 50% incentives.

Figure 4-27: Likelihood to Upgrade Heating System to High Efficiency



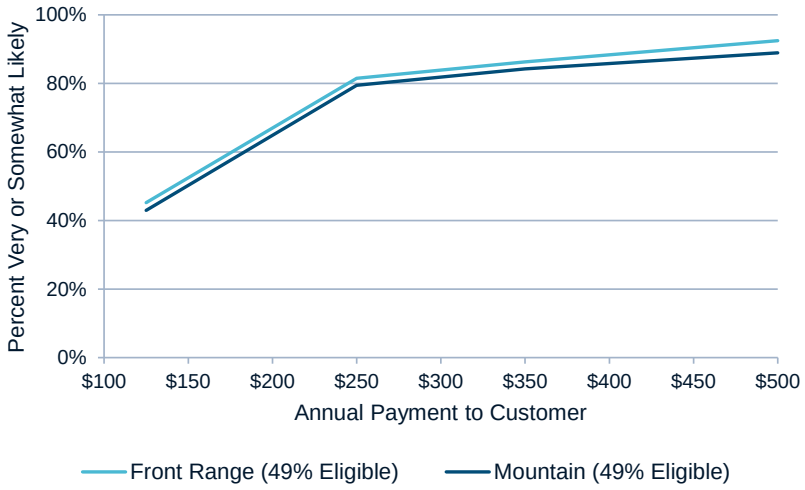
Since annual savings of a higher efficiency system can vary due to specifics of equipment purchased and replaced and variable gas costs, we also assessed likely participation if annual savings were higher. Figure 4-28 shows the likelihood of upgrading a heating system to a higher efficiency version assuming savings of $1,200 per year on the gas bill. The results are like those interested with lower annual savings indicating that uncertainty around annual savings do not significantly affect interest.

Figure 4-28: Efficient Furnace or Boiler with Increased Savings



The survey also tested interest in a possible thermostat adjustment program where the Company could automatically adjust settings by up to 4 degrees for up to 4 hours per day and up to 20 days per year. We tested four incentive levels ranging from $125 per year to $500 per year. Figure 4-29 shows those indicating likely participation in a thermostat adjustment program of slightly over 40% with payments of $125 per year, but up to around 90% with payments of $500 per year.

Figure 4-29: Likelihood of Adding Automatically Adjusting Thermostat



The next set of questions asked about possible water heat replacements. We tested three incentive levels ranging from 50% to 100% of the replacement costs. Figure 4-30 shows those indicating likelihood to replace a gas water heater with a heat pump at the same operating costs.

Figure 4-30: Likelihood to Replace Gas Water Heater with Heat Pump at Same Operating Costs

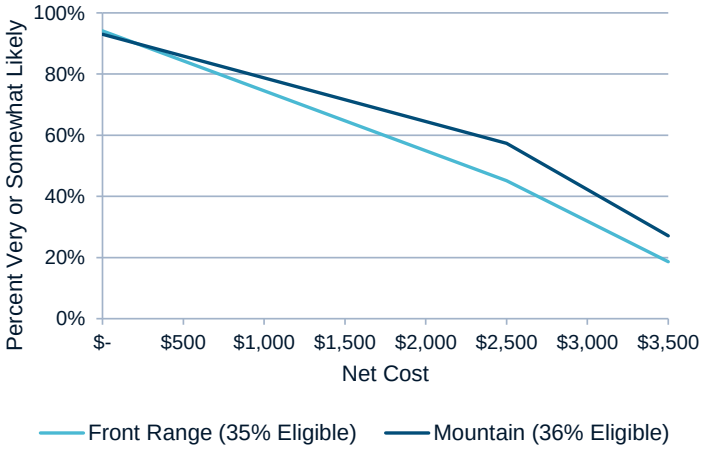
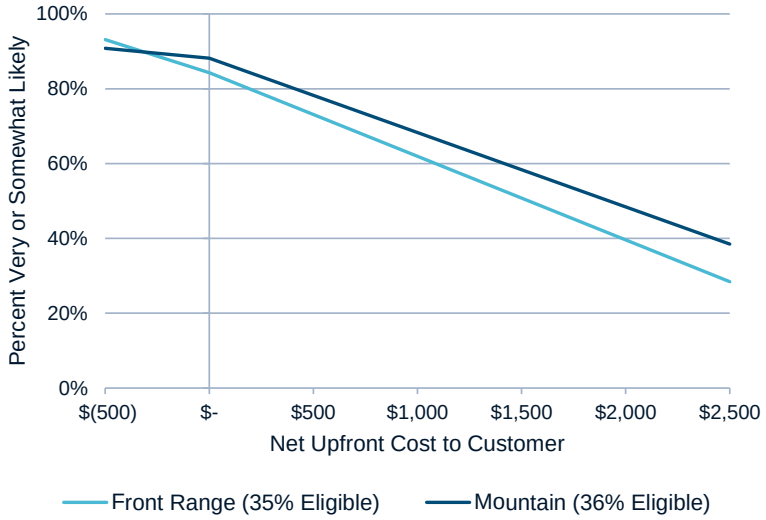


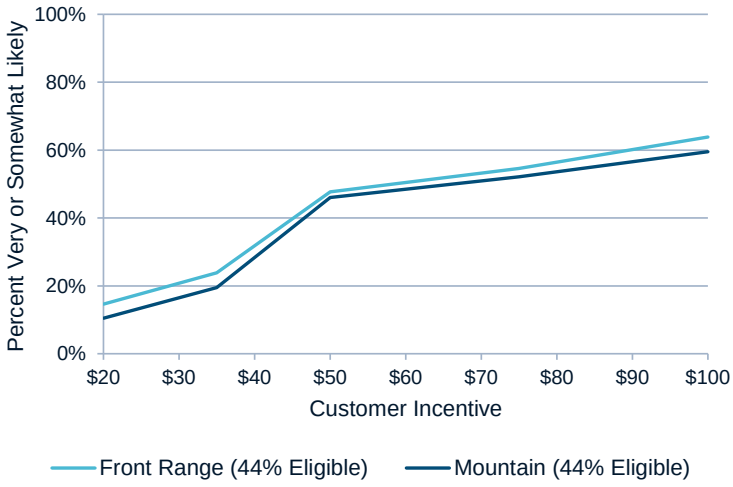
Figure 4-31 shows those indicating the likelihood of replacing a gas water heater with a heat pump assuming increased operating costs of $100 per year. We asked incentive levels of 50%, 100% and 120% of the full cost in incentives. Even with potentially higher operating costs, over 80% of respondents indicated a likelihood of participating with incentives of 100% or more.

Figure 4-31: Likelihood to Replace Gas Water Heater with Heat Pump at $100 Increase in Operating Costs



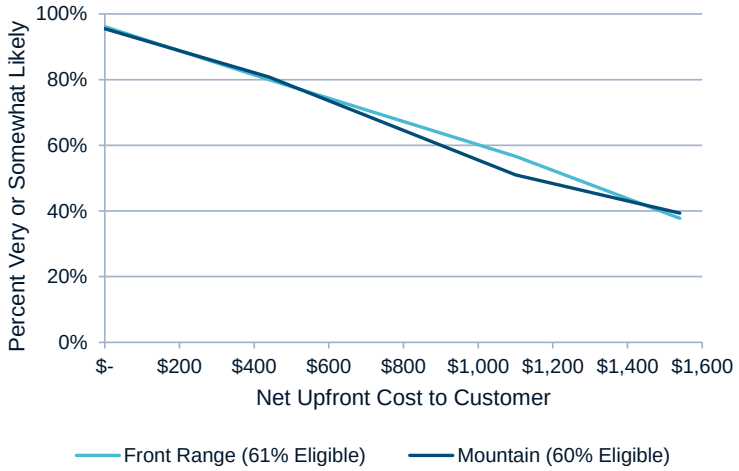
The survey asked about participation in a program that would cycle a hot water heater for up to 10 days per year. We tested four incentive levels ranging from $20 to $100 per year. Figure 4-32 shows those indicating participation likelihood of below 20% at $20 per month, to above 60% with a $100 per year incentive.

Figure 4-32: Likelihood of Adding Cycling Water Heater Device



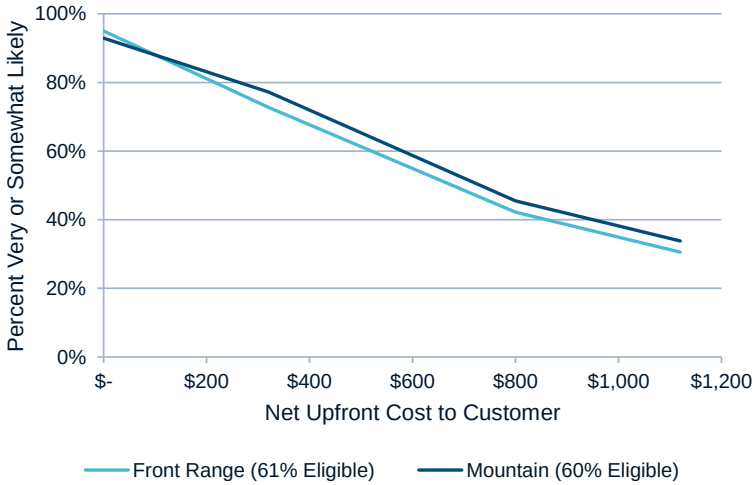
The survey asked about participation in insulation and air sealing with four incentive levels ranging from 50% to 100%. Figure 4-33 shows the shares of those indicating likelihood to participate in a program to add insulation and air sealing saving $120 per year which are over 90% at 100% of costs and drop to about 40% at 50% of costs.

Figure 4-33: Likelihood to Add Insulation and Air Sealing Saving $120 a Year



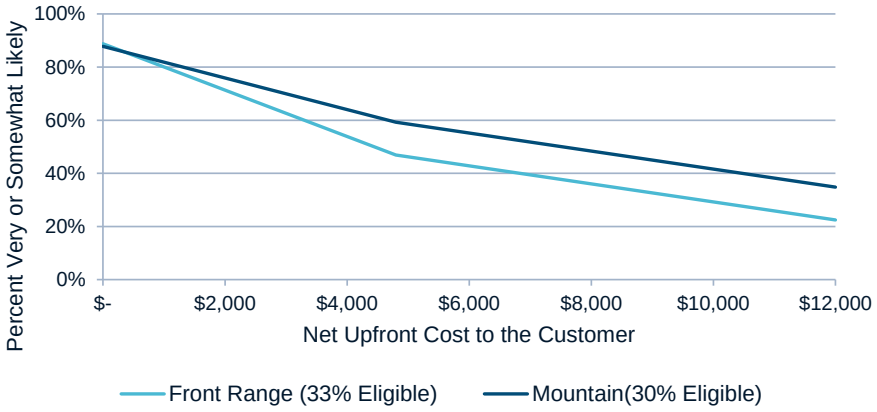
Because annual savings from insulation and air sealing can vary depending on levels installed, heating system settings, and gas prices, we tested interest in a program assuming lower annual savings than the previous question, of $35 per year. Figure 4-34 shows the shares of those indicating likelihood to participate in a program to add insulation and air sealing saving $35 per year is only slightly lower than when savings are $120 per year.

Figure 4-34: Likelihood to Add Insulation and Air Sealing Saving $35 a Year



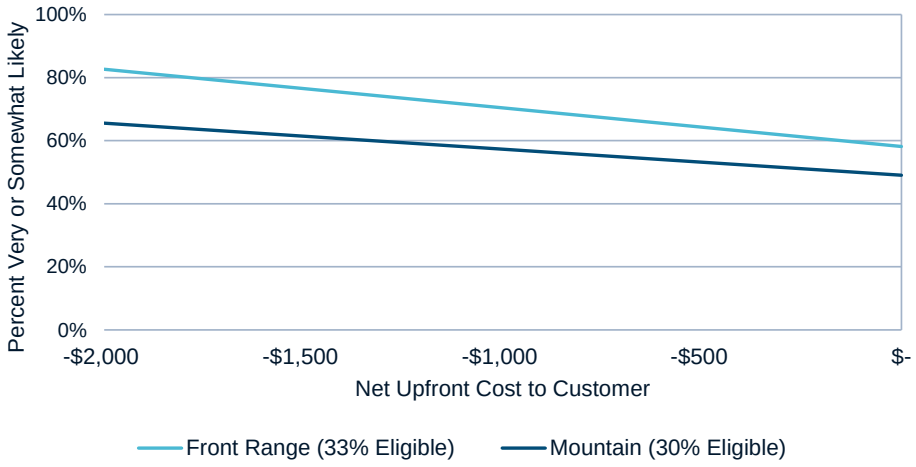
The next set of questions were asked test combinations of measures and operating costs. Figure 4-35 shows the shares of those indicating the likelihood to convert their home to electricity and increase air sealing and insulation while keeping the same annual energy bills. Participation drops significantly when the incentives are less than 100% of costs.

Figure 4-35: Likelihood to Convert Gas Plus Weatherization Same Heating Bill



As with other upgrades that involve fuel switching from gas to electricity, we tested the whole home conversion scenario while assuming a higher energy bill. Figure 4-36 shows the shares of those indicating likelihood to convert their home to electricity and increase air sealing and insulation while having a $1,000 per year higher energy bill. In this scenario, we only asked about 100% incentives and greater. About 50% of eligible mountain area customers would be likely participants if the incentive is designed to pay 100% of costs.

Figure 4-36: Likelihood to Convert Gas Plus Weatherization $1,000 Higher Energy Bill



Conclusions

Most mountain area homes use gas for both heat and water heat. Gas stoves and gas fireplaces are also common. Most of the survey respondents are not familiar with the Company's programs, with mountain area customers being less familiar than front range area customers. Mountain area customers have some barriers to participation compared to other Company service territories, including a higher percentage of customers that are absentee owners. However, mountain area customers are more likely to own their homes and have higher education and income levels which makes them more likely to participate. Initial interest for participating in programs to reduce gas use varied by end use, with those willing to add insulation and air sealing being highest at 60% and those willing to convert their heating system to heat pump the lowest at 29.9%. The interest was slightly higher in mountain areas than front range. Of those expressing an initial interest, over 90% would be likely to convert if the incentive paid for the entire amount of the upgrade and that percentage dropped significantly as the incentive levels decreased. Differences between the mountain and front range respondents in terms of their likelihood at different incentive levels were small.

4.5.3 Commercial Customer Survey

The PA team conducted a survey of a random sample of the Company's commercial customers, segmented by gas usage (high and low categories) and area as defined as the Primary NPA area (Breckenridge, Keystone, and Grand Lake) and Secondary NPA area (remaining affected mountain areas. We designed the survey to assess business characteristics, use of gas fueled equipment, and interest in equipment upgrades and different incentive levels. We recruited businesses through email and telephone outreach and offered a $50 gift card incentive to complete a web-based survey. We received response rates as shown in Table 4-14. With these response rates, the results have confidence and precision of 90% +/- 10% for the survey overall. A copy of the survey instrument is included in Appendix 6.3.

Table 4-14: Commercial Survey Response Rates

Category	Population	Completes
High Use	61	6
Primary NPA Low Use	536	23
Secondary NPA Low Use	795	37
Total	1392	66

4.5.4 Commercial Customer Survey Results

We gathered firmographic information about each surveyed business. Figure 4-37 shows the distribution of responses by the primary business type at the facility indicating that businesses in the mountain areas represent a diverse array of business types.

Figure 4-37: Primary Business Activity (n=66)

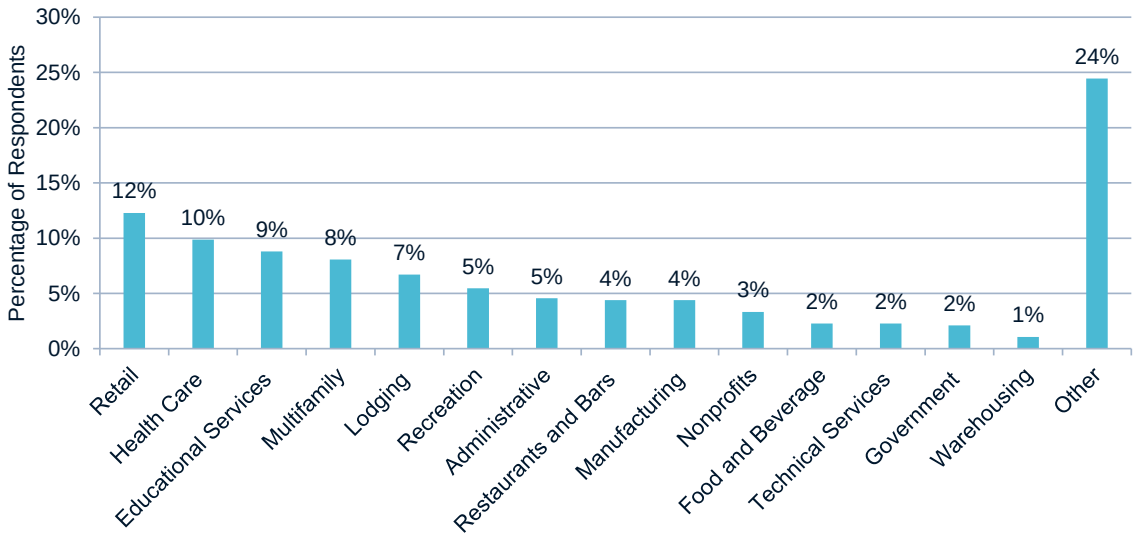


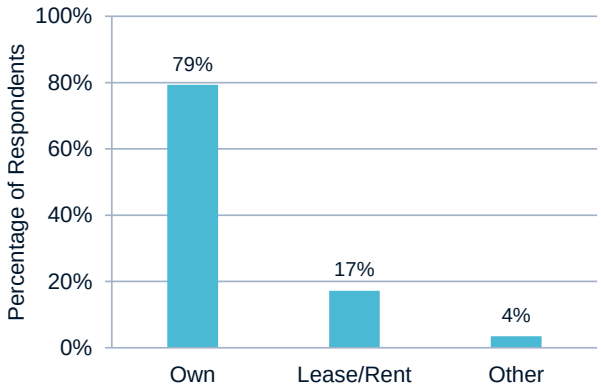
Table 4-15 shows the average building square footage in each of the segments sampled and for the sample.

Table 4-15: Square Footage of Building (N = 47)

Category	Number of Responses	Average Square Footage
Secondary NPA Low Use	28	10,444
Primary NPA Low Use	16	10,103
High Use	3	25,756
Weighted Average		15,375

Since buildings that are owned by the users tend to invest more in the building, we asked each respondent whether they owned or rented the building. Figure 4-38 shows the owner and renter shares of respondents.

Figure 4-38: Owning vs. Renting Rates (n=66)



To understand operating hours, we asked respondents about what days of the week they are open. Figure 4-39 shows the shares of businesses open on each day of the week, with a high percentage open every day.

Figure 4-39: Days of Week Building is Open (n=66)

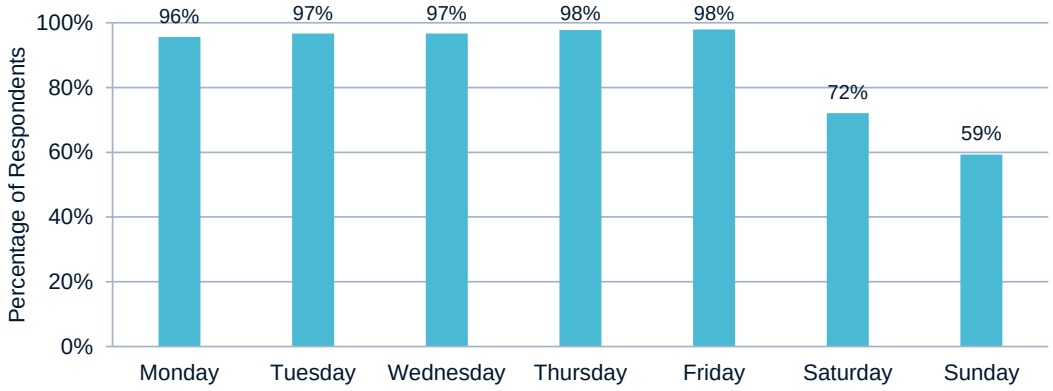
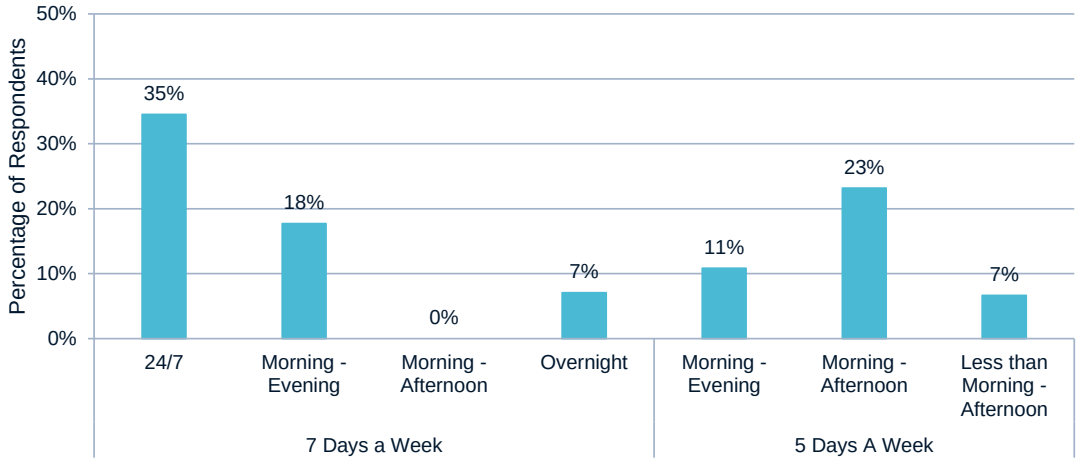


Figure 4-40 shows the distribution of operating hours among survey respondents.

Figure 4-40: Times of Facility Occupation (n=55)



Because businesses often have multiple buildings, may have centralized decision making, as well as unique situations of how their energy use is managed and paid, we asked customers how many buildings their business covered. When marketing programs to businesses, is it important to understand the organization structure of the business. Figure 4-41 shows the distribution of multiple facilities that were represented by the survey respondent. Slightly over half are single facilities where the remainder have multiple buildings.

Figure 4-41: Facility Description (n=66)

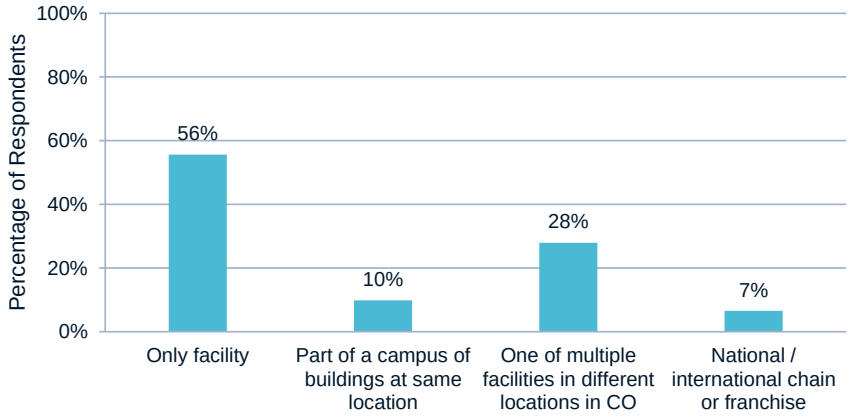


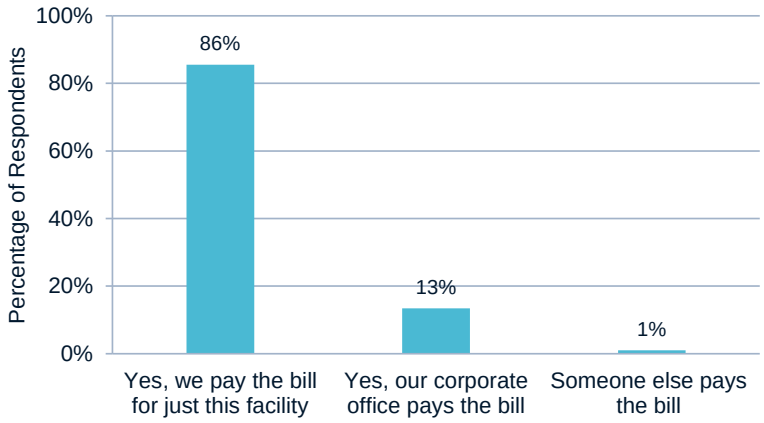
Table 4-16 shows the number of survey respondents in each area that indicated they represent multiple facilities and the average number of facilities represented.

Table 4-16: Multiple Facilities if More Than One (n=24)

Category	Number of Responses	Average Number of Facilities
Secondary NPA Low Use	12	2.75
Primary NPA Low Use	8	2.25
High Use	4	29

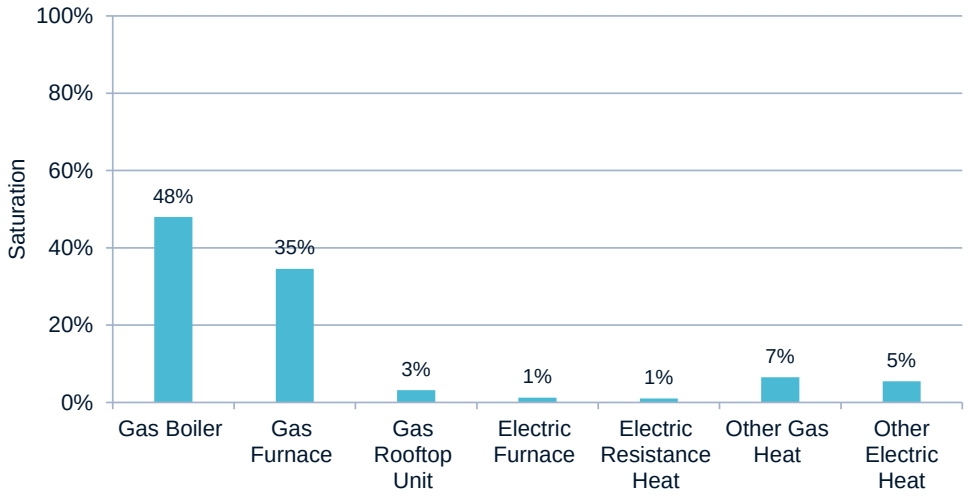
Customers that pay their own bill for a facility are more likely to engage with local programs. Figure 4-42 shows that 86% of respondents pay their own energy bills versus a corporate office or a landlord or other entity.

Figure 4-42: Who Pays the Bill? (n=66)



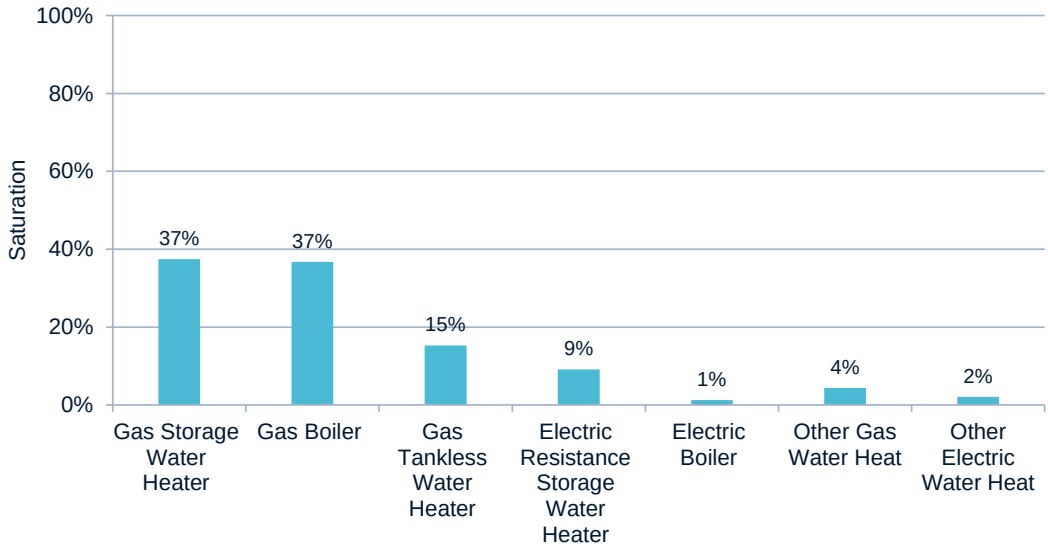
As we expected that heating load would be the most significant opportunity for peak day gas savings, we asked respondents about their primary heating source. Figure 4-43 shows the distribution of primary heat source for each respondent. The overwhelming majority are types of gas systems.

*Figure 4-43: Primary Source of Heat (*n=66)



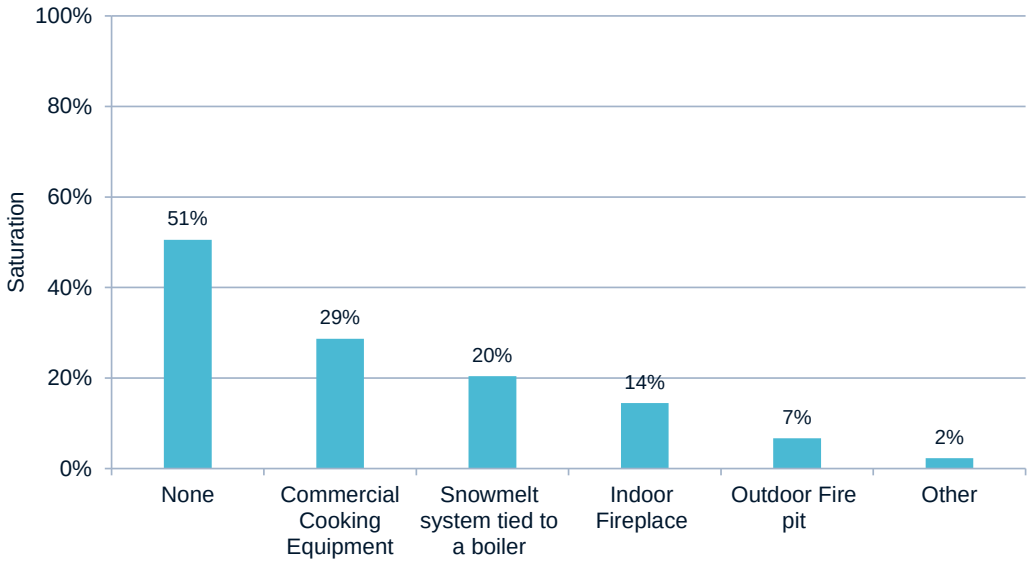
As water heating may also contribute significantly to peak gas consumption, we asked customers about their type of water heating system. Figure 4-44 shows the distribution of primary water heating types for each respondent. The overwhelming majority are fueled by gas.

*Figure 4-44: Types of Water Heating (*n=66)



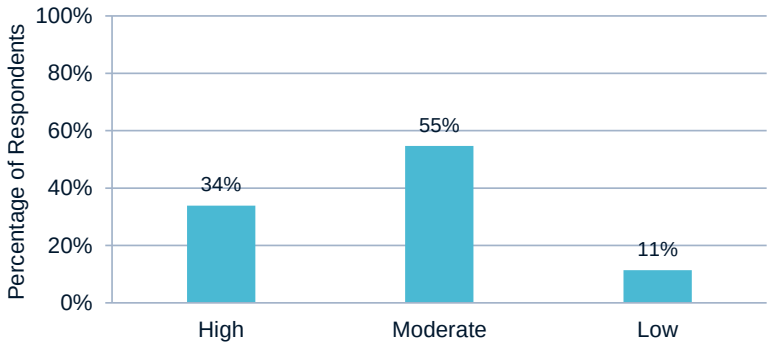
To assess any additional opportunities for savings peak gas use, we asked customers to identify additional gas fueled equipment in their building. Figure 4-45 shows the distribution of other gas fueled equipment.

Figure 4-45: Natural Gas Fueled Equipment (n=66)



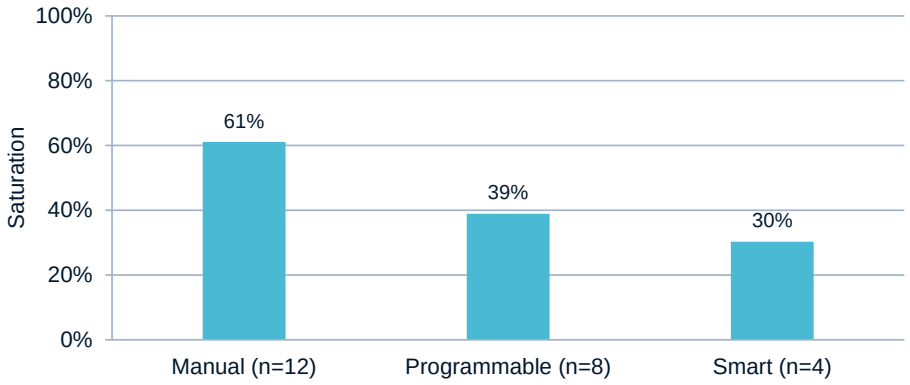
Insulation and air sealing may offer opportunities for gas savings, and we asked respondents to describe how well they believe their facility is insulated. Figure 4-46 shows customer responses to a question about their perceived level of insulation and air sealing.

*Figure 4-46: Insulation Levels (*n=65)



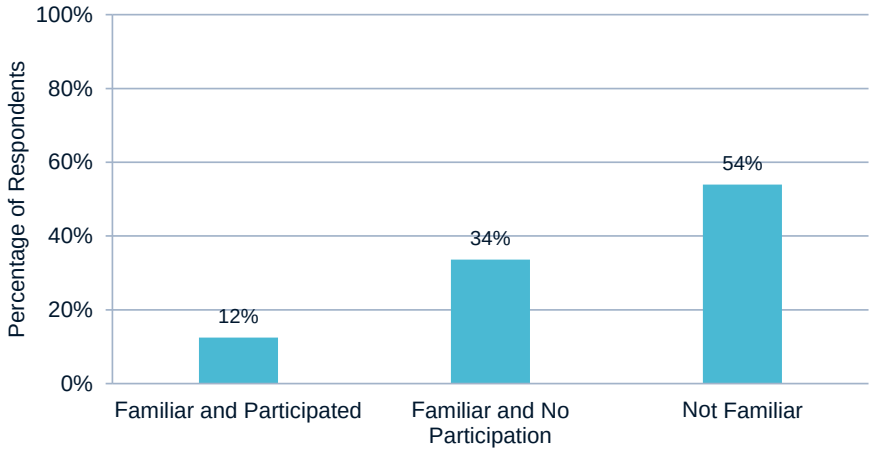
To assess opportunities for thermostat control, we asked customers about what types of thermostats are installed in their building. Figure 4-47 shows responses with the majority having manual thermostats.

Figure 4-47: Types of Thermostats (n=20)



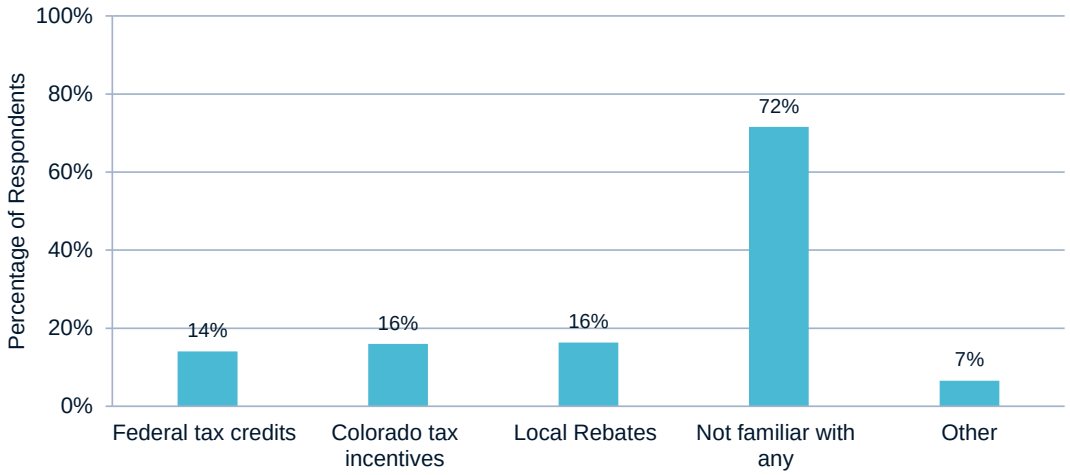
To assess the current understanding of mountain area commercial customers of the Company's programs, we asked their familiarity and levels of past participation. As shown in Figure 4-48, only 12% have previously participated and over half are not familiar with any programs.

Figure 4-48: Familiarity with Company Programs (n=65)



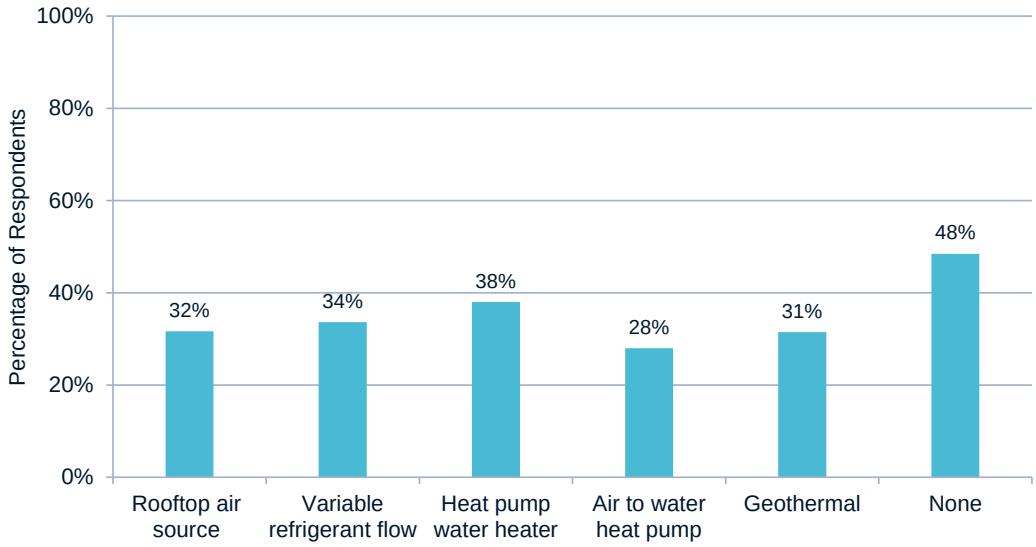
To assess whether respondents actively seek opportunities for energy reducing incentives, we asked customers about their familiarity with other types of incentives for EE. Figure 4-49 shows that most customer (72%) are not familiar with any other incentives.

Figure 4-49: Familiarity with Other Incentives (n=65)



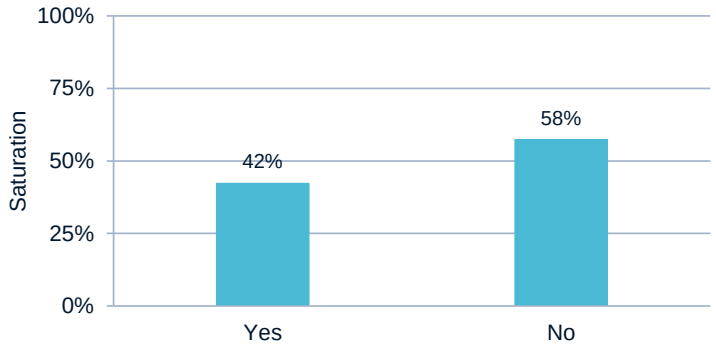
The survey asked respondents about their familiarity with different types of heat pumps to provide context about future interest in incentives for heat pumps. As shown in Figure 4-50 about half of respondents have no familiarity with any type of heat pump.

Figure 4-50: Heat Pump Familiarity (n=66)



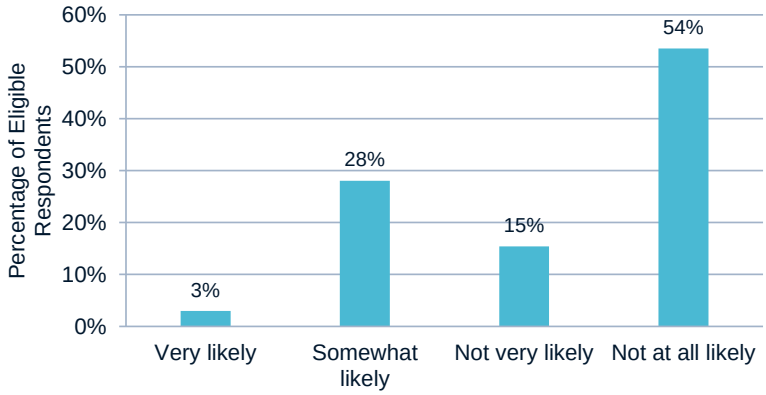
Since one of the benefits of heat pumps is the ability to provide air conditioning as well as heating, the survey asked whether the business currently has air conditioning. As shown in Figure 4-51 only 42% of respondents currently have air conditioning.

Figure 4-51: Air Conditioning System Presence (n=65)



We also asked businesses if they would be likely to add air conditioning if they were replacing their heating system. This could be a selling point for heat pumps that provide both heating and air conditioning. As shown in Figure 4-52, 32% of respondents are very or somewhat likely to consider air conditioning if they were also upgrading the heating system.

Figure 4-52: Likelihood of Adding Air Conditioning When Upgrading Heating System (n=43)



The next set of questions asked whether the respondent would be very or possibly interested in participating in different types of programs to reduce gas use. Figure 4-53 and Figure 4-54 show the results of these initial interest questions for a variety of equipment options.

Figure 4-53: Interest in Participating

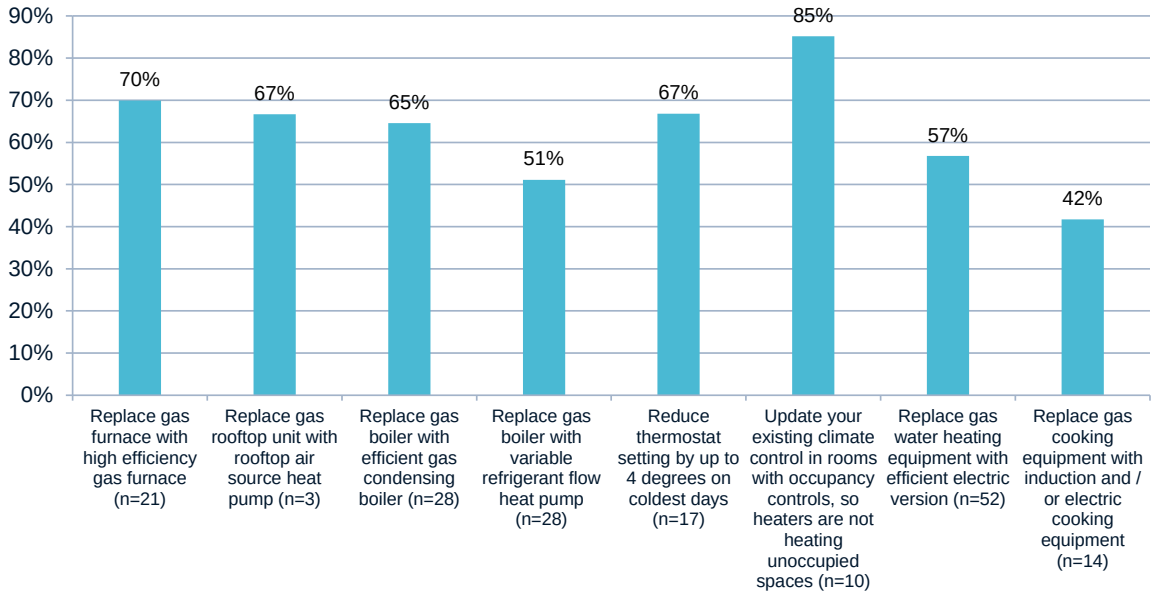
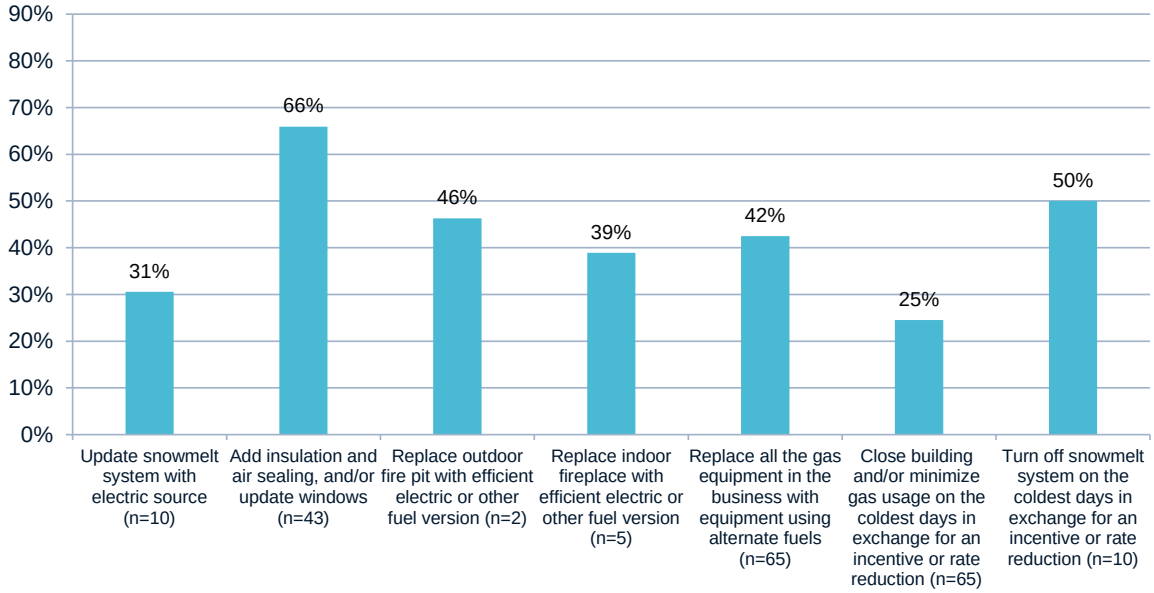


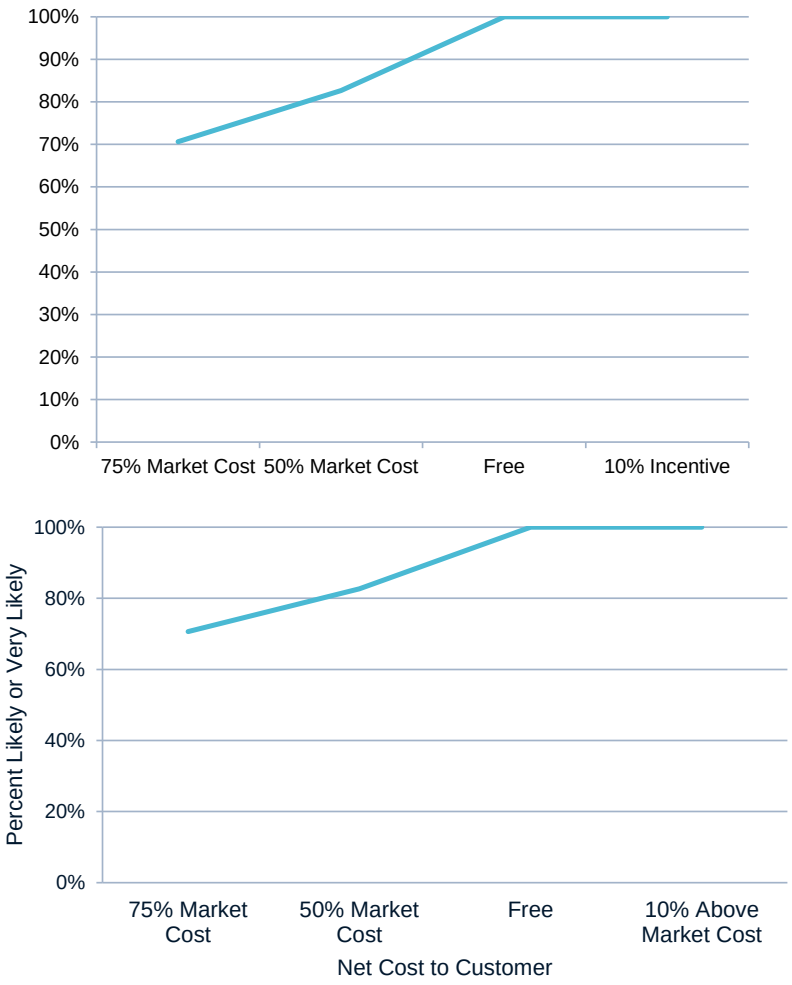
Figure 4-54: Interest in Participating (continued)



For the next set of figures, any respondent that expressed an interest in participating in a particular opportunity was asked more specifics about what percentage of the cost would need to be covered by a program to achieve their participation assuming different operation costs. For each of these opportunities we tested a variety of cost sharing arrangements from incentives equaling 25% to over 100% of the expected costs. This allowed us to assess the sensitivity of participation to incentive levels.

Figure 4-55 shows the share of respondents likely to convert their heating equipment to electric if they paid the portion noted on the x-axis and annual operating costs did not change.

Figure 4-55: Gas Heat Conversion to Heat Pump (n=46 facilities)



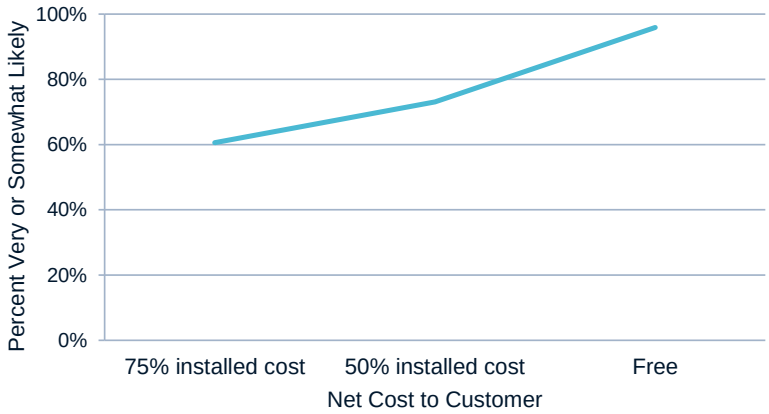
When converting gas equipment to electricity, the change in operating costs is uncertain and dependent on operation characteristics and the relative price of fuels which can vary significantly. For this reason, we tested the heating system conversion at different operating costs. Figure 4-56 shows the share of respondents likely to convert their heating equipment to electric if they paid the portion noted on the x-axis and annual operating costs increased by 5%. When the incentives equal the costs, operating costs do not appear to significantly affect participation levels.

Figure 4-56: Gas Heat Conversion to Heat Pump with Cost Increase (n=27 facilities)



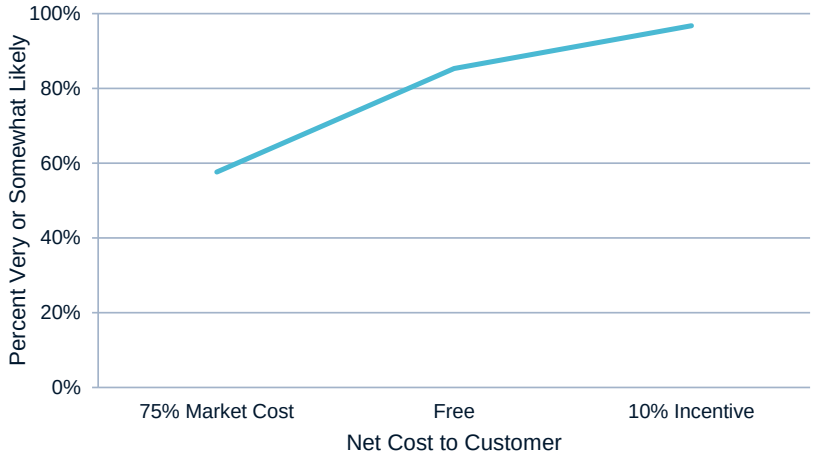
Figure 4-57 shows the share of respondents likely to convert their water heating equipment to electric if they paid the portion noted on the x-axis and annual operating costs stayed the same.

Figure 4-57: Water Heating Conversion from Gas to Heat Pump (n=40 facilities)



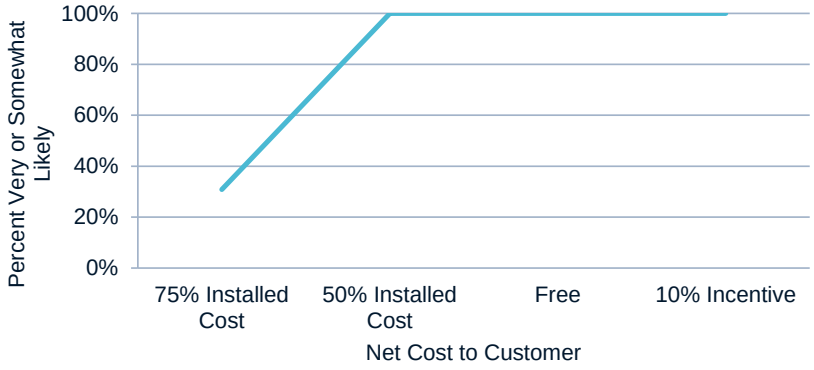
Because operating costs can vary depending on operation characteristics and the relative costs of different fuels, we tested the participation likelihood assuming annual operating costs increased by 5%. Figure 4-58 shows that when the incentive is more that 100% of the costs, the operating costs do not significantly affect likelihood of participation.

Figure 4-58: Water Heating Conversion from Gas to Electric with Cost Increase (n=39 facilities)



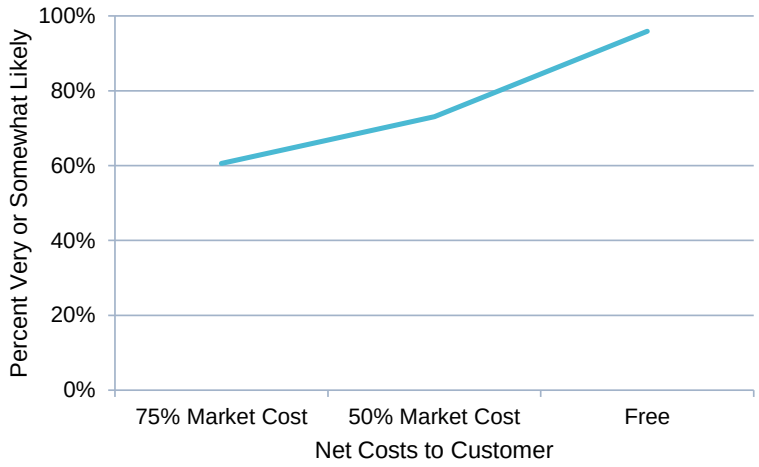
The survey asked the small sample of respondents with snowmelt systems about their likelihood to participate at incentives ranging from 25% to 110% of the expected costs. As shown in Figure 4-59 all four respondents were somewhat or very likely to participate at incentives equal to 50% of the installed cost or more when operating costs are the same.

Figure 4-59: Snowmelt System Conversion (n=4 facilities)



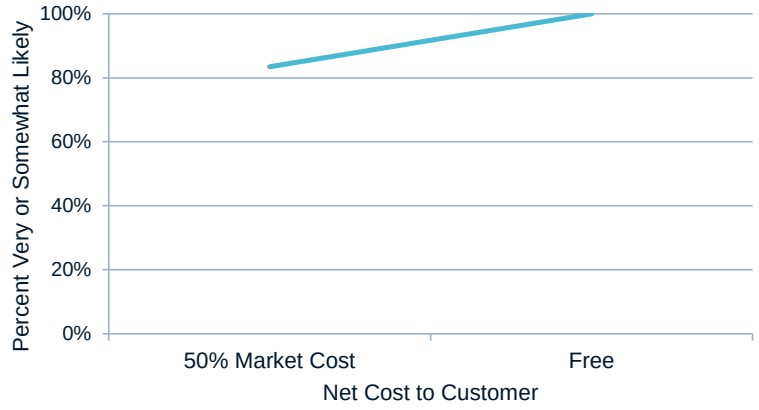
Because operating costs may vary when changing fuels due to operational characteristics and variations in relative cost of the fuels, we tested respondents interest levels assuming an increase in operating costs. As shown in Figure 4-60 the share of respondents likely to convert their snow melting equipment to electric when operating costs increase is lower than when operating costs are the same.

Figure 4-60: Snowmelt System Conversion with Cost Increase (n=4 facilities)



The survey tested likelihood of participation at two different incentive levels for insulation and air sealing assuming a payback period of 5 years. As shown in Figure 4-61 the share of respondents likely to add insulation and air sealing if they paid the portion noted on the x-axis is 80% at a 50% incentive and 100% if the incentive is 100%.

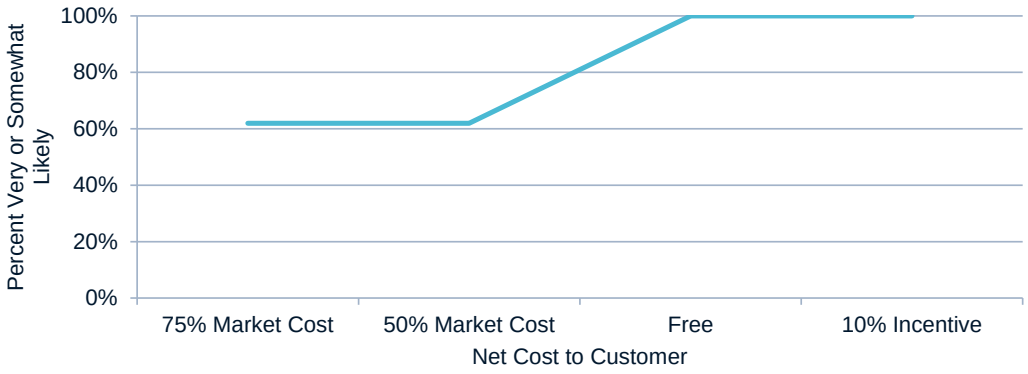
Figure 4-61: Add Insulation and Air Sealing (n=4 facilities)



The survey asked about likelihood of participation in converting gas cooking equipment under two scenarios of operating costs (assuming the same operating costs and assuming higher operating costs after conversion) and at incentive levels ranging from 25% incentives to 110% of the costs paid (10% incentive).

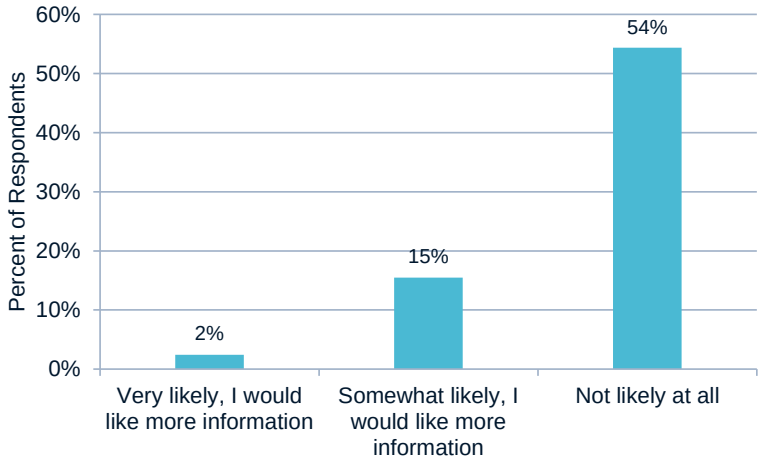
Figure 4-62 shows the share of customers likely to convert their gas cooking equipment to electric if they paid the portion noted on the x-axis and annual costs stayed the same.

Figure 4-62: Gas Cooking Conversion to Electric (n=16)



The survey asked respondents about their interest in learning more about a whole building interruptible program that would allow the Company to interrupt their service on peak gas load days. Figure 4-63 shows that only a small share of respondents showed interest in learning more about being on an interruptible rate.

Figure 4-63: Interest in Interruptible Rate (n=65)



Conclusions

Most mountain area business respondents use gas for both heat and water heat, while 29% have gas cooking and fewer have other types of gas equipment. Most of the survey respondents are not familiar with the Company's programs. Barriers to program participation for businesses include when they have non-local decision makers, lease their space, or do not pay their own energy bill. Less than half of the respondents have these barriers. Business types in the mountain areas were diverse as was the applicability of certain upgrades. Adding vacancy controls to heating systems was popular among lodging facilities while adding insulation and air sealing was popular among most businesses. Converting natural gas cooking was less popular. Of those expressing an initial interest, most respondents indicate a likelihood of converting if the incentive paid for the entire amount of the upgrade and that percentage dropped significantly as the incentive levels decreased.

4.5.5 Contractor/Builder Interviews

The PA team conducted qualitative interviews with a sample of the Company's mountain region program trade partners. The goal of the research efforts was to understand the current familiarity and experience with heat pumps, challenges they see, and assess the number of incentives, marketing and training that would be required to implement a successful electrification program. We screened the Company's database for contractors that work in heating, ventilating and air conditioning systems along with builders that work in the mountain areas. We received responses as shown in Table 4-17. We conducted the interviews using by experienced energy research staff via telephone and offered $50 gift card incentives for a completed interview. A copy of the interview guides are included in Appendix 6.4.

Table 4-17: Sample Disposition and Characteristics

Category	Builders (N)	Commercial Contractors	Residential Contractors
Qualified Sample	19	16	18
Non-eligible (contact error)	4	0	1
Refused	3	1	0
Complete	3	4	3
Response Rate	20%	25%	18%

4.5.6 Contractor/Builder Interviews Results

For builders, the PA team asked questions around familiarity with electric technologies for heating and water heating, the challenges in building all-electric homes, role of incentives, and the role of marketing. For contractors, we asked questions to understand the contractor's current knowledge and engagement with heat pumps, identify shared traits among customers that decide to use electric equipment, understand the customer decision and contractors influence in adoption of new technologies, and identify incentive needs and opportunities if the Company were to pursue a program to convert gas equipment to electricity.

Familiarity and Experience

All builders and contractors indicated they were familiar with heat pumps. Only 4 of 10 have installed heat pumps for heating in at least one application, while 6 of 10 have installed heat pump water heaters in at least one application. Buildings and Contractors had mixed experience with the technologies:

- 1/10, a residential contractor is a proponent of heat pumps for heating but not water heating, 2 residential contractors had a bad experience and refuse to work with them now
- 2/3 Residential builders believe there are no heat pump alternatives to boilers
- 6/10 Concern it won't work at low temps, fear of customer complaints, maintenance, and longevity unknowns.
- 6/10 Concerned about skilled workforce and lack of knowledgeable and capable installers
- 6/10 state that customers want gas, decision already made, or customer needs to replace like for like
- 6/10 believe installation is more expensive due to involvement of additional trades (electrical + plumbing, maybe drywall for retrofits)
- 3/10 believe water heaters are too noisy and may pump unwanted cold air into space

Customer Interest

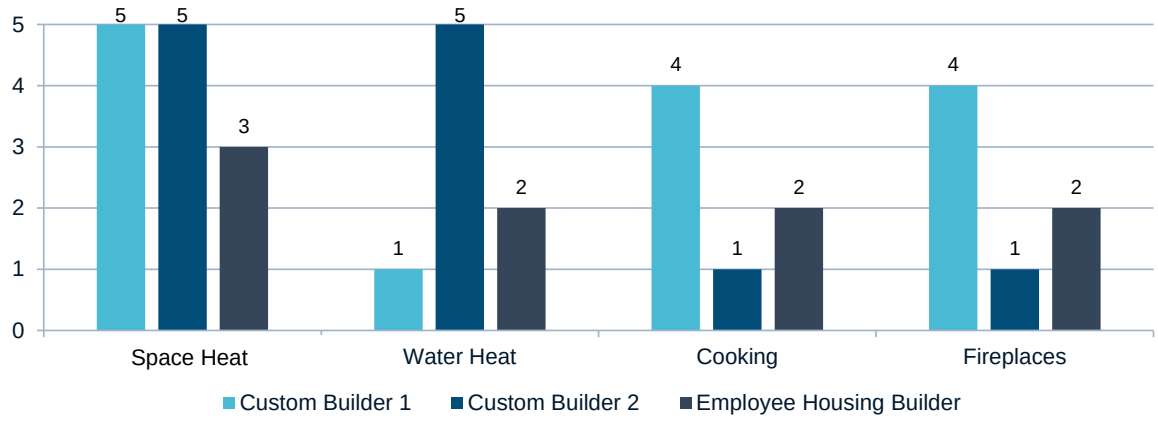
Contractors and builders report having seen customer interest increase over the past three years (7/10). One commercial contractor indicated they had only seen interest in water heaters, and one residential contractor said they had only had interest in new construction, but not retrofit. When asked when they would recommend heat pumps to customers the following responses were provided:

- 3/10 If cost effective - new construction or retrofit with an existing ducted system and have a backup electric baseboard or backup wood stove, dual fuel natural gas furnace with a coil can also be a heat pump. One stated “simpler systems” such as where a customer wants to cool one room.
- 5/10 “If customers asked, I would consider / become educated.”
- 1/10 Never at high altitude
- 1/10 Never when converting existing gas systems due to higher installation and operating costs
- 1/10 Noted life expectancy of a heat pump is longer than natural gas system

Ease of Selling

The three builders were asked about customer interest in going electric by end-use. Figure 4-64 shows the response of each builder. The most favorable opportunity was space heating, while cooling and fireplaces were least favorable.

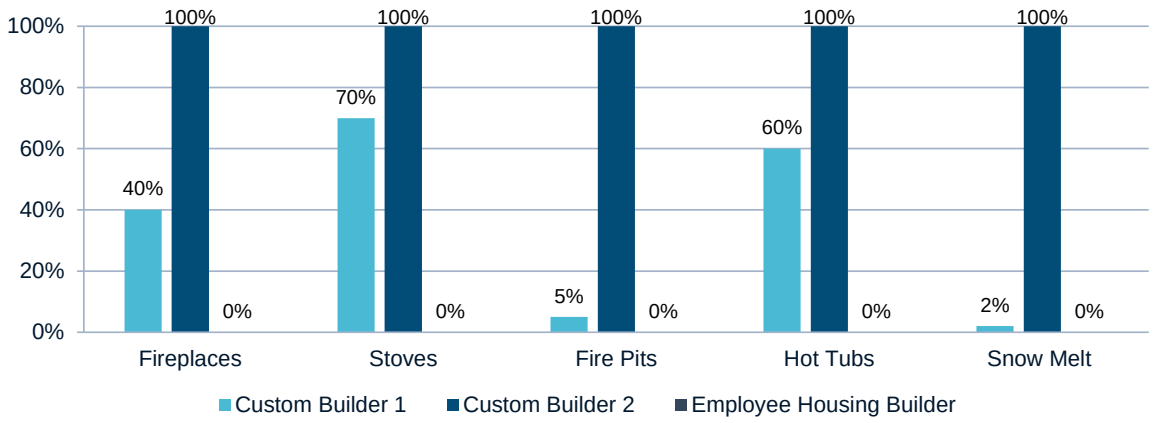
Figure 4-64: Perception of Builders – Ease of Selling Electric Homes by End-Use



Current New Construction Practices

The three builders also reported how often they install different types of gas end-uses. As shown in Figure 4-65, the two custom gas builders most often install multiple gas end-uses beyond heating and water heating.

Figure 4-65: Builder Experience – Typical Gas End-Uses Installed



Incremental Costs

Builders and Contractors all perceive an increased cost to go electric over gas. The responding builders noted that the installation requires both an electrician and a plumber, but doesn't involve drywall, which is likely required for a retrofit. A couple of respondents also reported specifics:

- One contractor said a 5,000 square foot home would require $16,000 to $20,000 to install a gas boiler, and $24,000 for a heat pump system.
- Another contractor said a boiler is $10,000 to $15,000 and a heat pump would be $15,000 to $20,000

Two contractors gas estimates for differences in water heater to heat pump water heater costs, one offered an estimate of $600 and the other was $5,000.

Role of Incentives

The contractors and builders were asked whether they are aware and if they believe customers are aware of the existing and upcoming federal incentives for heat pumps along with any state or local incentives.

- One commercial and 3 residential contractors are aware of local and upcoming federal incentives for heat pump technology. Six of 10 were confident in their knowledge and reported they look up specifics when requested by clients.
- Builders believe about half of their clients are aware of incentives.
- One residential contractor believes customers are aware of local and federal incentives for heat pumps, but the remainder were unsure.

When asked what types of incentives contractors and builders thought it would take to encourage customers to convert to heat pumps, 6 responded as follows:

- 3/6 believe 100% incentive
- 1/6 believe 75% incentive
- 2/6 believe 50% incentive

Most Likely to Participate

We asked contractors and builders what types of customers would be most likely to participate in a program to convert to heat pumps. Responses were as follows:

- 5/10 those with existing climate concerns and a desire to lower emissions
- 3/10 Sophisticated and educated regarding the technology
- 2/10 Interested in lowering their energy bill over time
- 3/10 Wealthy, 40's with kids, new construction
- Those interested in reducing climate impacts (ski resorts, box stores), employee housing, or those with local government requirements
- New construction
- Least likely: convenience stores and food service.

Trade Partner Needs

We asked contractors and builders about what they need to be "ready" to promote electrification to their customers. The key themes we heard through the interviews were that they would need more trust in the technology, have the incentives and process to receive them be simple, and be provided marketing templates to assist them in marketing the technology. Trade partners felt that having distributors and manufacturers and architects driving education and technology applications would improve their trust. They also mentioned needing assistance in recruiting and training a workforce skilled with heat pumps or other new technologies. The partners indicated that a fixed rebate amount is simple and prefer those over rebates that require detailed calculations to determine the amount. The trade partners were flexible on whether the rebate is paid to a supplier or installer or end user. Around marketing some contractors requested ideas for print, web, and radio advertising and would appreciate direct marketing from the Company through emails and bills as well through other advocacy groups such as High Country conservation.

Conclusions

Builders and contractors reported low familiarity and low trust of heat pumps. They are concerned about the opportunity to completely displace gas heating due to high altitudes and cold mountain temperatures. Respondents believe that both upfront costs and operating costs are higher with heat pumps because installations are more complicated and require more types of trades (electrician, plumbers, and drywallers). The interviews indicated that significant training and preparation of market structure will be needed as manufacturers, distributors, and architects will need to lead the contractors and builders to choose new electrification technologies.

4.6 Estimating DSM Potential

Using the measure-level savings estimates and inputs from the customer and contractor research, the PA team assessed the potential of each NPA measure/technology in three categories:

- ***Technical potential* –** the theoretical maximum amount of energy use that could be displaced, disregarding all non-engineering constraints such as cost effectiveness and the willingness of end users to adopt the EE measures.
- ***Economic potential* –** subset of technical potential that is economically cost effective.
- ***Achievable potential* –** subset of economic potential that further limits potential by taking into consideration market of programmatic barriers or constraints such as program budget caps or implementation issues.

The DSM potential estimates were created for the entirety of the Mountain System, allowing for implementation plans to treat more or less of the Mountain System, depending on the results and cost-effectiveness of measures implemented in specific geographic areas.

4.6.1 Technical Potential

The technical potential describes the maximum demand reduction that is possible at each constraint point. Technical potential does not factor in economic constraints, customer preference, or market ability to deliver a technology and thus should not be used in setting policy. The technical potential shown in this section does not include technical potential for LDC customers but does include transport customers.

To estimate the demand reduction that can be achieved at a pipeline constraint point there are two important factors to consider; 1) How much reduction in peak demand is achieved at the point of the customer, and 2) how much reduction is achieved at the point of constraint.

Accounting for the reduction based on geography, the team assessed the technical potential that could be delivered at each constraint point. Table 4-18 shows the top ten measures for technical potential. The measure level technical potential below is shown before competition of measures. I.e., the technical potential shown below is for each measure in isolation. The top ten measures with the highest technical potential were all either heating system upgrades or building envelope efficiency measures.

Table 4-18: Top Ten Technical Potential Measures in 2033

Sector	Measure Name	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)
Residential	Ground Source Heat Pump	1,123.0	390.5	57.2
Residential	Boiler Electrification with ccASHP	556.9	193.7	28.4
Residential	Furnace Electrification with ccASHP	556.6	193.6	28.4
Commercial	ASHP	335.7	115.0	3.8
Commercial	Ground Source Heat Pumps	223.8	76.7	2.5
Commercial	VRF	208.0	71.3	2.4
Residential	Gas Furnace Replacement	128.6	44.7	6.6
Residential	Air Sealing	112.6	39.1	5.7
Commercial	Commercial Wall Insulation	111.2	38.1	1.3
Commercial	Commercial Windows	108.5	37.2	1.2

Table 4-19 and Table 4-20 show the technical potential for each measure category and in total for residential and commercial, respectively. A single inefficient piece of equipment may have multiple efficient technologies that could replace that equipment. For example, a residential furnace could either be replaced by an all-electric air-source heat pump, or by a more efficient gas furnace. To calculate total technical potential, the efficient measure with the highest gas savings is used to estimate potential (in the prior example, that would be the air-source heat pump since it displaces all gas usage). A competition group is the concept of selecting a single efficient measure from a group of possible measures that will replace an inefficient measure. Total technical potential for the residential and commercial sectors is shown after competition. Note that the gas equipment has a technical potential of 0.0. This is because the equipment could technically be electrified, which saves more gas than a gas equipment replacement. An additional caveat is that the total technical potential does not consider interactive effects between shell measures and electrification.

Table 4-19: Residential Technical Potential by Measure Category After Competition in 2033

Measure Category	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)
Electrification	1,149.6	399.8	58.7
Building Shell	267.8	93.1	13.6
DR	38..2	13.1	2.1
Behavior	5.7	2.0	0.3
Whole Building	4.5	1.6	0.2
Water Saving	0.3	0.1	0.0
Gas Equipment	0.0	0.0	0.0
Gas Equipment Tune Up	0.0	0.0	0.0
Thermostat Retrofit	0.0	0.0	0.0
Total	1,466.0	509.6	74.9

Table 4-20: Commercial Technical Potential by Measure Category After Competition in 2033

Measure Category	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)
Electrification	552.8	189.7	6.3
Building Shell	277.1	94.9	3.1
DR	23.2	7.6	0.3
Gas Equipment	0.0	0.0	0.0
Total	853.0	292.2	9.8

Technical potential is slightly higher than the total peak hour consumption in the NPA region because the technical potential is shown for 2033, where estimates on consumption are derived from customer data from 2022. Additionally, a customer cannot achieve peak gas savings from installation of electrification, DR, and shell measures simultaneously.

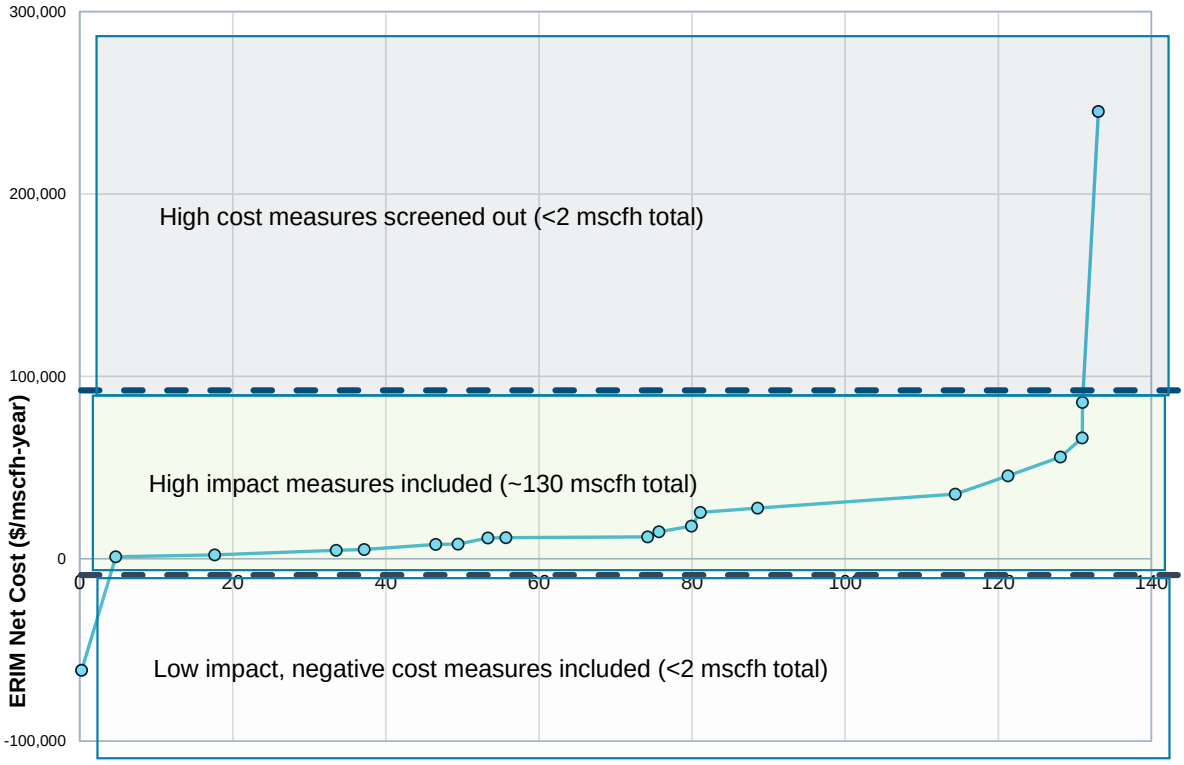
4.6.2 Economic Supply Curves

To evaluate the economic viability of measures, the PA team estimated cost-effectiveness and modeled overall potential at each constraint point for each geography for each measure. The team chose to evaluate cost effectiveness using a modified Residential Impact Test (RIM) test, “ERIM”, that included the economic value of carbon reduction in addition to the standard elements in a RIM test.[9]

These results were stacked to make a supply curve. The supply curve for the Breckenridge constraint is shown in Figure 4-66. The other areas have almost the exact same supply curve, so only one is presented here.

[9] The standard ratepayer impact measure (RIM) evaluates the impact of intervention on utility rates. It includes avoided costs for both the gas and electric system, program overhead, incentives, and lost revenue.

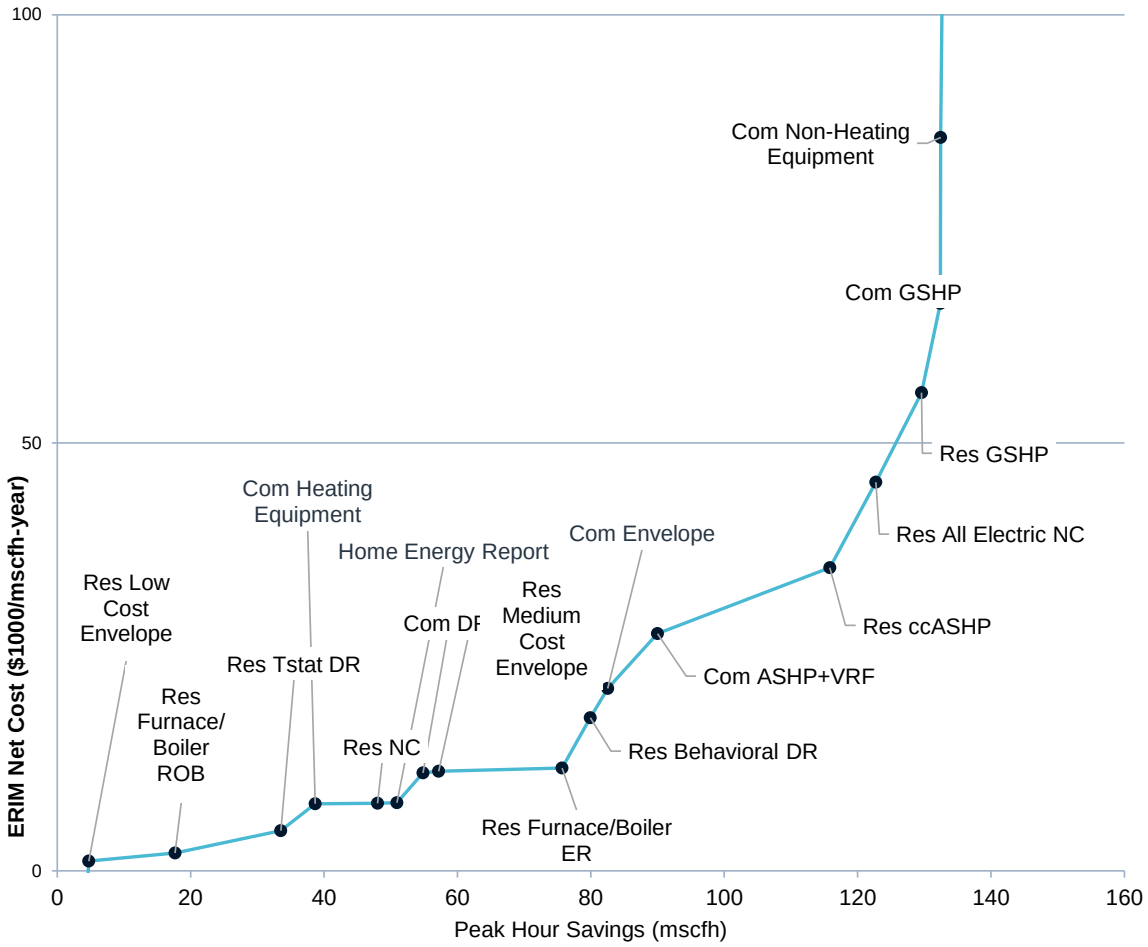
Figure 4-66: Breckenridge Economic Supply Curve Using Expanded Ratepayer Impact Measure Test (ERIM)



For the purposes of this potential study, the measures were split into 3 groups, those with extremely high costs (ERIM or incentives higher than $100,000/mscfh-year), those with low to medium costs, and those with negative ERIM costs. The high-cost measures removed from further consideration in the analysis consist of non-heating measures with high costs and make up less than 2% of total achievable potential. The negative cost measures consist of non-heating measures with low costs. They are cost-effective because of their energy and GHG benefits, while delivering almost no gas peak hour benefits. These negative cost measures were included in achievable potential, but also make up less than 2% of total achievable potential. The remaining measures, which make up almost the entire achievable potential, have positive costs below $100,000/mscfh-year.

Figure 4-67 shows the same economic supply curve, but only for the high impact portion of the curve, with the measures labeled. This shows the large variability in ERIM net costs across the different measures, with residential envelope, gas equipment, and DR all having large potential at cost of thousands of dollars per mscfh-year, while electrification measures have large potential at costs of tens of thousands of dollars per mscfh-year. **The higher costs of electrification measures are driven primarily by the high costs of additional electrical capacity required to serve these new loads.**

Figure 4-67: Breckenridge Economic Supply Curve Showing High Impact Measures



4.6.3 Achievable Potential

Achievable potential represents the amount of peak hour demand reduction that could be achieved given limitations on customer acceptance and technology diffusion. Achievable potential is calculated by year, reflecting the expected rate of market adoption of different measures and available stock of opportunities each year. Results are generally presented as achievable potential through 2033.

Given the magnitude of the capacity shortfall, the team modeled uptake when customers were given 100% of incremental costs for technologies that reduced their peak load. The survey showed a steep increase in willingness to adopt up to 100% incentives, with little change beyond 100% incentives.

The table below shows the achievable potential for the top ten measures in the study. Most of the top measures are BE measures, but the most important measure was a gas equipment measure, meaning replacing gas equipment with more efficient gas equipment.

Table 4-21: Top Ten Achievable Potential Measures

Sector	Measure Name	Measure Type	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)
Residential	Gas Furnace Replacement	Gas Equipment	40	14	2
Residential	Thermostat DR	EE	33	11	2
Commercial	Com ASHP	BE	31	11	0
Residential	Furnace Electrification with ccASHP	BE	29	10	1
Residential	Boiler Electrification with ccASHP	BE	26	9	1
Commercial	Com Load Shedding	DR	22	7	0
Residential	Energy Star New Home	EE	20	7	1
Commercial	Com VRF	BE	17	6	0
Residential	Whole Building Electrification	BE	15	5	1
Residential	Ground Source Heat Pump	BE	14	5	1

Table 4-22 shows achievable potential by measure type and measure category, including transport customers. **Electrification, gas equipment (furnaces and boilers), and DR make up most of the achievable potential by measure category.**

Table 4-22: Achievable Potential by Measure Category

Measure Type	Measure Category	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)	Total (mscfh)
BE	Electrification	148	51	5	204
DR	DR	59	20	2	82
Gas Equipment	Gas Equipment	57	20	3	79
EE	Building Shell	21	7	1	29
EE	Whole Building	20	7	1	27
EE	Water Saving	0	0	0	0
Behavior	Behavior	6	2	0	9
Total	**Total**	306	105	12	423

Figure 4-68, Figure 4-69, and Figure 4-70 show the total achievable potential for all measures and all building sectors in Breckenridge, Keystone, and Grand Lake.

Figure 4-68: Breckenridge Achievable Potential

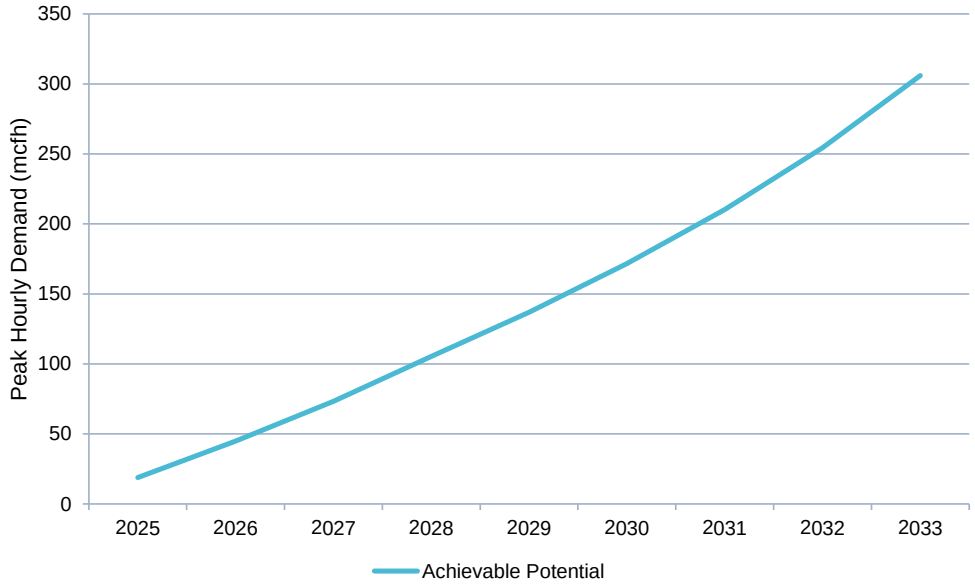


Figure 4-69: Keystone Achievable Potential

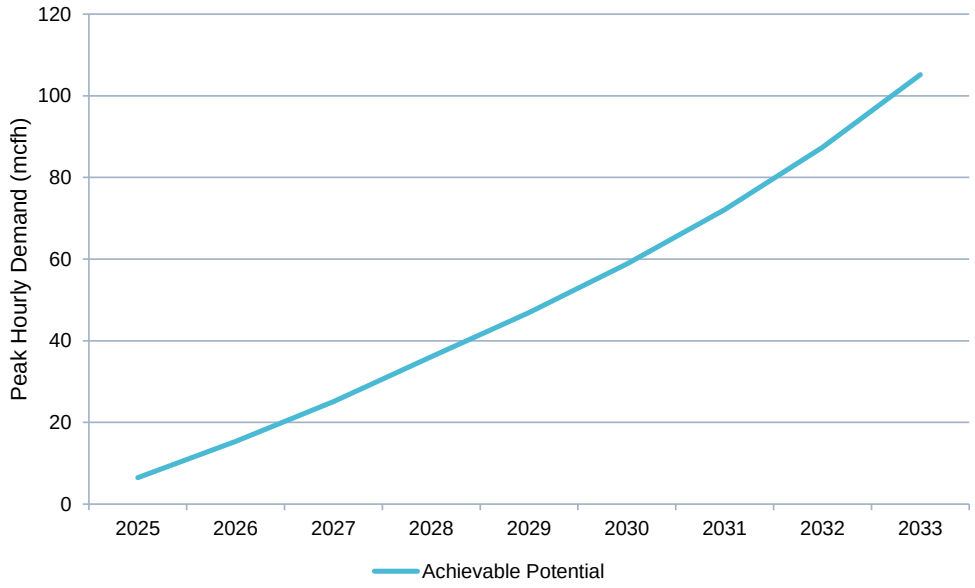
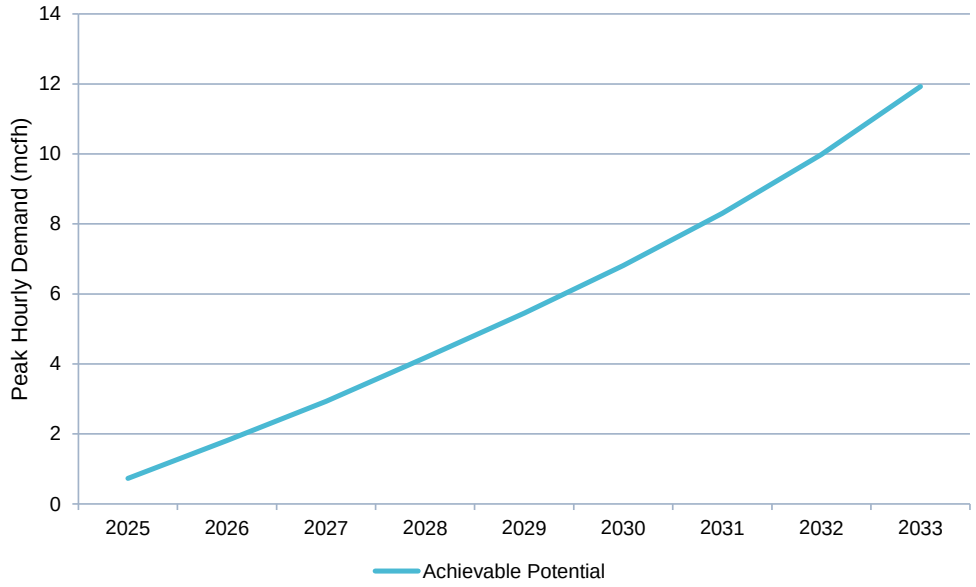


Figure 4-70: Grand Lake Achievable Potential



The residential sector had the highest achievable potential, as shown in Table 4-23, as a result of the residential building group contributing more than other building groups to peak load as well as a higher market maturity for electrification technologies. Historically, transport customers have not been eligible to participate in gas EE programs since they do not contribute to funding gas programs. However, **transport customers consume a significant amount of gas during the system peak hour and represent a significant portion of overall achievable potential in Breckenridge and Keystone.**

Table 4-23: Achievable Potential by Building Type

Building Sector	Building Type	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)	Total (mscfh)
Residential	SF	178	62	9	249
	MF	34	12	2	47
Commercial	Commercial	30	12	1	43
	Multifamily Commercial	8	2	0	11
Transport	Transport	48	17	0	65
	Multifamily Transport	18	5	0	23
Total	Total	306	105	12	423

Figure 4-71, Figure 4-72, and Figure 4-73 show the total achievable potential by measure type and all building sector in Breckenridge, Keystone, and Grand Lake. Residential building electrification measures have the highest achievable potential. Most of the commercial potential is located at transport customer facilities.

Figure 4-71: Cumulative Achievable Potential by Sector and Measure Type Delivered to RB-4 (Breckenridge)

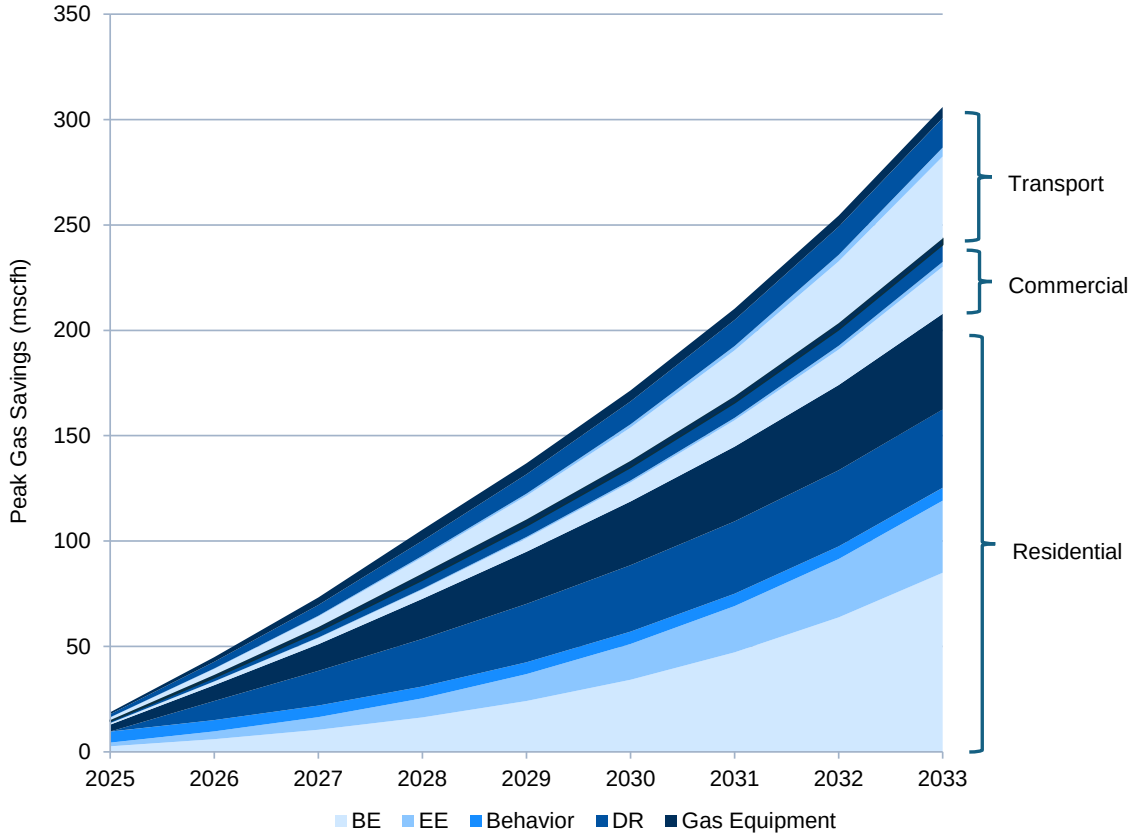


Figure 4-72: Achievable Potential by Sector and Measure Type Delivered to RX-7 (Keystone)

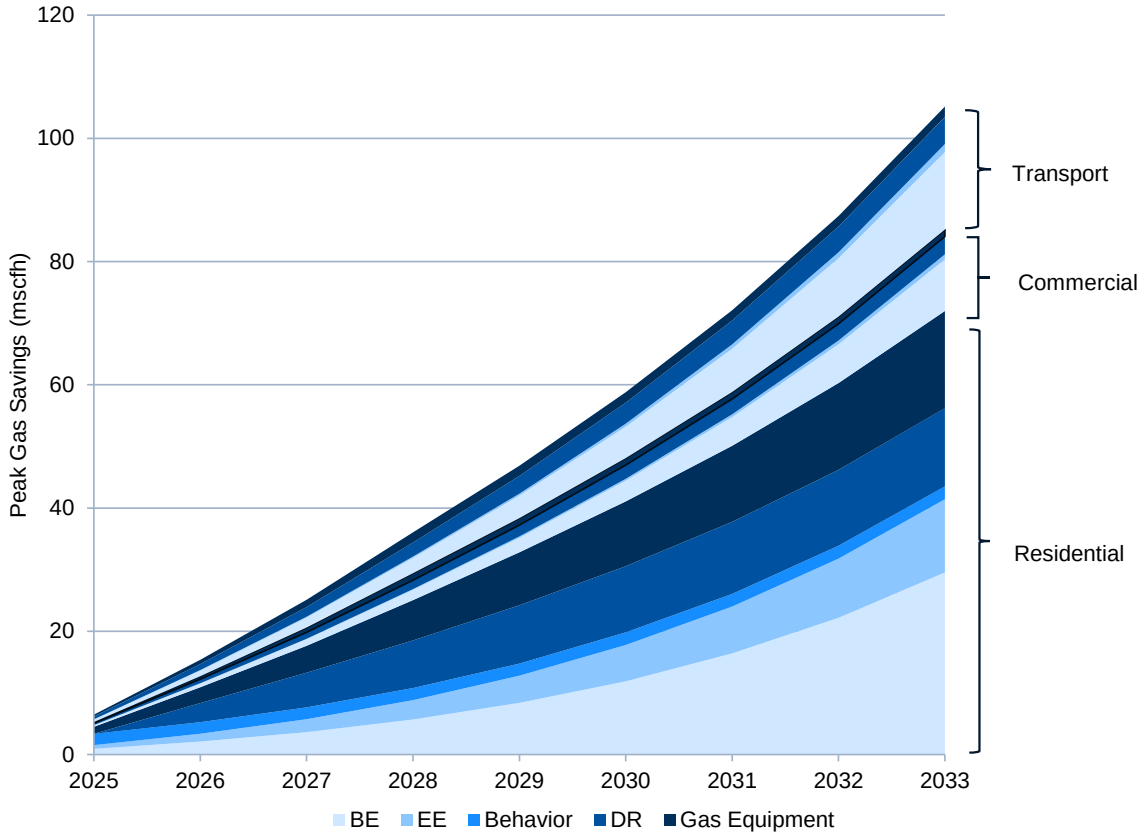
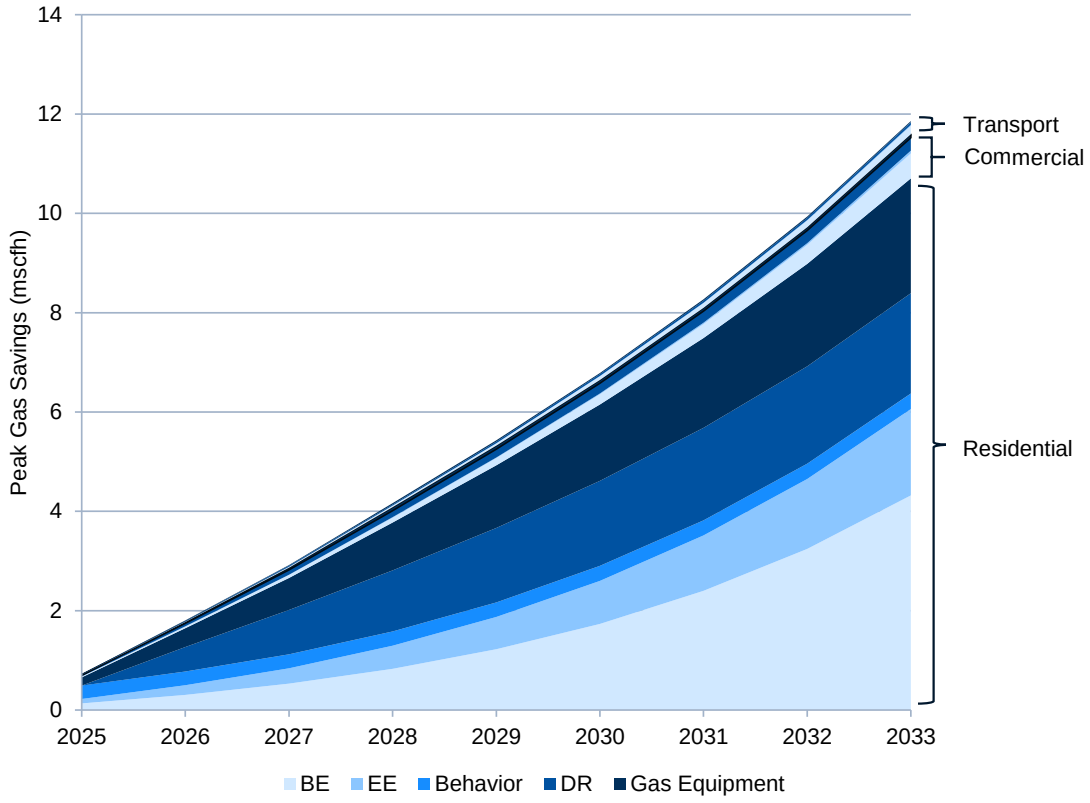


Figure 4-73: Achievable Potential by Sector and Measure Type Delivered to RG-12 (Grand Lake)



Achievable potential, delivered to each constraint point from each geographic area was calculated separately. As shown in Table 4-24, the Breckenridge and Keystone are both helped the most by actions taken immediately adjacent to the constraint, with some additional benefits derived from nearby areas. Meanwhile, the Grand Lake constraint can only be solved by actions taken in Grand Lake. The modeling also showed that actions in Area 4 have minimal benefits at the constraint point in the Eastern Mountain Gas System, which should not be surprising, given that Area 4 is in the Southern Mountain System, with only a very limited connection to the Eastern Mountain Gas System.

Table 4-24: Achievable Potential by Geographic Area of Installation

Geographic Area	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)	Total (mscfh)
Area 2 - Breckenridge	155	7	0	162
Area 2 - Keystone	35	56	0	91
Area 3	46	15	0	60
Other Area 2	28	12	0	40
Other Area 1	21	8	0	29

Geographic Area	RB-4 (Breckenridge) (mscfh)	RX-7 (Keystone) (mscfh)	RG-12 (Upper Grand Lake) (mscfh)	Total (mscfh)
Area 1 – Other Grand Lake	19	7	0	26
Area 1 - Grand Lake Top	8	3	12	23
Area 4	6	2	0	8
Total	306	105	12	423

4.7 NPA DSM Solution Development Conclusions

The NPA DSM solution development effort resulted in a series of conclusions that feed directly into the design of NPA portfolios. These conclusions are reiterated below for convenience.

4.7.1 Building Type, End Use Disaggregation, and Geographic Area Analysis Conclusions

Conclusion 1: Based on analysis of existing peak hour gas demand, single family residential buildings were identified as having the highest peak hour loads, with master-metered multifamily and lodging the commercial areas with the highest peak hour loads.

- *Implication for Portfolio and Plan Development:* The development of the portfolios and plan should focus on residential solutions first. Within commercial areas, the portfolios and plan should focus extra effort on master-metered multifamily and lodging.

Conclusion 2: Space heating is by far the largest end use contributing to peak hour consumption.

- *Implication for Portfolio and Plan Development:* Space heating should be the focus of NPA portfolio and plan development, with a particular focus on residential space heating.

Conclusion 3: Areas 2 and 3 in Summit County including Breckenridge, Keystone, other parts of Area 2, and Area 3 deliver the highest fraction of peak hour reductions to Breckenridge and Keystone. The immediate area around Grand Lake (Grand Lake Top) is the only area that can deliver peak hour reductions to the Grand Lake constraint.

- *Implication for Portfolio and Plan Development:* The delivery of NPA solutions should focus on Area 2 and Area 3, including Summit County and the area running from Minturn to Leadville, including the towns of Minturn, Red Cliff, and Leadville, plus surrounding area, as well as the immediate area around Grand Lake.

4.7.2 Residential Survey Conclusions

Conclusion 4: Survey respondents in the mountains were much more likely to rent out their home on a short-term basis than respondents on the front range.

Conclusion 5: Survey respondents in the mountains had higher income and education than respondents on the front range.

- *Implication for Portfolio and Plan Development:* Messaging and marketing should be adjusted to reflect the different homeowner demographics in the mountains.

Conclusion 6: Many more homes in the mountains have boilers when compared to the front range.

Conclusion 7: Very few homes in the mountains have cooling currently or are looking to add cooling.

- *Implication for Portfolio and Plan Development:* Marketing heat pumps to customers in the mountains will need to focus more on ductless heat pumps installed at homes with boilers and selling other benefits besides comfort from cooling.

Conclusion 8: A large majority of survey respondents are unfamiliar with existing Company program offerings and other incentive opportunities.

- *Implication for Portfolio and Plan Development:* Increased marketing focused on program awareness may be helpful.

Conclusion 9: Respondents were highly sensitive to upfront costs of equipment in their willingness to participate. Willingness to participate did not change appreciably above 100% of costs being covered.

Conclusion 10: Respondent were less sensitive to increases in operating costs, with 50% of customers willing to install a free heat pump, even with an increase in operating costs of $1,000 per year.

- *Implication for Portfolio and Plan Development:* Offering 100% incentives will dramatically increase willingness to participate, even if operating costs are going up significantly.

4.7.3 Commercial Survey Conclusions

Conclusion 11: A significant number of respondents indicated they were somewhat likely to add to cooling.

- *Implication for Portfolio and Plan Development:* This represents an opportunity to sell some businesses on the cooling benefits of heat pumps.

Conclusion 12: 20% of respondents had snow melt systems connected to a boiler and 7% had outdoor fireplaces.

- *Implication for Portfolio and Plan Development:* This represents an opportunity for facility-specific DR actions.

Conclusion 13: 80% of respondents were interested in installing a free heat pump, even with an increase in operating costs.

- *Implication for Portfolio and Plan Development:* 100% incentives may motivate people to adopt heat pumps, even with an increase in operating costs.

4.7.4 Contractor/Builder Interview Conclusions

Conclusion 14: Builders and contractors reported low familiarity and low trust of heat pumps. They are concerned about the opportunity to completely displace gas heating due to high altitudes and cold mountain temperatures.

- *Implication for Portfolio and Plan Development:* The interviews indicated that significant training and preparation of market structure will be needed as manufacturers, distributors, and architects will need to lead the contractors and builders to choose new electrification technologies.

4.7.5 Potential Conclusions

Conclusion 15: Technical potential: Electrification measures have the highest technical potential, allowing for technical potential to eliminate almost 100% of existing gas load.

- *Implication for Portfolio and Plan Development:* In the long run, electrification has the highest potential, so preparing the market for electrification will be required for large reductions in the long run.

Conclusion 16: Economic supply curves: Electrification measures have high costs, driven primarily by cost of capacity increases.

- *Implication for Portfolio and Plan Development:* If electrification measures can be developed with lower peak demand impacts (e.g. using other backup systems besides electric resistance), economics of electrification can be significantly reduced.

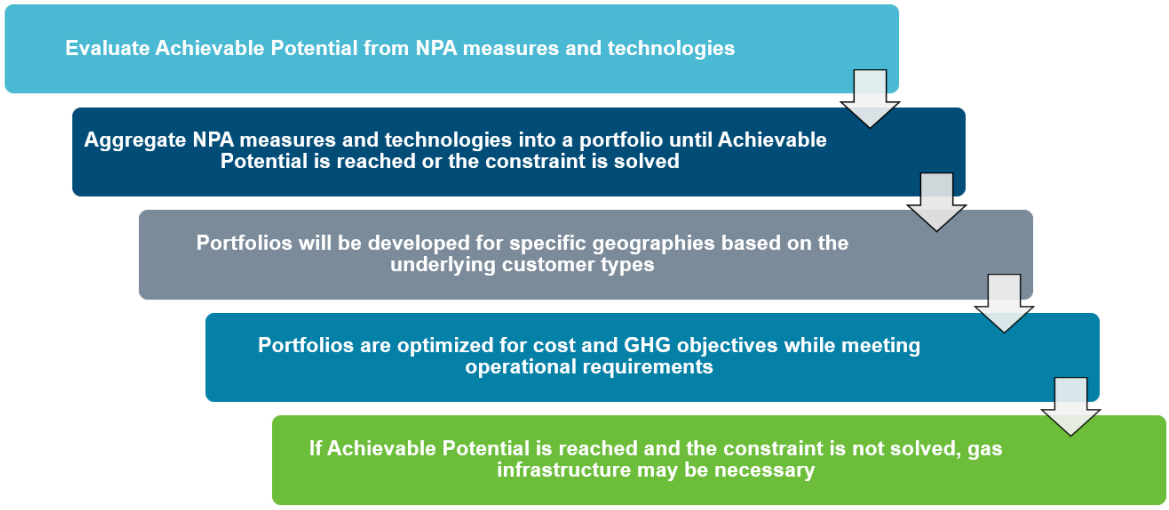
Conclusion 17: Achievable potential: The highest potential comes from high efficiency gas equipment, electrification, and DR.

- *Implication for Portfolio and Plan Development:* Plan should develop solutions for all three of these areas and not exclude any of them from the solution.

5 Alternative Portfolios

Alternative portfolios, comprised of a variety of measures to alleviate the capacity constraint, were developed for specific geographies based on the underlying customer types. The alternative portfolios were optimized for the lowest cost, while meeting operational requirements. To develop portfolios, a multistep approach was implemented, as demonstrated in Figure 5-1.

Figure 5-1: Alternative Portfolio Development Process



Five alternative portfolios were developed for the Eastern Mountain Gas System. The alternative portfolios included an Electric Portfolio, several NPA-Only Portfolios, and several Hybrid Portfolios. The alternative portfolio analysis focused on the least cost among all achievable potential solutions. A baseline gas infrastructure project was supplied by the Company for comparative purposes to measure the success of the alternative portfolios. Each alternative portfolio was evaluated based on its ability to meet the capacity constraint in the Eastern Mountain Gas System. If an alternative portfolio was able to meet the capacity constraint, then the cost effectiveness of the portfolio was assessed using a cost benefit analysis framework.

Five potential alternative portfolios were considered for alleviating the capacity constraint in the Eastern Mountain Gas System. The alternative portfolios can be divided into two categories:

1. Demand Side Portfolios – these alternative portfolios included an Electric Portfolio and two NPA-Only Portfolios, differing in their inclusion of gas consuming appliance incentives and transport customers.
2. Two Hybrid Portfolio options combing NPA portfolios with supplemental supply infrastructure.

Once assembled, the alternative portfolios were evaluated under four criteria through an iterative process. The first threshold an alternative portfolio must successfully pass was whether the alternative portfolio could meet the capacity constraint and close the gap within 10 years. If the alternative portfolio could not achieve this baseline, the portfolio was removed from additional consideration. If the portfolio was able to close the capacity constraint within 10 years, the alternative portfolio was analyzed using the cost-benefit analysis tool to assess 1) program and incentive costs, 2) electric system impacts, and 3) emission impacts.

Additionally, the Company provided a baseline gas infrastructure solution to test the other alternative portfolios for cost effectiveness. These alternative portfolios and their potential for alleviating the capacity constraint in the Eastern Mountain Gas System are presented in the following sections.

5.1 Demand Side Portfolios

The three alternative portfolios considered as demand side portfolios were the Electric Portfolio and two NPA-Only Portfolios. The NPA-Only Portfolios can be further broken down into additional portfolios, inclusive and exclusive of transport customers and LDC growth.

Electric Only Portfolio

The Electric Only Portfolio was a portfolio comprised of only customer side solutions (i.e. NPA measures and technologies) including DR, building electrification, and non-equipment gas EE measures for residential and commercial customers, not including transport customers. The portfolio excluded incentives for gas consuming equipment. While gas demand response and building shell measures are not strictly electrification measures, they are included in the electric portfolio as they do not promote gas infrastructure or gas appliance installation. This potential alternative portfolio was analyzed to determine whether the capacity constraint could be solved without the need for gas consuming appliance incentives.

Figure 5-2, Figure 5-3, and Figure 5-4 below show the peak hour savings contribution to the Electric Only Portfolio over time for the different measure types by building sector, compared to the shortfall in Breckenridge, Keystone, and Grand Lake, respectively.

Figure 5-2: Electric Portfolio Peak Hour Impacts Delivered to RB-4 (Breckenridge)

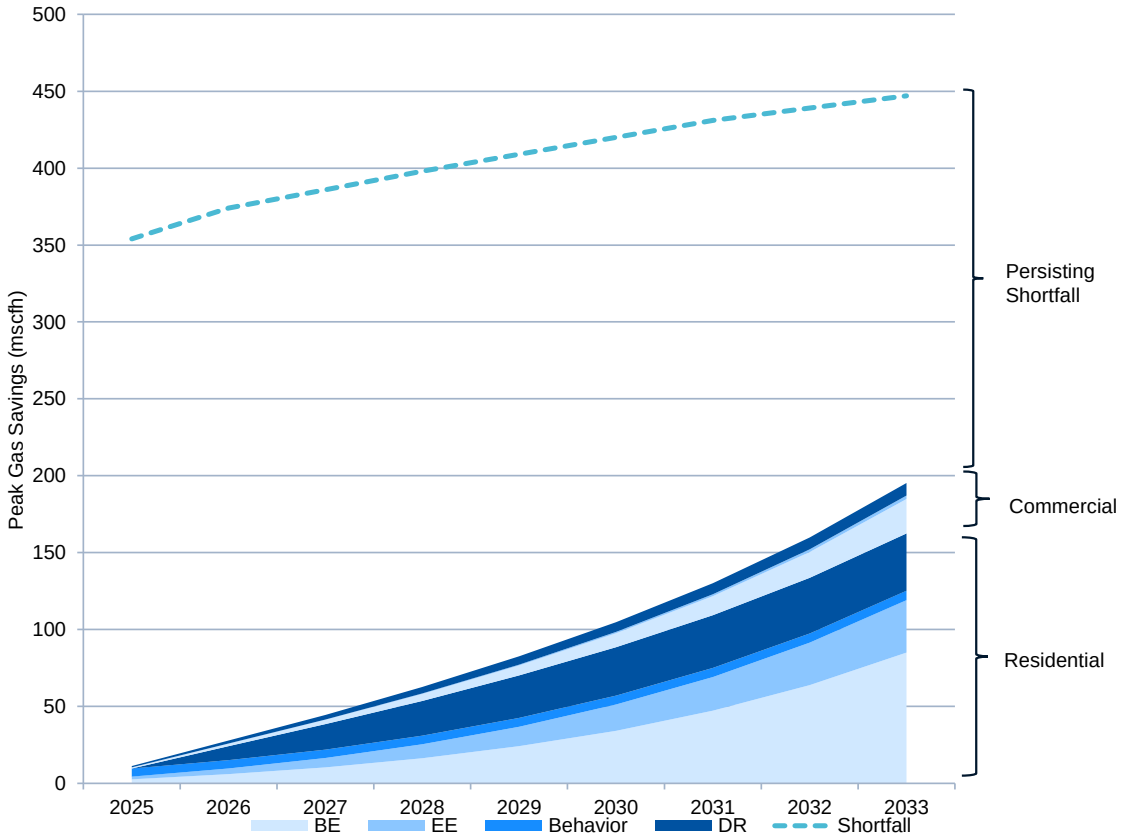


Figure 5-3: Electric Portfolio Peak Hour Savings Delivered to RX-7 (Keystone)

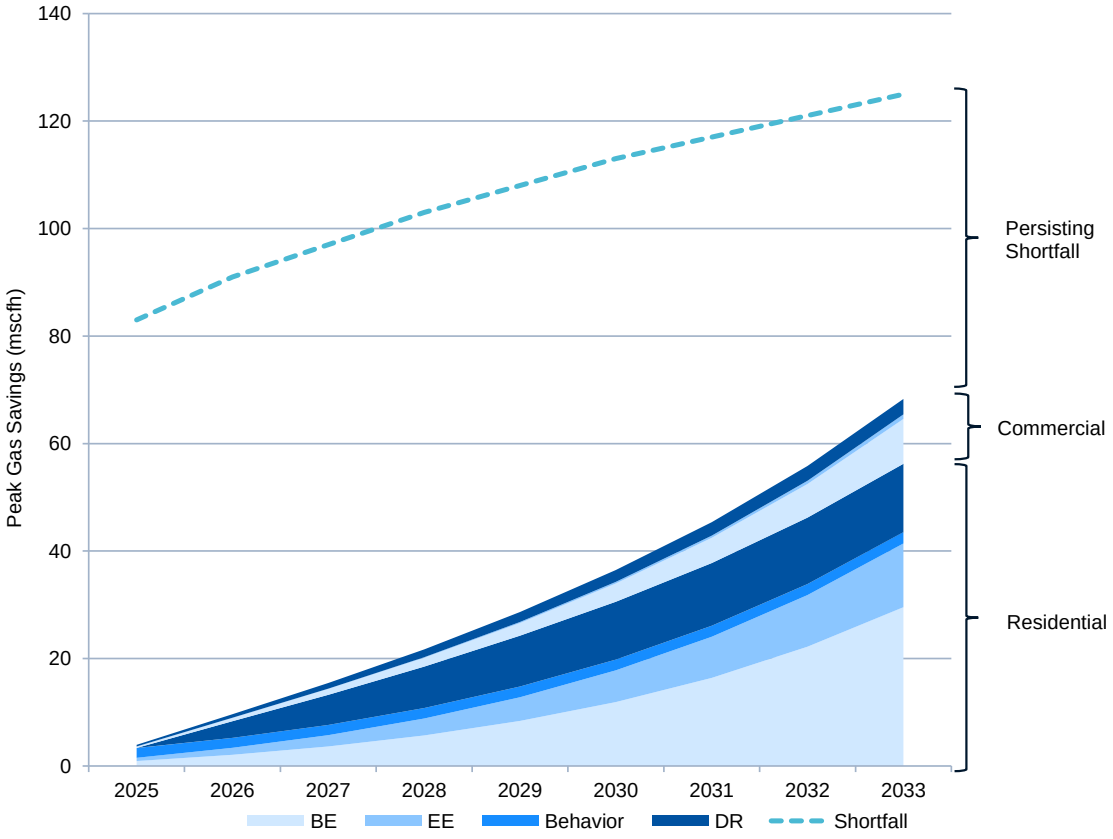


Figure 5-4: Electric Portfolio Peak Hour Savings Delivered to RG-12 (Grand Lake)

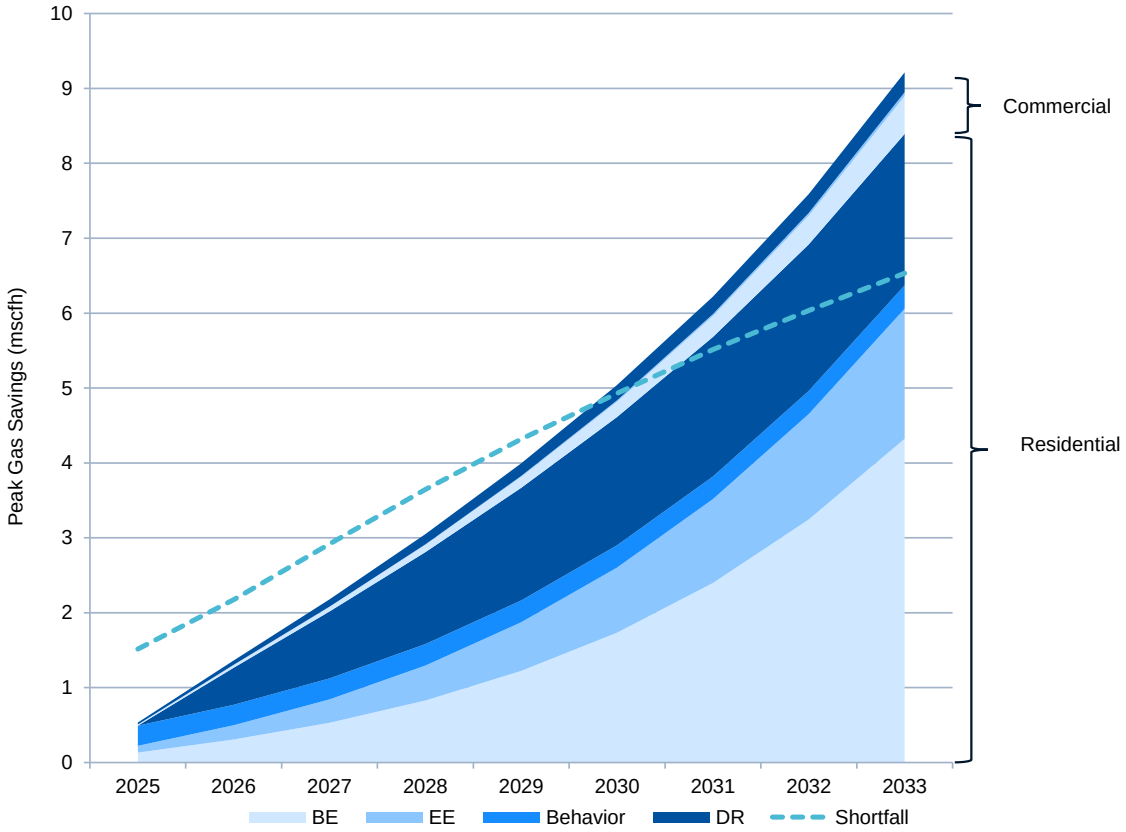


Table 5-1 below shows a summary of cumulative program impacts by year. Electric capacity costs make up a significant portion of the overall direct utility costs associated with this portfolio. The resulting portfolio has direct utility costs of $425,000 per mscfh delivered in 2033.[10]

[10] The direct utility costs include electric capacity costs, incentive costs, and program administration and marketing costs. The costs per mscfh are calculated by dividing the 2033 value for "Total Program + Electric Capacity Costs" by the sum of 2033 RB-4 Peak Hour Gas Impact, RX-7 Peak Hour Gas Impact, and RG-12 Peak Hour Gas Impact.

Table 5-1: Electric NPA Portfolio Cumulative Impacts and Costs by Year

Year	Premise-level Peak Hour Gas Impact (mscfh)[11]	RB-4 Peak Hour Gas Impact (mscfh)[12]	RX-7 Peak Hour Gas Impact (mscfh)[13]	RG-12 Peak Hour Gas Impact (mscfh)[14]	Electric Grid Impacts (kW)[15]	Marginal Electric Capacity Costs[16]	Program + Incentive Costs[17]	Total Program + Electric Capacity Costs[18]
2025	17	11	4	1	982	$185,459	$ 3,212,344	$3,397,803
2026	43	28	10	1	2,262	$621,181	$ 7,425,854	$8,047,035
2027	68	45	15	2	3,949	$1,397,116	$12,856,411	$14,253,526
2028	96	63	22	3	6,191	$2,637,916	$19,848,203	$22,486,120
2029	126	83	29	4	9,156	$4,509,717	$28,701,532	$33,211,249
2030	160	105	36	5	13,047	$7,230,142	$39,819,603	$47,049,745
2031	199	130	45	6	18,102	$11,080,277	$53,694,417	$64,774,695
2032	245	160	56	8	24,607	$16,418,642	$70,926,054	$87,344,696
2033	299	195	68	9	32,933	$23,705,823	$92,214,523	$115,920,346

While the Electric Portfolio did have the achievable potential to solve the shortfall in Grand Lake in 2029 and beyond, it did not have the achievable potential to solve the capacity shortfall within the next 10 years in Breckenridge or Keystone. Therefore, this portfolio was omitted from further analysis. Realizing an Electric Only Portfolio would not be viable in meeting the capacity constraint, the PA team determined that energy efficient gas appliances would likely be required to further reduce the shortfall, leading to the development of the NPA-Only Portfolios.

NPA-Only Portfolios

After determining the Electric Portfolio was insufficient for alleviating the capacity constraint in the Eastern Mountain Gas System, the PA team tested the potential of including gas equipment EE and including combination transport gas customers who are also the Company's electric customers in two additional portfolios. With the addition of gas appliance incentives, the team examined the achievable potential of the NPA-Only alternative portfolios to assess if the capacity constraint could be alleviated with the addition of energy efficient gas appliances. Given the magnitude of the capacity shortfall, the team modeled uptake when customers were given 100% of incremental costs for technologies that reduced their peak load. Thus, the

[11] Premise-level Peak Hour Gas Impact is defined by the reductions in peak gas that occurs at the premise level, with reductions defined as positive. This is before adjusting for the impact at constraint points, as discussed in section 4.3.
[12] RB-4 Peak Hour Gas Impact is defined as the peak hour gas impacts achieved at the shortfall location RB-4 in Breckenridge, with reductions defined as positive. It is calculated by multiplying Premise-level Peak Hour Gas Impact in each geographic area by the associated Peak Demand Ratios as explained in section 4.3.
[13] RX-7 Peak Hour Gas Impact is defined as the peak hour gas impacts achieved at the shortfall location RX-7 in Keystone, with reductions defined as positive. It is calculated by multiplying Premise-level Peak Hour Gas Impact in each geographic area by the associated Peak Demand Ratios as explained in section 4.3.
[14] RG-12 Peak Hour Gas Impact is defined as the peak hour gas impacts achieved at the shortfall location RG-12 in Grand Lake, with reductions defined as positive. It is calculated by multiplying Premise-level Peak Hour Gas Impact in each geographic area by the associated Peak Demand Ratios as explained in section 4.3.
[15] Electric Grid Impacts are defined as the expected winter peak demand impacts associated with the NPA solution, with increases defined as positive.
[16] Marginal Electric Capacity Costs are calculated by multiplying Electric Grid Impacts by annual cost of generation, transmission, and distribution capacity.
[17] Program and Incentive Costs are defined as the expected incentive costs paid to program participating customers by the Company, plus the incremental program administration and marketing costs associated with the NPA.
[18] Total Program + Electricity Capacity Costs represent the total direct utility costs and are calculated by adding the Marginal Electric Capacity Costs and the Program and Incentive Costs.

achievable potential results shown below should be considered as an aggressive scenario representing the maximum achievable available.

NPA Portfolio 1

NPA Portfolio 1 is identical to the Electric Portfolio, focusing on customer side NPA solutions, except this portfolio includes incentives for gas consuming appliances. NPA measures within this portfolio included DR, electrification, shell measures, and energy efficient gas appliances. The NPA Portfolio 1 includes energy efficient gas equipment with a phase out of incentives for this equipment beginning in 2029. The phase out in 2029 aligns with Department of Energy standards requiring residential gas furnaces to meet high efficiency standards. Savings associated with high efficiency gas equipment required by standards after this date are included in this portfolio, to reflect the impact of these standards in reducing the shortfall, while costs are excluded, because incentives will no longer be offered after 2028.

Figure 5-5, Figure 5-6, and Figure 5-7 below show the peak hour savings contribution to NPA Portfolio 1 over time for the different measure types by building sector (transport not included), compared to the shortfall in Breckenridge, Keystone, and Grand Lake, respectively.

Figure 5-5: NPA Portfolio 1 Peak Hour Impacts Delivered to RB-4 (Breckenridge)

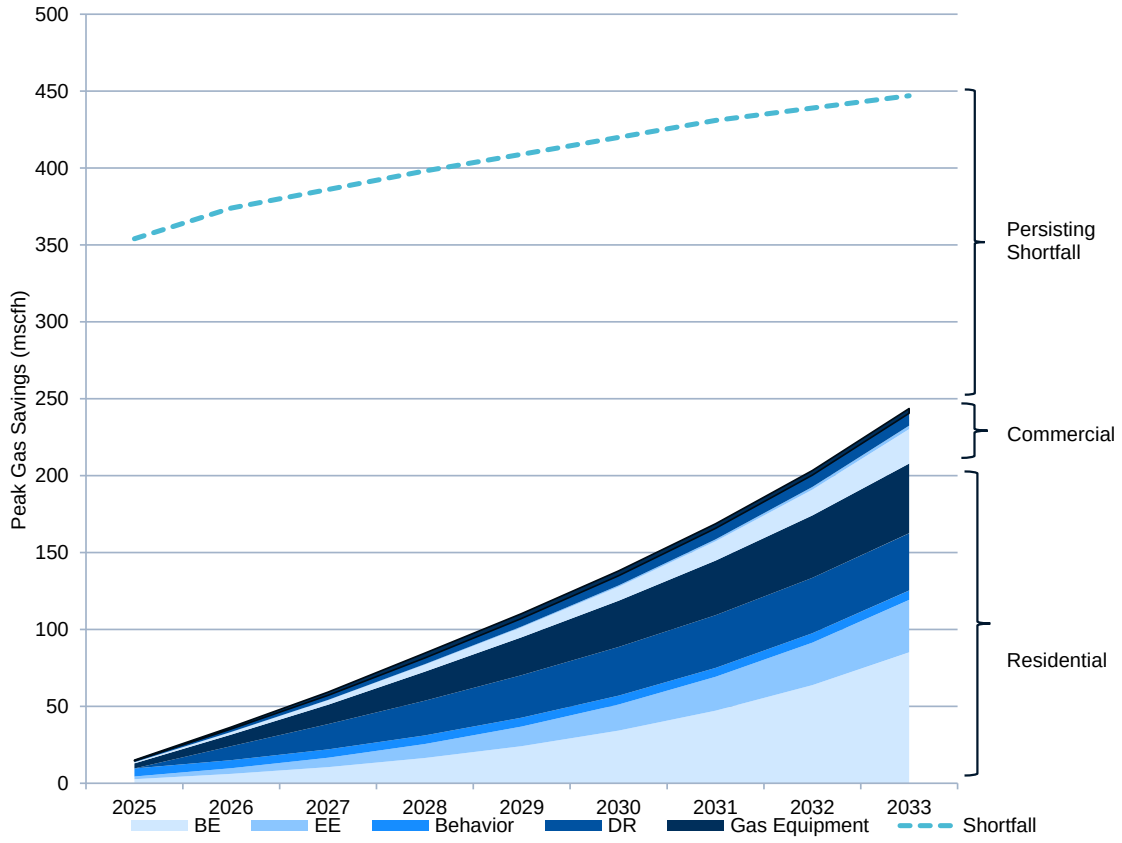


Figure 5-6: NPA Portfolio 1 Peak Hour Impacts Delivered to RX-7 (Keystone)

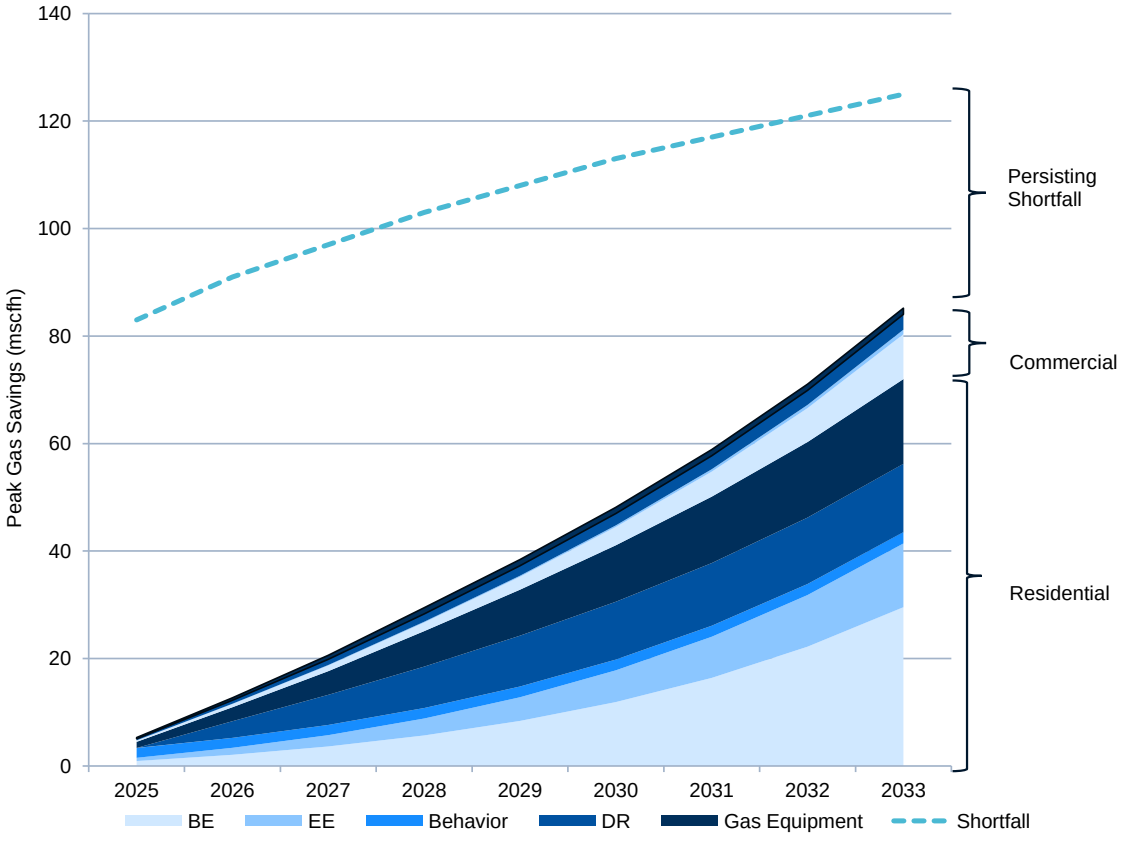
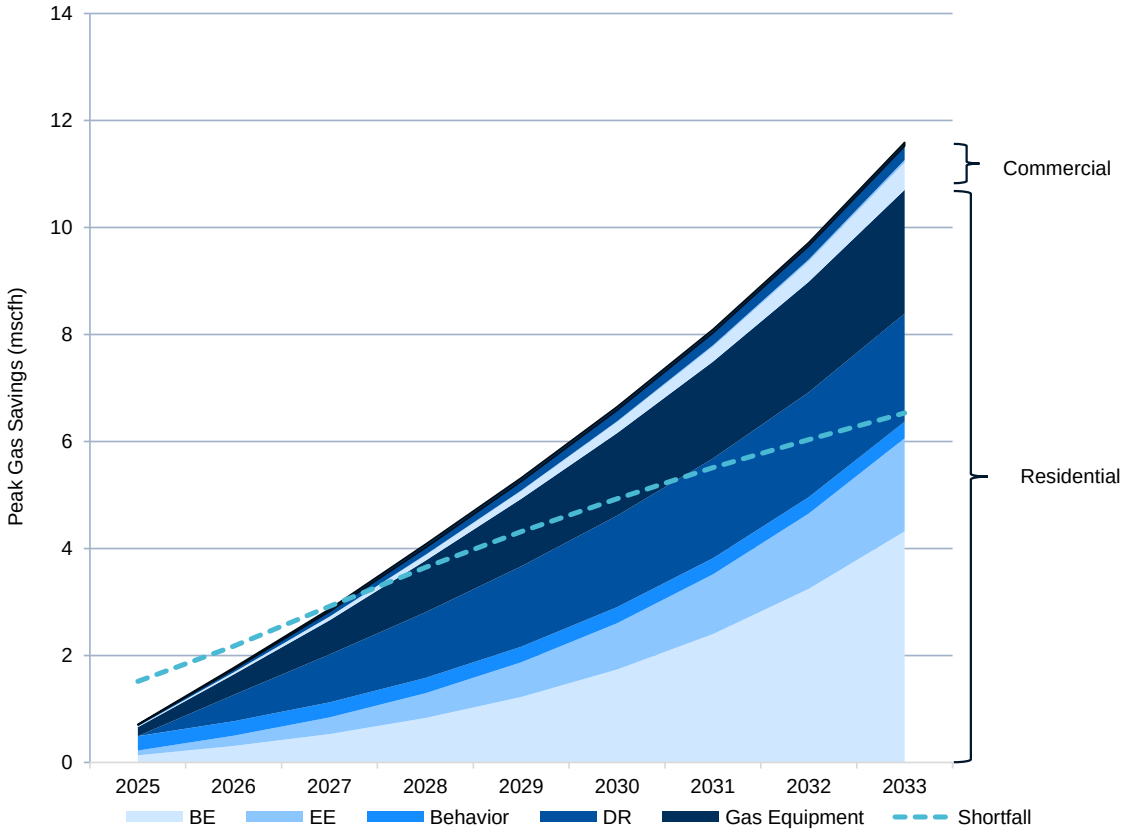


Figure 5-7: NPA Portfolio 1 Peak Hour Impacts Delivered to RG-12 (Grand Lake)



Even with aggressive incentives and the significant addition of gas equipment measures, the team found a persisting shortfall at the Breckenridge and Keystone constraint points for NPA Portfolio 1.

Table 5-2 below shows a summary of cumulative program impacts by year. Electric capacity costs make up a significant portion of the overall direct utility costs associated with this portfolio. The resulting portfolio has direct utility costs of $362,000 per mscfh delivered in 2033. While the savings include savings from furnaces after the federal standard goes into effect in 2029, the costs do not include costs from furnaces after this point in time.

Table 5-2: NPA Portfolio 1 Cumulative Impacts and Costs by Year

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2025	23	15	5	1	982	$185,459	$4,424,263	$4,609,722
2026	56	36	13	2	2,262	$621,181	$10,196,308	$10,817,489
2027	90	59	21	3	3,949	$1,397,116	$17,591,663	$18,988,779
2028	129	85	29	4	6,191	$2,637,916	$27,011,003	$29,648,919
2029	169	110	38	5	9,156	$4,509,717	$35,864,331	$40,374,048
2030	211	138	48	7	13,047	$7,230,142	$46,982,403	$54,212,544

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2031	258	169	59	8	18,102	$11,080,277	$60,857,217	$71,937,494
2032	311	203	71	10	24,607	$16,418,642	$78,088,853	$94,507,495
2033	373	244	85	12	32,933	$23,705,823	$99,377,323	$123,083,145

NPA Portfolio 2

The inability of NPA Portfolio 1 to alleviate the shortfall in Breckenridge and Keystone prompted the team to explore an additional scenario (NPA Portfolio 2) where transport customers are included in demand-side programs.

Figure 5-8, Figure 5-9, and Figure 5-10 below show the peak hour savings contribution to NPA Portfolio 2 over time for the different measure types by building sector (including transport), compared to the shortfall in Breckenridge, Keystone, and Grand Lake, respectively.

Figure 5-8: NPA Portfolio 2 Peak Hour Impacts Delivered to RB-4 (Breckenridge)

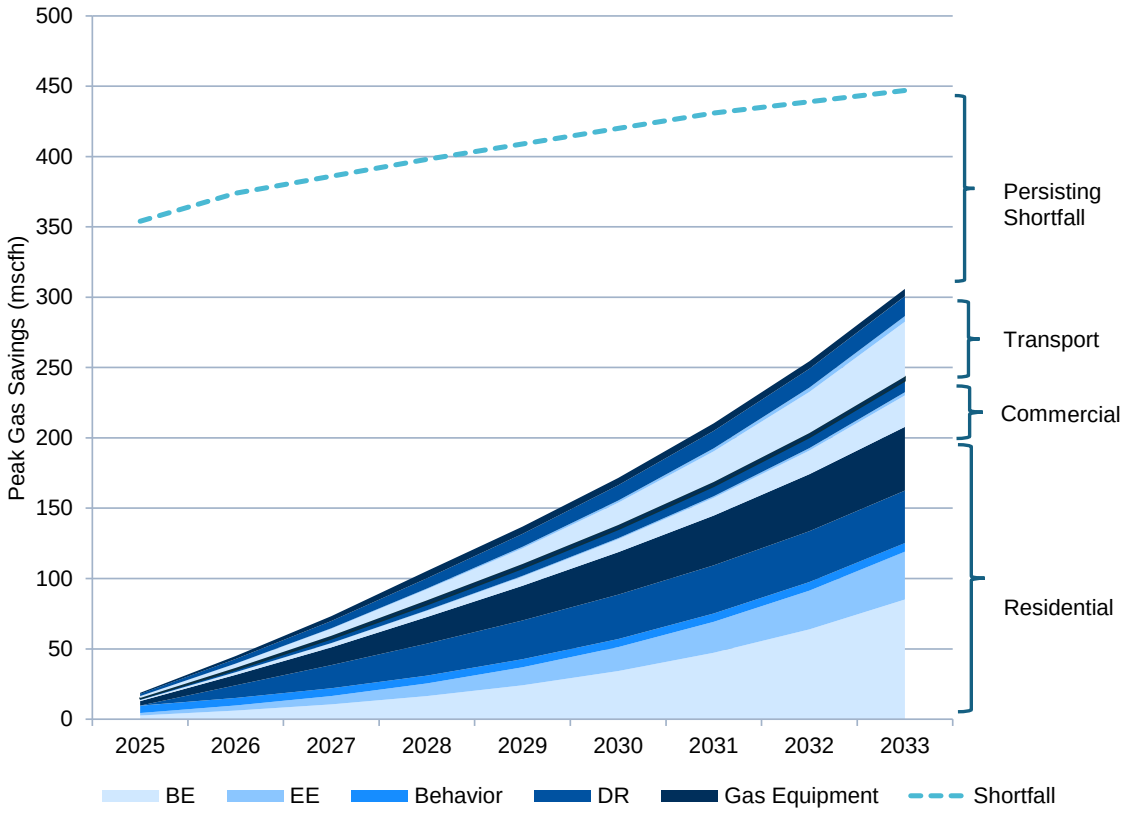


Figure 5-9: NPA Portfolio 2 Peak Hour Impacts Delivered to RX-7 (Keystone)

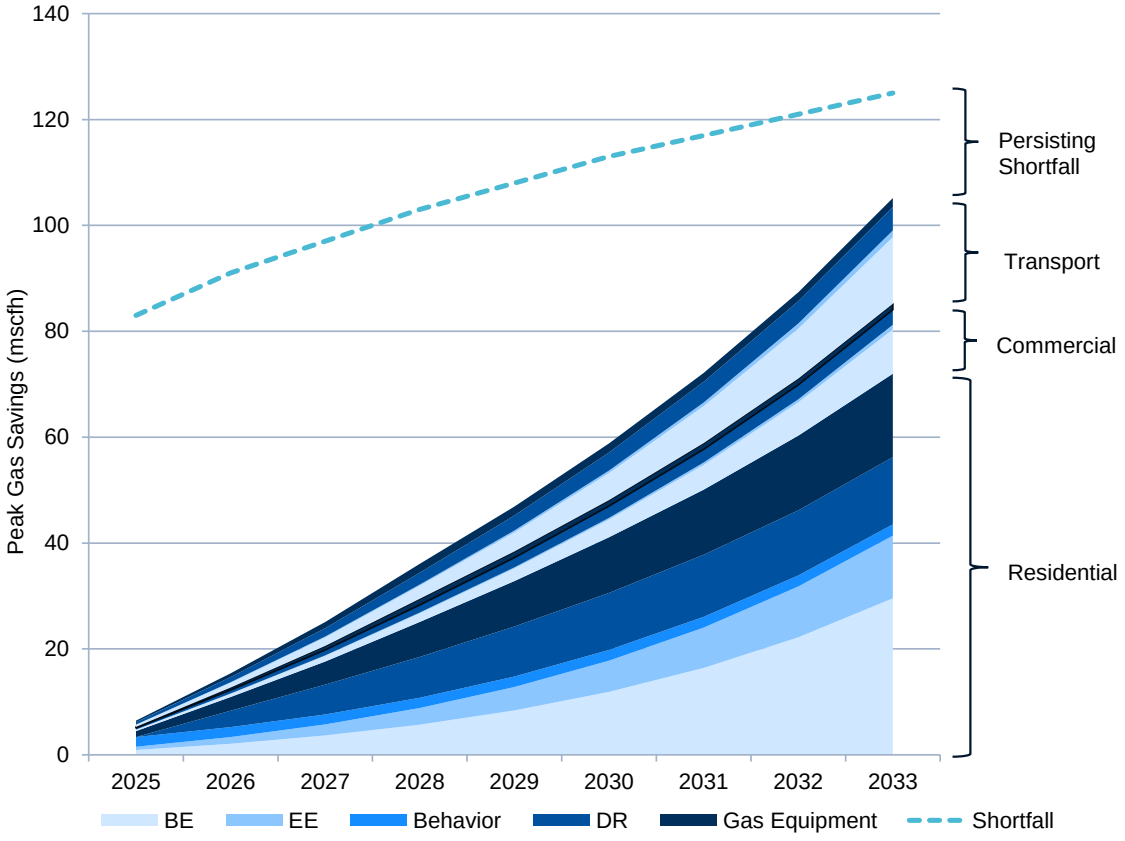
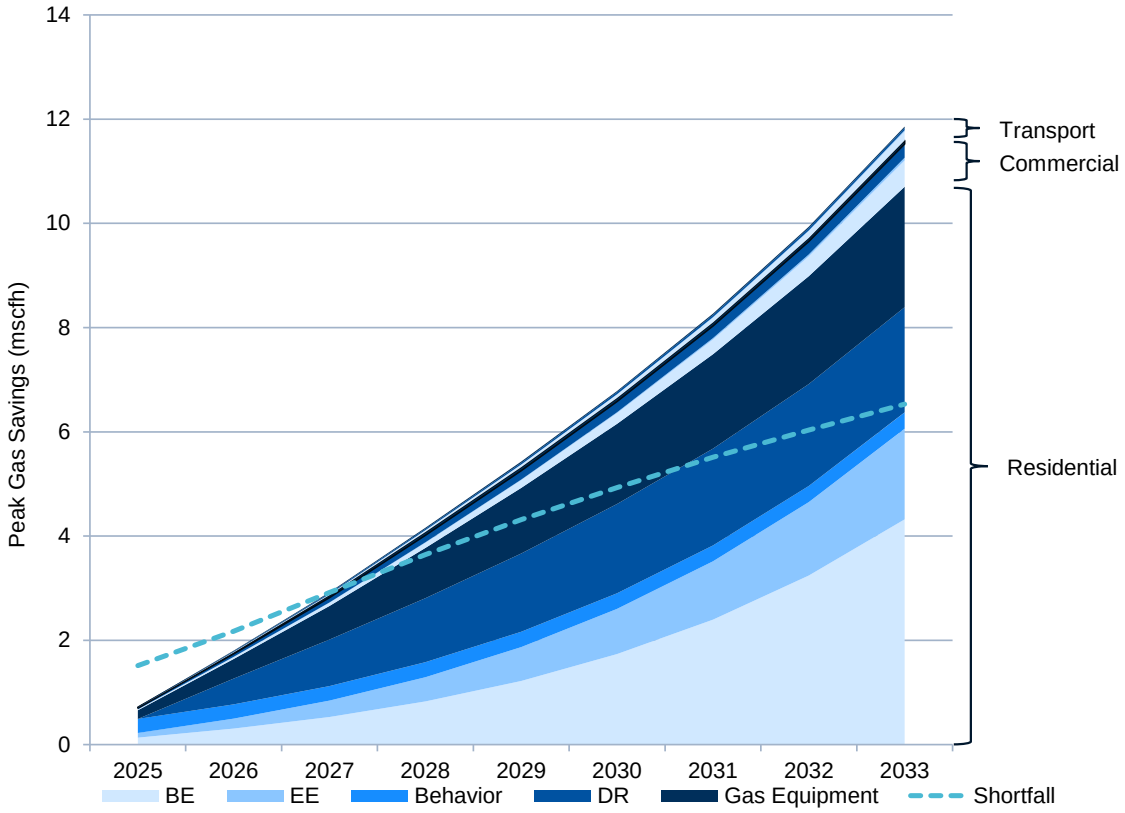


Figure 5-10: NPA Portfolio 2 Peak Hour Impacts Delivered to RG-12 (Grand Lake)



The shortfall in Breckenridge and Keystone remained under all scenarios. Given that each of the NPA-Only Portfolios resulted in a persistent capacity shortfall in Breckenridge and Keystone over the next ten years, the PA team and Company determined that NPA-only solutions were insufficient to eliminate the shortfall.

Table 5-3 below shows a summary of cumulative program impacts by year. Electric capacity costs make up a significant portion of the overall direct utility costs associated with this portfolio. The resulting portfolio has direct utility costs of $390,000 per mscfh delivered in 2033. While the savings include savings from furnaces after the federal standard goes into effect in 2029, the costs do not include costs from furnaces after this point in time.

Table 5-3: NPA Portfolio 2 Cumulative Impacts and Costs by Year

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2025	27	19	6	1	1,174	$248,040	$5,573,471	$5,821,511
2026	65	44	15	2	2,715	$830,772	$12,735,168	$13,565,890
2027	107	72	25	3	4,745	$1,866,448	$21,568,011	$23,434,460
2028	153	104	36	4	7,424	$3,516,535	$33,376,197	$36,892,732
2029	199	135	46	5	10,951	$5,994,280	$44,781,454	$50,775,734

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2030	255	172	59	7	16,393	$9,582,553	$59,560,726	$69,143,280
2031	312	210	72	8	22,714	$14,646,125	$78,570,815	$93,216,940
2032	377	254	87	10	30,839	$21,648,220	$102,855,043	$124,503,262
2033	454	306	105	12	41,205	$31,177,571	$133,638,398	$164,815,970

5.2 Hybrid Portfolio Development

Once the NPA Analysis concluded that an Electric Only and both NPA-Only Portfolios were insufficient for alleviating the capacity constraint in the Eastern Mountain Gas System, the PA team tested the potential for including gas infrastructure reinforcement (supplemental supply) to new portfolios. The Company informed the PA team that up to 285 mscfh of supplemental supply could be added in Breckenridge or Keystone. The PA team tested two Hybrid Portfolios, described in the following sections. Hybrid Portfolio 1 consisted of NPA Portfolio 2 with supplemental supply. Hybrid Portfolio 1 had relatively high costs of NPA measures and relatively low utilization of the supplemental supply in the late years. Hybrid Portfolio 2 was developed to explore the possibility of using more of the supplemental supply capacity in later years to reduce the cost of the portfolio. Hybrid Portfolio 2 utilizes a higher fraction of supplemental supply capacity in the later years, with a smaller, lower cost portfolio of NPA measures. Hybrid Portfolio 2 was ultimately the most cost-effective portfolio, discussed below.

5.2.1 Hybrid Portfolio 1

Hybrid Portfolio 1 comprises a portfolio that includes all achievable potential solutions, utilizing gas infrastructure, electrification, and NPA measures and technologies. Hybrid Portfolio 1 includes all NPA measures and incentives from NPA Portfolio 2, in addition to supplemental supply, and near-term use of temporary mitigation measures. The contents of Hybrid Portfolio 1 were determined thus:

First, the PA team determined if supplemental supply was required at each shortfall point. While the Grand Lake shortfall at RG-12 could be met with the NPA-only portfolios, the shortfalls at RB-4 (Breckenridge) and RX-7 (Keystone) could not. Second, the PA team decided which measures and customers to include in the NPA portion of the Hybrid Portfolios. The inclusion of gas equipment DSM, through 2028, and transport customers in the NPA solution results in a lower cost per unit of peak reduction, so the PA team decided to include gas equipment DSM and transport customers in the NPA portion of Hybrid Portfolio 1, along with supplemental supply.

Figure 5-11, Figure 5-12, and Figure 5-13 show the peak hour gas capacity delivered by Hybrid Portfolio 1 over time for the different measure types by building sector, compared to the shortfall in Breckenridge, Keystone, and Grand Lake respectively, while adding in contribution from supplemental supply and/or temporary mitigation measures. In this portfolio, the achievable NPA Portfolio from the potential study continues to be implemented throughout the time period, resulting in the supplemental supply contribution dropping over time as the NPA measures reduce incremental Design Day peak hour demand.

Figure 5-11: Hybrid Portfolio 1 Peak Hour Gas Capacity Delivered to RB-4 (Breckenridge)

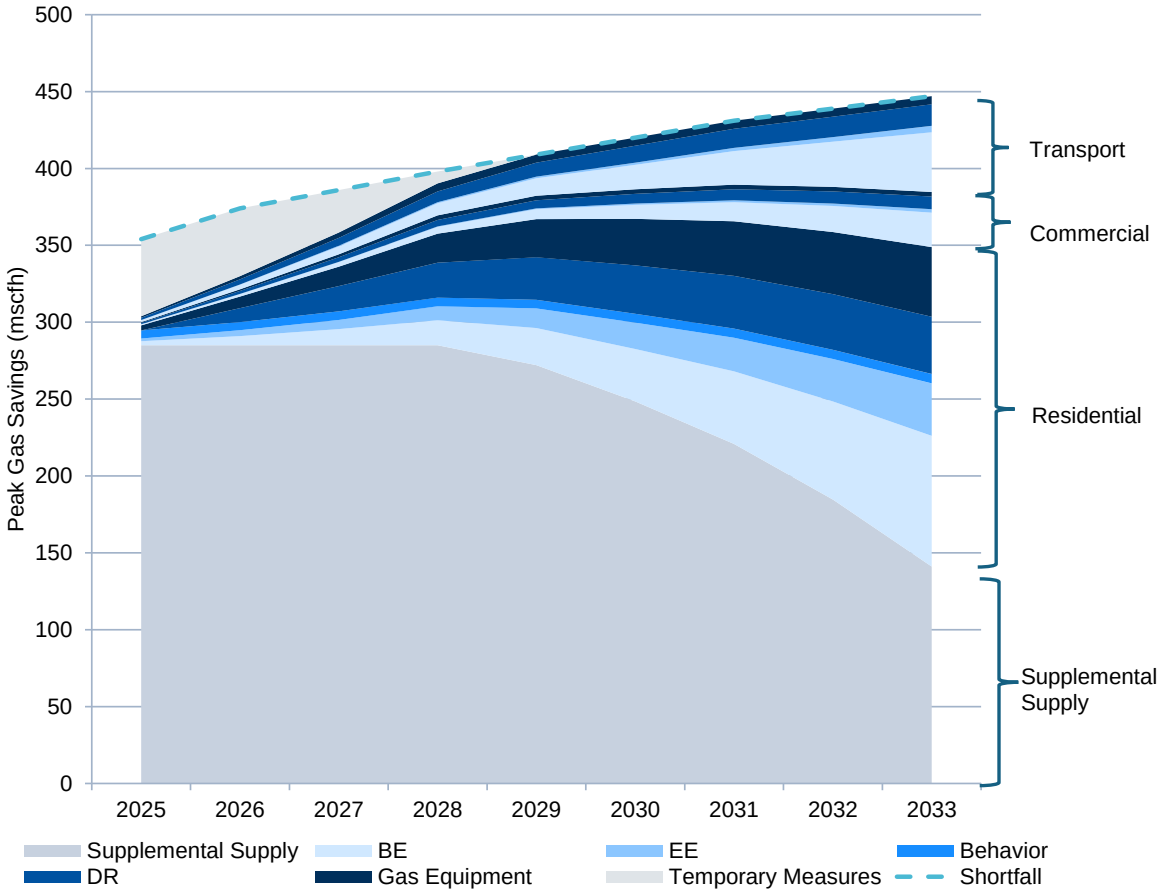


Figure 5-12: Hybrid Portfolio 1 Peak Hour Gas Capacity Delivered to RX-7 (Keystone)

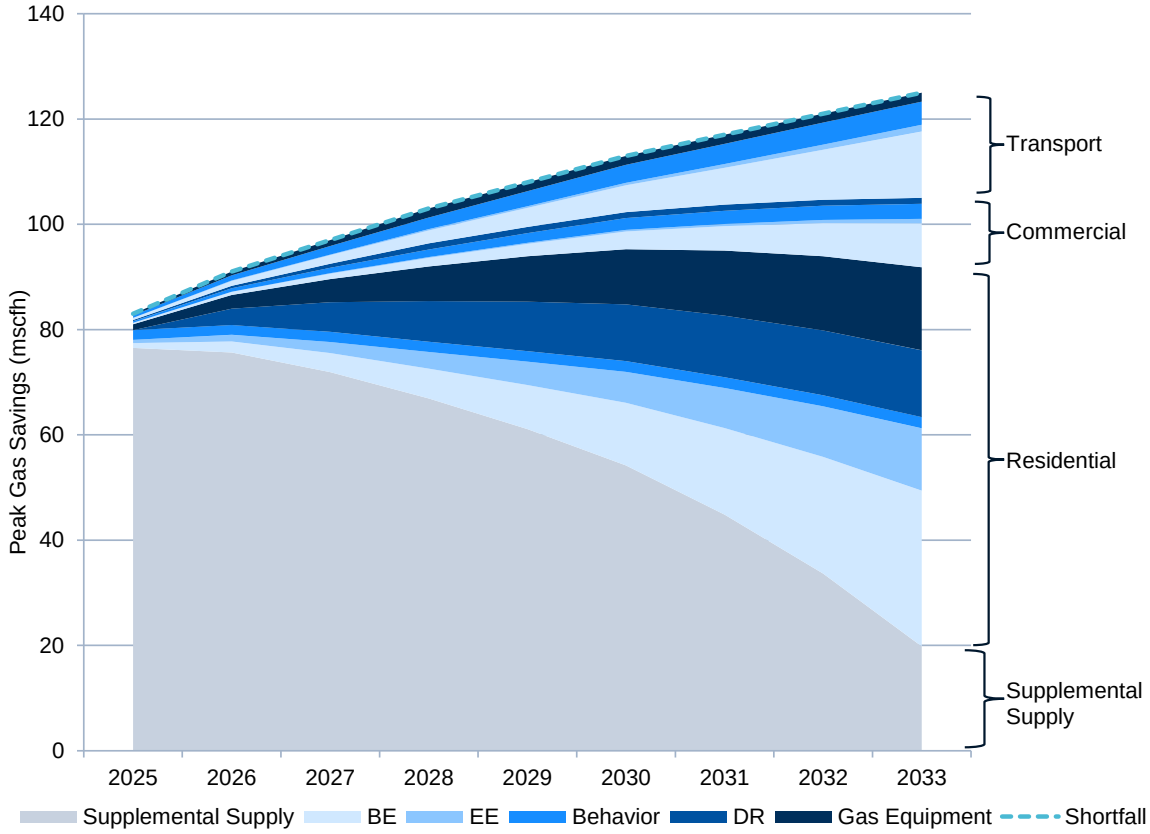


Figure 5-13: Hybrid Portfolio 1 Peak Hour Gas Capacity Delivered to RG-12 (Grand Lake)

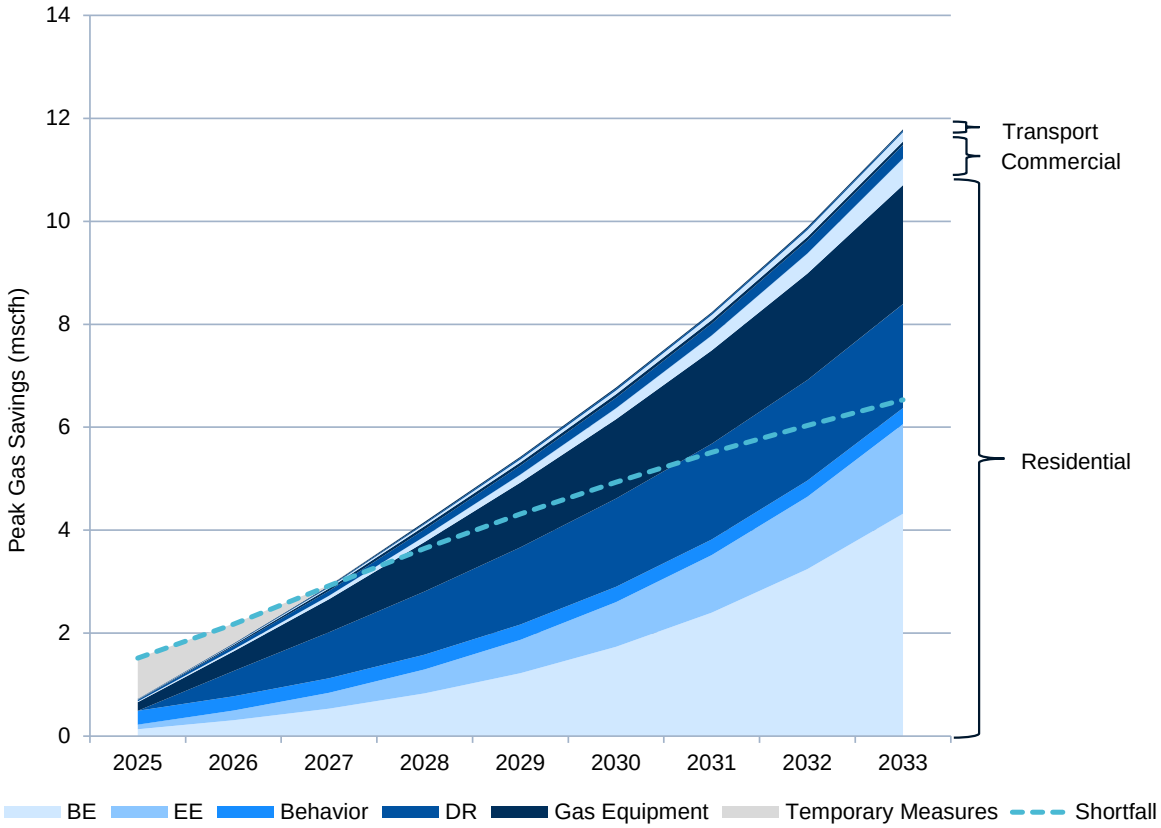


Table 5-4 below shows the resulting impacts and costs associated with the NPA portion of Hybrid Portfolio 1, not including impacts and costs of supplemental supply or temporary measures. The NPA impacts and costs are the same as in NPA Portfolio 2, with a direct utility cost of $390,000/mscfh for the NPA portion. While the savings include savings from furnaces after the federal standard goes into effect in 2029, the costs do not include costs from furnaces after this point in time.

Table 5-4: Hybrid Portfolio 1 NPA Cumulative Impacts and Costs by Year

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2025	27	19	6	1	1,174	$248,040	$5,573,471	$5,821,511
2026	65	44	15	2	2,715	$830,772	$12,735,168	$13,565,890
2027	107	72	25	3	4,745	$1,866,448	$21,568,011	$23,434,460
2028	153	104	36	4	7,424	$3,516,535	$33,376,197	$36,892,732
2029	199	135	46	5	10,951	$5,994,280	$44,781,454	$50,775,734
2030	255	172	59	7	16,393	$9,582,553	$59,560,726	$69,143,280
2031	312	210	72	8	22,714	$14,646,125	$78,570,815	$93,216,940

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2032	377	254	87	10	30,839	$21,648,220	$102,855,043	$124,503,262
2033	454	306	105	12	41,205	$31,177,571	$133,638,398	$164,815,970

While Hybrid Portfolio 1 was able to meet the full required shortfall, the results of Hybrid Portfolio 1 showed relatively high costs of NPA solutions, along with an underutilization of supplemental supply expected in the later years. Higher utilization of the supplemental supply would allow for a smaller (and lower cost) NPA portfolio, by eliminating some of the additional NPA solutions after the shortfall is closed. As a result of these findings in Hybrid Portfolio 1, the team decided to explore further cost optimization in the development of Hybrid Portfolio 2.

5.2.2 Hybrid Portfolio 2

As discussed above, the installation of large quantities of NPA measures has a higher cost than continued use of supplemental supply. Therefore, it was determined to reduce the scope of the NPA portfolio after the initial four years of installation and eliminate high-cost measures and reduce the size of the NPA portion in Hybrid Portfolio 2 after this point to solve the constraint, with continued consistent utilization of supplemental supply in the later years. The resulting Hybrid Portfolio 2 supports system reliability while reducing capitalized gas infrastructure spend.

To optimize the cost of Hybrid Portfolio 2, the PA team applied a more stringent measure-level cost-effectiveness screen to installations occurring after 2029. This rigorous screen resulted in many higher cost measures, including most full electrification measures, to have their incremental NPA incentives eliminated from Hybrid Portfolio 2 after 2029. The team continued to model additional adoption of gas furnaces, without incentives, as required by federal code after 2028.

Figure 5-14, Figure 5-15, and Figure 5-16 show the peak hour gas capacity delivered by Hybrid Portfolio 2 over time for the different measure types by building sector, compared to the shortfall in Breckenridge, Keystone, and Grand Lake, respectively, while adding in contribution from supplemental supply.

It's important to recognize that the peak hour capacity delivered is based on extreme conditions used in gas modeling. As a result, there's a distinction between usage of always-on NPA solutions, including EE and building electrification, and the usage of dispatchable resources, like DR and the supplemental supply solutions.

Figure 5-14: Hybrid Portfolio 2 Peak Hour Gas Capacity Delivered to RB-4 (Breckenridge)

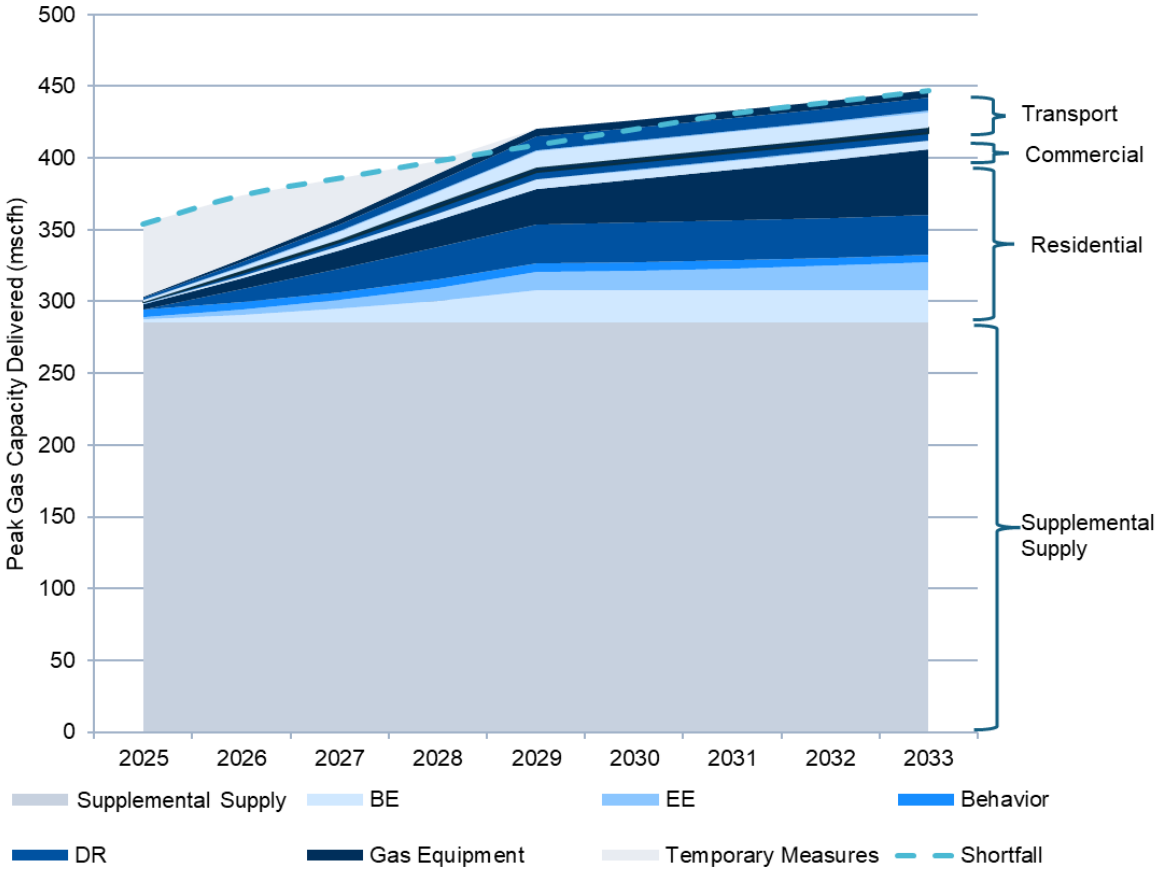


Figure 5-15: Hybrid Portfolio 2 Peak Hour Gas Capacity Delivered to RX-7 (Keystone)

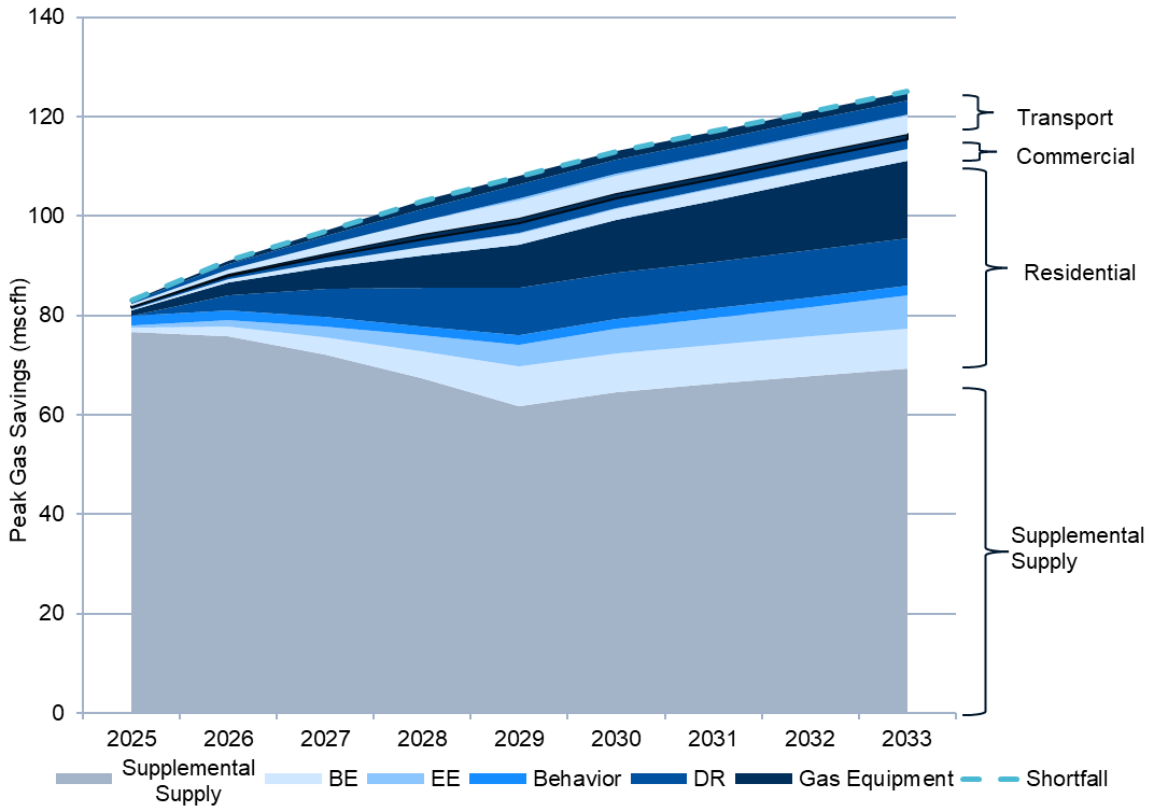
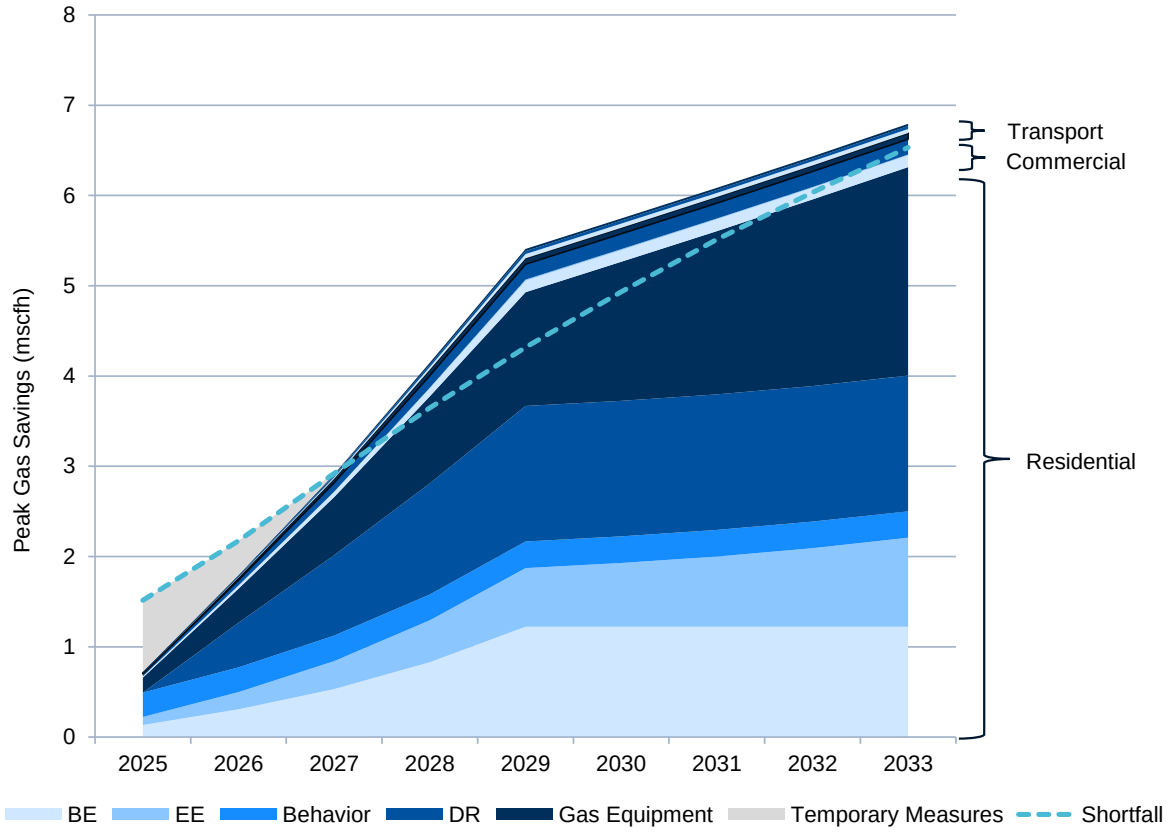


Figure 5-16: Hybrid Portfolio 2 Peak Hour Gas Capacity Delivered to RG-12 (Grand Lake)



In consultation with the Company's implementation team, the team decided to reduce the area served in this portfolio to focus on the areas with the highest concentration of potential savings. The PA team determined that installations in Area 2, Area 3, and Upper Grand Lake, collectively deliver over 85% of the achievable potential benefits in Breckenridge, Keystone, and Grand Lake. As such, the Company's implementation team and PA team determined that the eligible area for implementation will include Area 2, Area 3, and Upper Grand Lake, which includes Summit County and the towns of Grand Lake, Leadville, Red Cliff, and Minturn. As a result, the same potential for savings is expected, but realized over a small geography. By concentrating program marketing effort in a smaller area, the team believes that it will be able to meet the NPA goals more cost-effectively.

The supplemental supply equipment allows for operational contingency against potentially slower than predicted NPA technology adoption, reduces stranded asset risk as compared to piping reinforcements, and provides peak hour demand shaving, as seen in Figure 5-17.

Figure 5-17: Hybrid Portfolio 2 Design Day Peak Hour Demand in 2033

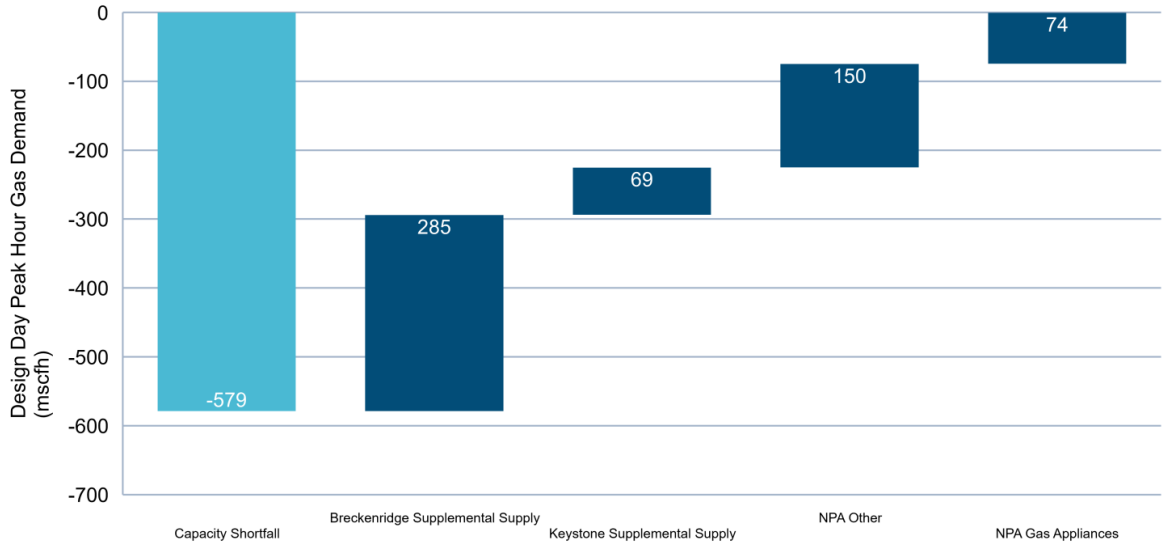


Table 5-5 below shows the cumulative impacts and costs associated with the NPA portion of Hybrid Portfolio 2. The NPA portion has a direct utility cost of $290,000 per mscfh. The NPA-related costs of Hybrid Portfolio 2 are less than half the NPA-related cost of Hybrid Portfolio 1, while the supplemental supply and temporary measures are anticipated to have similar costs. While the savings include savings from furnaces after the federal standard goes into effect in 2029, the costs do not include costs from furnaces after this point in time.

Table 5-5: Hybrid Portfolio 2 NPA Cumulative Impacts and Costs by Year

Year	Premise-level Peak Hour Gas Impact (mscfh)	RB-4 Peak Hour Gas Impact (mscfh)	RX-7 Peak Hour Gas Impact (mscfh)	RG-12 Peak Hour Gas Impact (mscfh)	Electric Grid Impacts (kW)	Marginal Electric Capacity Costs	Program + Incentive Costs	Total Program + Electric Infrastructure Costs
2025	27	19	6	1	1,174	$248,040	$5,573,471	$5,821,511
2026	65	44	15	2	2,715	$830,722	$12,735,168	$13,565,890
2027	107	72	25	3	4,745	$1,866,448	$21,568,011	$23,434,460
2028	153	104	36	4	7,424	$3,516,535	$33,376,197	$36,892,732
2029	199	135	46	5	10,951	$5,994,280	$44,781,454	$50,775,734
2030	209	142	49	6	10,950	$8,521,579	$45,691,415	$54,212,994
2031	219	148	51	6	10,948	$11,099,468	$46,648,431	$57,747,898
2032	229	155	53	6	10,946	$13,728,907	$47,661,588	$61,390,495
2033	239	162	56	7	10,943	$16,410,857	$48,742,311	$65,135,169

5.2.3 Supply Side Measures Supporting the Hybrid Portfolio

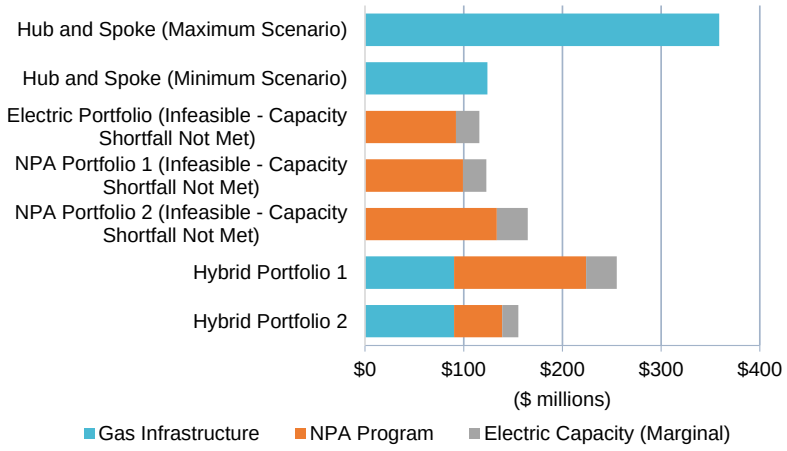
Given the Electric and NPA-Only alternative portfolios were unable to solve for the capacity constraint, a modular LNG site in Breckenridge and a modular CNG site in Keystone were included as part of the Hybrid Portfolios to support system reliability and growth.

Assumptions around the costs associated with these supply side measures, provided by the Company, included temporary LNG and CNG equipment lease payments and modular CNG and LNG costs at Keystone and Breckenridge, respectively. Costs were provided in nominal dollars and reflect the in-service/retire dates.

5.3 Results, and Recommendations

Following development and analysis of optimized alternative portfolios, results support recommendation of Hybrid Portfolio 2. Portfolios were developed to optimized for cost and GHG objectives, while meeting operational requirements. Hybrid Portfolio 2 solves the capacity constraints and is the lowest cost option, while also supporting less reliance on gas infrastructure and progress towards end-use decarbonization. Figure 5-18 shows the 10-year long term plan cost estimates for the potential solutions evaluated.

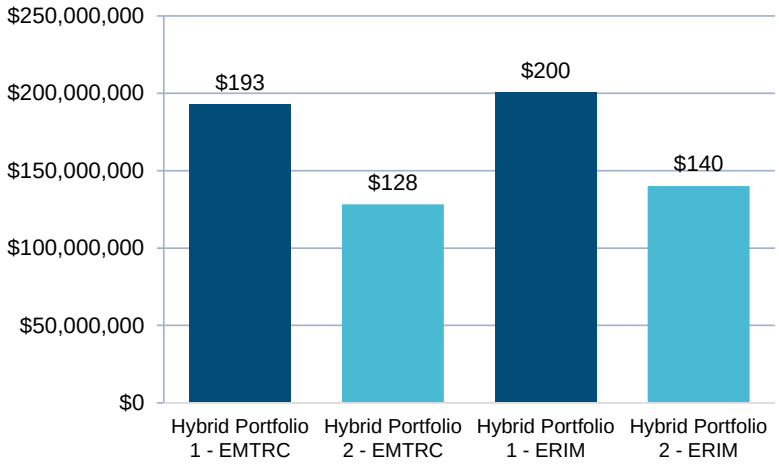
Figure 5-18: 10-Year Long Term Plan Cost Estimates[19]



The implementation of the NPA measures and technologies in Hybrid Portfolio 2 results in end-use emissions reductions, with emissions decreasing 150% as compared to the maximum gas infrastructure solution . The PA team performed the cost-benefit analysis of both Hybrid Portfolio 1 and Hybrid Portfolio 2. As seen in Figure 5-19, Hybrid Portfolio 2 resulted in being more cost-effective as compared to Hybrid Portfolio 1 under both the primary modified total resource cost test (EMTRC) and the secondary expanded, rate-payer impact measure test (ERIM). Hybrid Portfolio 2 is more cost effective than Hybrid Portfolio 1 because Hybrid Portfolio 2 eliminates the implementation of higher-cost NPA measures after the initial four years when the constraint is met. Both Hybrid Portfolio 1 and 2 utilize supplemental supply, the difference being Hybrid Portfolio 2 favors utilization of supplemental supply at a consistent level as the lower-cost alternative to more expensive NPA measures.

[19] Includes the marginal cost of electric capacity.

Figure 5-19: Cost Effectiveness Comparison of Hybrid Portfolios



As seen in Figure 5-20 to 5-22, the modular LNG equipment at the proposed Breckenridge site is assumed to be fully utilized at the equipment maximum flow rate of 285 mscfh in the 2033-'34 heating season on Design Day. If required, additional LNG equipment can be added if the NPA program adoption is less successful than anticipated. The modular CNG equipment at the proposed Keystone site is assumed to be utilized at a flow rate of 69 mscfh in the 2033-'34 heating season on Design Day. If required, additional modular supplemental supply equipment can be added if the NPA program adoption is less successful than anticipated.

Figure 5-20: Hybrid Portfolio 2 Modular LNG Breckenridge

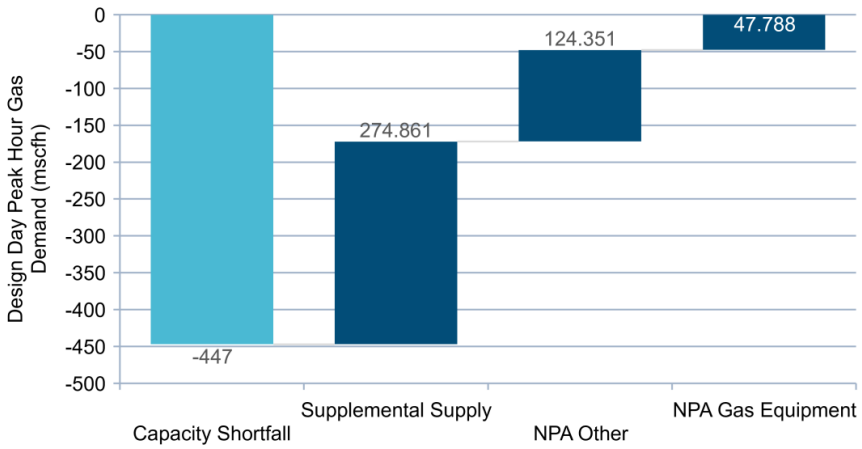


Figure 5-21: Hybrid Portfolio 2 Modular CNG Keystone

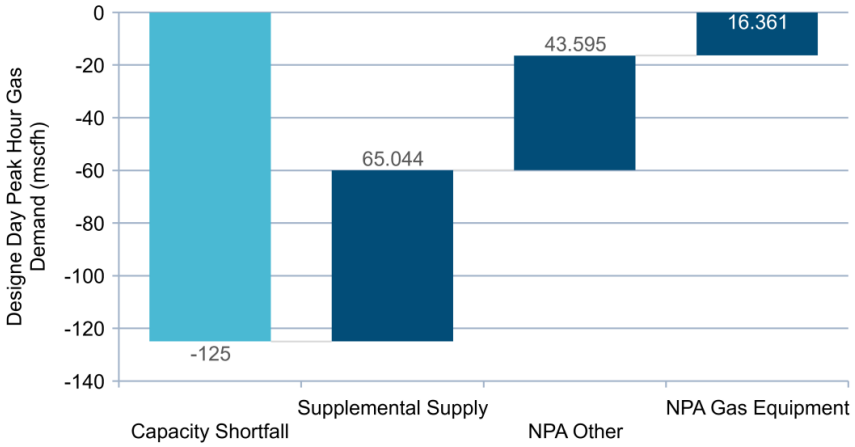
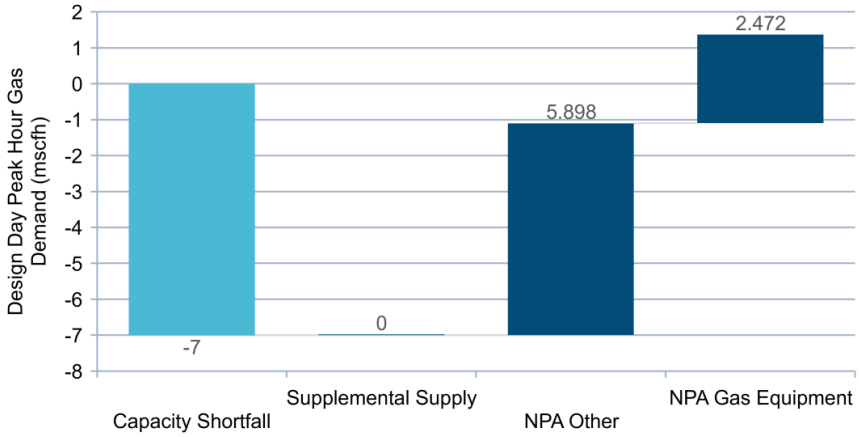


Figure 5-22: Hybrid Portfolio 2 Modular CNG Grand Lake



Hybrid Portfolio 2, which includes gas appliances, reflects the implementation of 34,000 customers within the NPA project area with 80% assumed to be residential and 20% commercial. Hybrid Portfolio 2 includes Behavior Response programs (47% of program), Thermostat DR (9%), Gas EE Appliances (13%), Building Shell Measures (4%), and Electrification (1%).

Hybrid Portfolio 2, in addition to being cost competitive and alleviating the capacity constraint, provides strategic considerations to the Company, especially as the Company navigates decarbonization in an emerging regulatory landscape. By implementing the Hybrid Portfolio 2, the Company can maintain physical flexibility of resources and planning flexibility over the next ten years. Through 2029, to meet the capacity constraint, the Company can fund and progress NPA measures and solutions, allowing the Company to learn about the implementation of NPAs while alleviating the constraint and progressing their decarbonization targets.

5.4 Electrification Analysis

Lastly, to understand the impact of the NPA measures on the electric distribution grid, the electric potential peak impacts at the feeder level were estimated using the portfolio analysis results, using the following steps:

1. For each premise, disaggregate peak hour gas load by end use. For each end use, apply assumed gas combustion efficiency and assumed electric efficiency during peak hours to estimate resulting

energy consumption during peak hour. Add up the peak hour electricity consumption to estimate peak hour electricity demand.

2. Estimate the total added electric demand for 100% electrification for each geographic area in the analysis by summing up the premise-level results from step 1.
3. Compile the estimated added electric demand for each geographic area in Hybrid Portfolio 2, after making adjustments for the planned area for implementation (Area 2, Area 3, and Grand Lake).
4. For each geography, derive the ratio of total potential electric demand increase by dividing the results of step 3 by the results of step 4.
5. For each feeder, estimate the added peak electric demand for 100% electrification by summing up the results of step 1 the feeder level.
6. Map each feeder to a geographic area.
7. For each feeder, multiply the results of step 5 by the electric demand increase ratio for the geographic area corresponding to each feeder to get feeder-level winter peak demand increases.

The resulting winter peak demand increases from the hybrid NPA solution, for each feeder, by year, are shown in Table 5-6 below. Increases stop after 2029, because electrification measures are assumed to be discontinued in Hybrid Portfolio 2 after 2029, along with other measures with poor cost-effectiveness.

Table 5-6. Hybrid Portfolio 2 Winter Peak Demand Increase by Feeder and Year

Cumulative Winter Peak Demand Increase by Year (kW)									
Feeder	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**
BREC2564M	63	145	252	396	585	585	585	585	584
BREC2565M	118	271	473	740	1,091	1,091	1,091	1,090	1,090
BREC2566M	50	116	202	315	461	461	461	461	461
BREC2568M	53	123	214	332	486	486	486	486	486
CLIM2531M	25	58	101	157	228	228	228	228	228
DILL2556M	34	79	137	214	315	315	315	315	315
DILL2557M	34	79	137	214	316	316	316	316	316
DILL2558M	13	30	53	82	120	120	120	120	120
DILL2559M	45	104	181	285	423	423	422	422	422
DILL2591M	6	13	22	34	50	50	50	50	50
GILM2525M	4	9	16	24	36	36	36	36	36
LEAD1205M	3	6	11	17	26	26	26	26	26
LEAD1207M	7	15	27	42	62	62	62	62	62
LEAD1209M	35	81	142	222	327	327	327	327	327
MAYF2541M	28	66	114	177	258	258	258	258	258
MAYF2542M	26	60	105	164	241	241	241	241	241
PTAR2105M	71	163	284	444	655	655	655	654	654
PTAR2107M	79	183	320	501	741	741	741	741	741
SUMM2604M	89	206	359	562	829	829	829	829	828
SUMM2605M	28	65	114	178	263	263	263	263	263
SUMM2606M	30	70	123	191	281	280	280	280	280

5.5 Cost-Benefit Analysis

The cost-benefit analysis provides the framework and support for evaluating the preferred Hybrid Portfolio 2 as compared to a gas infrastructure solution.[20] The primary cost effectiveness test and the modified total resource cost test measures the net cost and benefits of an alternative portfolio, including both energy savings and non-energy benefits. These include utility incentives, equipment costs, and utility system cost that result from the implementation of NPAs, as well as social impacts such as avoided social emissions cost and other non-energy benefits.

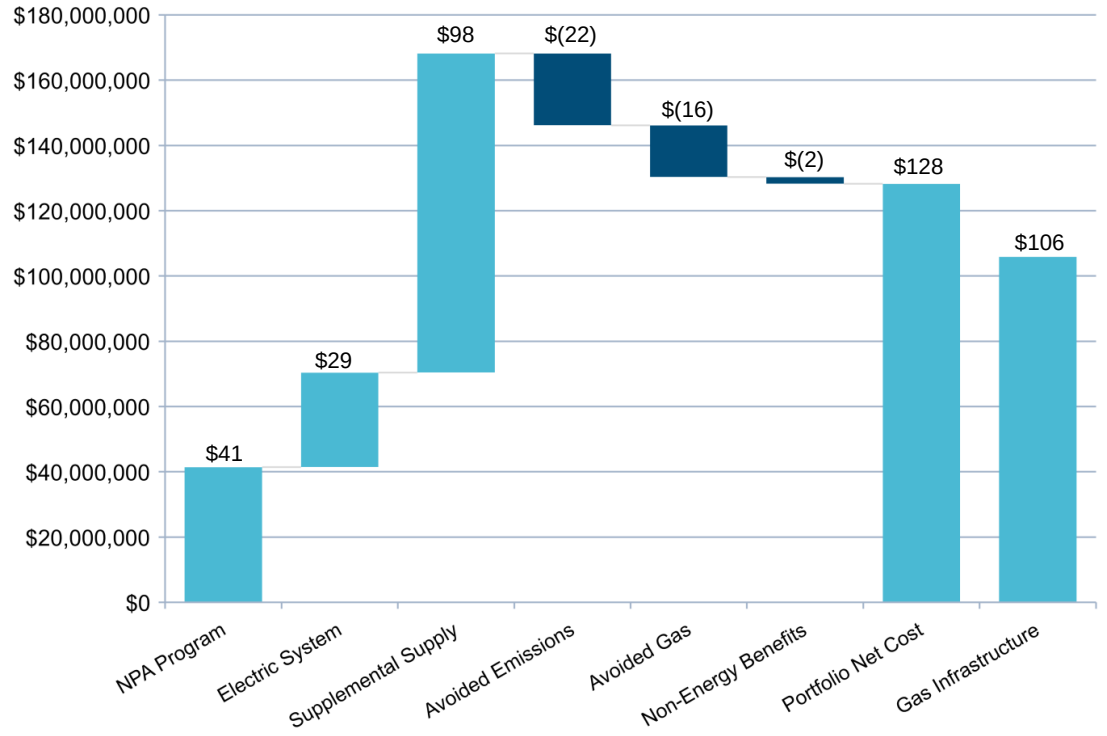
To support the alternative portfolio results and recommendation, a primary and secondary cost effectiveness tests were calculated through a cost-benefit analysis framework. A modified total resource cost test, which is modified to include the benefit of avoided social emissions and other non-energy benefits, was utilized as the primary cost effectiveness test. An expanded ratepayer impact measure test was utilized as a secondary test to review the potential impacts to electric and gas customer rates and was expanded to include the benefit of

[20] The PA team ran the cost-benefit analysis of both Hybrid Portfolio 1 and Hybrid Portfolio 2. Hybrid Portfolio 2 resulted in being more cost-effective under both the primary modified total resource cost and the secondary expanded, rate-payer impact measure test, leading to Hybrid Portfolio 2 being compared to the baseline gas infrastructure solution within this section.

avoided social emissions and other non-energy benefits. The modified total resource cost test resulted in a net present value of cost of $128 million for Hybrid Portfolio 2 and expanded ratepayer impact measure test results in a net present value cost of $140 million.

Hybrid Portfolio 2 reflected the least cost option with the cost-benefit analysis framework reflecting favorable results compared to the gas-only solution. A breakdown of the cost-benefit analysis for Hybrid Portfolio 2 can be seen in Figure 5-23 as compared to the minimum gas infrastructure solution cost.

Figure 5-23: Recommended Hybrid Portfolio 2 EMTRC NPV Cost-Benefit Analysis – Minimum Gas Infrastructure



The Hybrid Portfolio 2 total net present value cost included $41 million for NPA program cost and $29 million for electric system upgrade cost. These costs were offset by benefits for a total net cost for the recommended Hybrid Portfolio 2 of $128 million. These benefits included $22 million benefits from avoided social emissions, $16 million in avoided gas usage, and $2 million which reflect other non-energy benefits. The baseline gas infrastructure solution, provided by the Company, resulted in a cost of $106 million for the minimum scenario and cost of $285 million for the maximum scenario. Figure 5-24 shows the breakdown of the cost-benefit analysis for Hybrid Portfolio 2 as compared to the maximum gas infrastructure solution cost and Figure 5-25 shows the results of the cost-benefit analysis for Hybrid Portfolio 2 as compared to the minimum and maximum gas infrastructure cost.

Figure 5-24: Recommended Hybrid Portfolio 2 EMTRC NPV Cost-Benefit Analysis – Maximum Gas Infrastructure

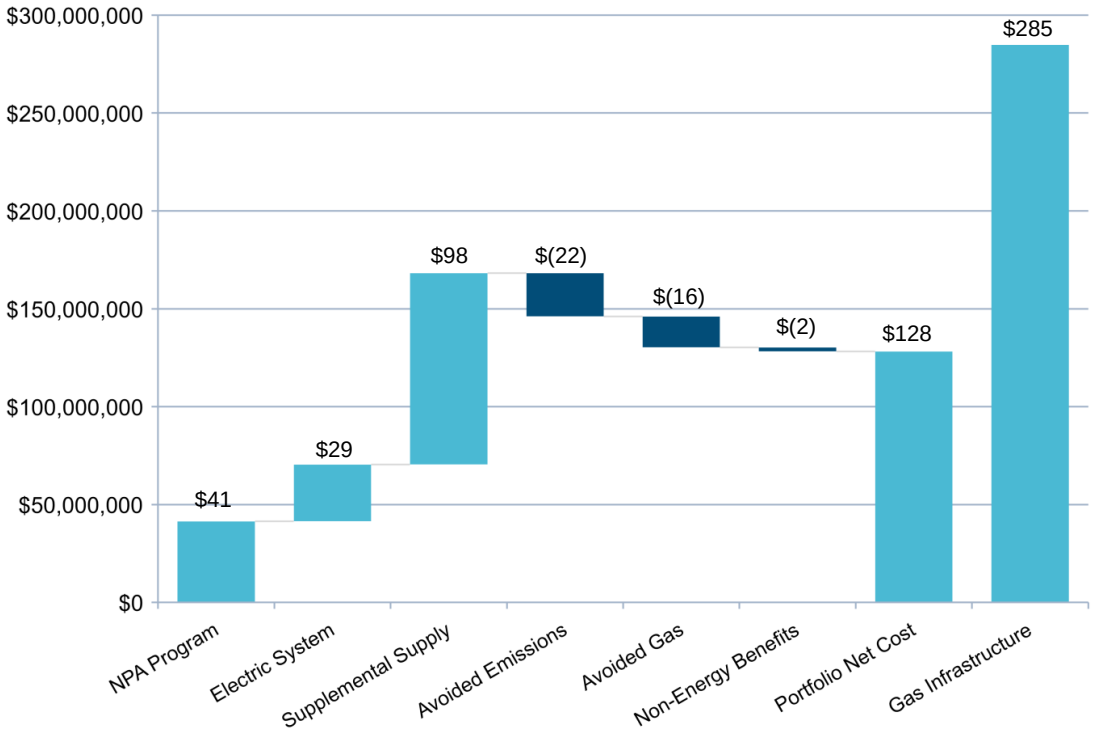
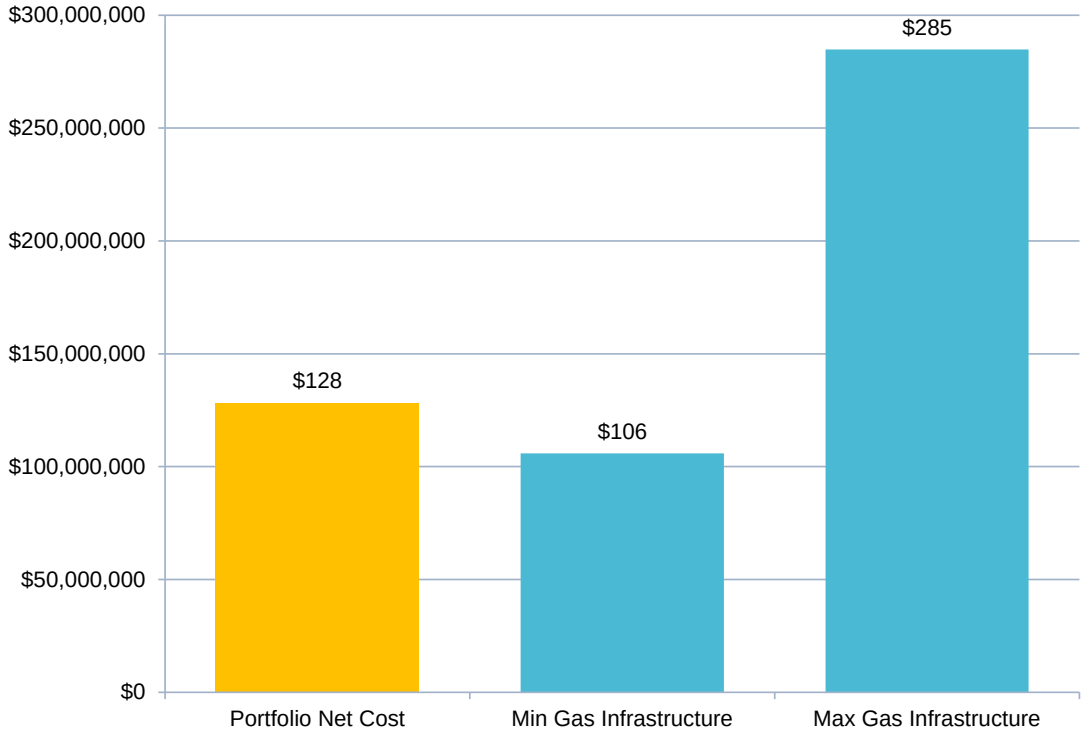


Figure 5-25: Recommended Hybrid Portfolio 2 NPV Cost-Benefit Analysis – Minimum and Maximum Gas Infrastructure



5.5.1 Included, but Not Quantified Costs and Benefits

Many costs and benefits were considered within the cost-benefit analysis framework to evaluate the NPA alternative portfolio as compared to the gas infrastructure solution. Some of these costs and benefits, although considered, are not explicitly quantified within the cost-benefit analysis, referred to as not applicable (N/A) within other PA generated documentation. These cost and benefit impacts are either expected to be minimal or they lack a defensible method for quantification. There are other costs and benefits within the tool that are included, but not quantified (INQ). This means that the component of the analysis was considered as important to the analysis but was challenging, if not impossible, to quantify. The aspects of the analysis would include, but are not limited to, electric reliability cost, NPA reliability benefits, air pollutants, incremental generation methane leakage cost, end of life replacement benefit, upstream benefit, avoided CHP compliance benefit, stranded asset risk, and gas commodity variability benefit.

- Electric reliability cost reflects the incremental investments that may be required to support the reliability of the Company's electric system such as restoration cost or outage cost. Electric reliability costs are considered but not explicitly quantified given lack of defensible method and approach.
- NPA solutions can provide benefits to host by either preventing outages or by reducing the length of outage events. NPA reliability benefits are not quantified explicitly, but the beneficial impact they can provide are considered.
- Air quality and human health can deteriorate due to increased concentration of pollutants like PM 2.5, SO2, and NOX. It is considered that NPA solutions can help reduce the amount of air pollutants, but it is not explicitly quantified.
- Incremental generation methane leakage cost can occur due to the potential increased need to procure fossil-fired generation to support increased electric usage. Incremental generation methane leakage cost is not quantified explicitly in this cost-benefit analysis framework.

- End of life replacement benefit represents a potential benefit value of the avoided future replacement cost of the existing equipment. This is not quantified explicitly given the lack of quantifiable method.
- Upstream benefits reflect a potential benefit of the value of avoided costs such as the cost to acquire upstream pipeline capacity to deliver gas to the Company's system. These benefits are not quantified explicitly in this framework.
- Avoided CHP compliance benefit represents potential value of avoided cost associated with GHG reductions which would be achieved through incremental spend via other programs. This would only be considered if the NPA portfolio is incremental to CHP.
- Stranded Asset risk reflect a potential benefit value of reduced risk of assets becoming stranded prior to being fully depreciated. This is not quantified explicitly in this framework given the lack of defensible quantification methodology.
- Gas commodity variability benefit represents the potential benefit of the value of avoided exposure to gas commodity cost fluctuations due to reduced dependence on natural gas. This potential benefit is acknowledged in this framework, but not quantified explicitly.

5.5.2 Conclusion

The analysis of the considered alternative portfolios demonstrates that Hybrid Portfolio 2 represents the most effective solution for addressing the Eastern Mountain Gas System's capacity constraints. Hybrid Portfolio 2 combines a suite of NPA measures, including gas demand response programs, energy efficient gas appliances, and building shell measures, as well as modular LNG and CNG supplemental supply. Of the alternatives considered, this portfolio best balances cost-effectiveness with environmental considerations and operational flexibility. While the potential analysis indicates that NPA measures alone fail to close the current and forecasted constraint, by combining NPA measures with supplemental supply infrastructure, Hybrid Portfolio 2 is able to solve the constraint while achieving a 150% reduction in emissions compared to the maximum gas infrastructure solution, and at a significantly lower cost than Hybrid Portfolio 1. In addition, Hybrid Portfolio 2 allows for an implementation pathway that maintains optionality for removal of supplementary supply infrastructure should NPA measures be adopted at a faster rate than anticipated, or conversely ensures sufficient supply should NPA adoption lag expectations, while avoiding the stranded asset risk associated with the alternative gas-only infrastructure solution. Of the options considered, Hybrid Portfolio 2 represents the best option for addressing the gas supply constraint, while balancing cost, environmental considerations, and operational flexibility.

6 Appendices

6.1 Measure-level Impacts per Premise

Table 6-1: Residential Single Family Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Air Sealing_Res_Space Heat_Retrofit	10	0.0138	0.249	20.34	-0.02	-46	$492
Attic Insulation_Res_Space Heat_Retrofit	20	0.0082	0.147	12.00	0.00	0	$2,213
Behavioral DR_Res_DR_Retrofit	1	0.0003	0.005	0.00	0.00	0	$10
Boiler Electrification with ccASHP_Res_Space Heat_Early	18	0.0690	1.243	101.54	16.68	12360	$17,872
Boiler Electrification with ccASHP_Res_Space Heat_ROB	18	0.0687	1.237	101.07	16.60	12303	$8,322
Energy Star New Home_Res_Space Heat_New	20	0.0151	0.271	22.15	-0.33	-1035	$3,559
Furnace Electrification with ccASHP_Res_Space Heat_Early	18	0.0690	1.242	101.49	16.67	12360	$17,872
Furnace Electrification with ccASHP_Res_Space Heat_ROB	18	0.0690	1.242	101.49	16.66	12360	$11,544
Gas Furnace Replacement_Res_Space Heat_Early	18	0.0182	0.328	26.83	0.00	0	$4,149
Gas Furnace Replacement_Res_Space Heat_ROB	18	0.0183	0.329	26.90	0.00	0	$1,313
Ground Source Heat Pump_Res_Space Heat_Early	20	0.0730	1.314	107.68	5.89	8229	$74,019
Ground Source Heat Pump_Res_Space Heat_ROB	20	0.0729	1.314	107.68	5.90	8229	$67,846
High Efficiency Boiler Upgrade_Res_Space Heat_Early	20	0.0122	0.220	17.99	0.00	0	$4,408
High Efficiency Boiler Upgrade_Res_Space Heat_ROB	20	0.0122	0.220	17.99	0.00	0	$1,346
Home Energy Report_Res_Space Heat_New	1	0.0014	0.026	2.14	0.00	-152	$4
Home Energy Report_Res_Space Heat_Retrofit	1	0.0015	0.026	2.14	0.00	-152	$4
Low Flow Aerator, Bathroom_Res_Water Heat_Retrofit	10	0.0000	0.000	0.26	0.00	0	$1
Low Flow Aerator, Kitchen_Res_Water Heat_Retrofit	10	0.0000	0.000	0.25	0.00	0	$2
Low Flow Showerhead_Res_Water Heat_Retrofit	10	0.0001	0.001	2.03	0.00	0	$3
Other Space Heat Electrification with ccASHP_Res_Space Heat_Early	18	0.0690	1.243	101.54	16.71	12360	$17,872
Storm Windows_Res_Space Heat_Retrofit	20	0.0020	0.039	3.22	0.00	-771	$149
Thermostat DR_Res_DR_Retrofit	1	0.0110	0.198	0.01	0.00	0	$51
Wall Insulation_Res_Space Heat_Retrofit	20	0.0233	0.420	34.28	0.00	0	$1,458
Whole Building Electrification_Res_Space Heat_New	18	0.0720	1.296	106.01	17.41	-2	$18,408

Table 6-2: Residential Multifamily Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Air Sealing_Res_Space Heat_Retrofit	10	0.0106	0.190	15.50	-0.01	-35	$375
Attic Insulation_Res_Space Heat_Retrofit	20	0.0062	0.112	9.14	0.00	0	$1,686
Behavioral DR_Res_DR_Retrofit	1	0.0002	0.004	0.00	0.00	0	$8
Boiler Electrification with ccASHP_Res_Space Heat_Early	18	0.0525	0.947	77.36	12.70	9417	$13,617
Boiler Electrification with ccASHP_Res_Space Heat_ROB	18	0.0523	0.943	77.01	12.67	9374	$6,341
Energy Star New Home_Res_Space Heat_New	20	0.0115	0.207	16.88	-0.25	-789	$2,711
Furnace Electrification with ccASHP_Res_Space Heat_Early	18	0.0526	0.946	77.32	12.70	9417	$13,617
Furnace Electrification with ccASHP_Res_Space Heat_ROB	18	0.0525	0.947	77.32	12.71	9417	$8,796
Gas Furnace Replacement_Res_Space Heat_Early	18	0.0139	0.250	20.44	0.00	0	$3,161
Gas Furnace Replacement_Res_Space Heat_ROB	18	0.0139	0.251	20.50	0.00	0	$1,000
Ground Source Heat Pump_Res_Space Heat_Early	20	0.0557	1.002	82.04	4.48	6270	$56,395
Ground Source Heat Pump_Res_Space Heat_ROB	20	0.0571	1.001	82.04	4.57	6270	$51,692
High Efficiency Boiler Upgrade_Res_Space Heat_Early	20	0.0093	0.168	13.71	0.00	0	$3,358
High Efficiency Boiler Upgrade_Res_Space Heat_ROB	20	0.0093	0.168	13.71	0.00	0	$1,025
Home Energy Report_Res_Space Heat_New	1	0.0011	0.020	1.63	0.00	-116	$3
Home Energy Report_Res_Space Heat_Retrofit	1	0.0011	0.020	1.63	0.00	-116	$3
Low Flow Aerator, Bathroom_Res_Water Heat_Retrofit	10	0.0000	0.000	0.20	0.00	0	$0
Low Flow Aerator, Kitchen_Res_Water Heat_Retrofit	10	0.0000	0.000	0.19	0.00	0	$1
Low Flow Showerhead_Res_Water Heat_Retrofit	10	0.0000	0.001	1.55	0.00	0	$3
Other Space Heat Electrification with ccASHP_Res_Space Heat_Early	18	0.0528	0.947	77.36	12.75	9417	$13,617
Storm Windows_Res_Space Heat_Retrofit	20	0.0003	0.030	2.45	0.00	-587	$114
Thermostat DR_Res_DR_Retrofit	1	0.0084	0.151	0.01	0.00	0	$39
Wall Insulation_Res_Space Heat_Retrofit	20	0.0177	0.320	26.12	0.00	0	$1,111
Whole Building Electrification_Res_Space Heat_New	18	0.0548	0.987	80.77	13.25	-1	$14,025

Table 6-3: Commercial Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Com Air Sealing_Com_Space Heat_Retrofit	20	0.0202	0.367	31.61	0.00	0	$33,622
Com ASHP_Com_Space Heat_Early	20	0.1599	2.876	244.95	38.09	29770	$18,924
Com ASHP_Com_Space Heat_ROB	20	0.1590	2.876	244.95	38.13	29770	$7,750
Com Gas Condensing Boiler_Com_Space Heat_Early	20	0.0243	0.437	37.26	0.00	0	$8,165
Com Gas Condensing Boiler_Com_Space Heat_ROB	20	0.0243	0.437	37.26	0.00	0	$3,629
Com Gas Furnace_Com_Space Heat_Early	20	0.0252	0.454	38.66	0.00	0	$3,629
Com Gas Furnace_Com_Space Heat_ROB	20	0.0251	0.454	38.66	0.00	0	$3,629
Com Load Shedding_Com_DR_Retrofit	1	0.4354	7.838	0.44	0.00	0	$4,898
Com VRF_Com_Space Heat_Early	16	0.1598	2.875	244.95	15.22	29770	$74,368
Com VRF_Com_Space Heat_ROB	16	0.1590	2.876	244.95	15.26	29770	$62,941
Commercial Roof Insulation_Com_Space Heat_Retrofit	20	0.0277	0.505	43.04	0.00	0	$7,409
Commercial Wall Insulation_Com_Space Heat_Retrofit	20	0.0905	1.646	140.31	0.00	0	$38,802
Commercial Windows_Com_Space Heat_Retrofit	20	0.0891	1.607	136.87	0.00	0	$33,185
Gas Process Condensing Boiler_Com_Process_ROB	20	0.0000	0.000	2.25	0.00	0	$219
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_Early	20	0.1759	3.155	259.80	16.09	19178	$203,680
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_ROB	20	0.1702	3.066	256.29	15.78	18919	$191,773
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_Early	20	0.1748	3.155	259.80	16.19	19178	$203,680
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_ROB	20	0.1719	3.067	256.29	16.03	18919	$191,773
HPWH_Com_Water Heat_ROB	15	0.0012	0.045	26.34	0.10	1943	$1,003

Table 6-4: Commercial Multifamily Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Com Air Sealing_Com_Space Heat_Retrofit	20	0.0258	0.487	35.28	0.00	0	$37,518
Com ASHP_Com_Space Heat_Early	20	0.2048	3.673	285.11	44.31	34651	$22,027
Com ASHP_Com_Space Heat_ROB	20	0.2073	3.672	285.12	44.36	34651	$9,021
Com Gas Condensing Boiler_Com_Space Heat_Early	20	0.0314	0.559	43.37	0.00	0	$9,503
Com Gas Condensing Boiler_Com_Space Heat_ROB	20	0.0312	0.559	43.37	0.00	0	$4,224
Com Gas Furnace_Com_Space Heat_Early	20	0.0318	0.580	45.00	0.00	0	$4,224
Com Gas Furnace_Com_Space Heat_ROB	20	0.0317	0.580	45.00	0.00	0	$4,224
Com Load Shedding_Com_DR_Retrofit	1	0.5064	9.122	0.51	0.00	0	$5,697
Com VRF_Com_Space Heat_Early	16	0.2045	3.672	285.11	17.72	34651	$86,562
Com VRF_Com_Space Heat_ROB	16	0.2000	3.671	285.11	17.34	34651	$73,260
Commercial Roof Insulation_Com_Space Heat_Retrofit	20	0.0340	0.645	50.10	0.00	0	$8,624
Commercial Wall Insulation_Com_Space Heat_Retrofit	20	0.1121	2.105	163.31	0.00	0	$45,164
Commercial Windows_Com_Space Heat_Retrofit	20	0.1083	2.057	159.31	0.00	0	$38,626
Gas Process Condensing Boiler_Com_Process_ROB	20	0.0000	0.000	0.00	0.00	0	$0
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_Early	20	0.2190	3.885	286.36	17.83	21139	$224,502
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_ROB	20	0.2126	3.832	288.54	17.42	21299	$215,900
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_Early	20	0.2187	3.886	286.35	17.86	21139	$224,502
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_ROB	20	0.2117	3.836	288.54	17.25	21300	$215,900
HPWH_Com_Water Heat_ROB	15	0.0013	0.103	109.76	0.40	8096	$4,181

Table 6-5: Transport Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Com Air Sealing_Com_Space Heat_Retrofit	20	0.1914	3.476	294.16	0.00	0	$312,843
Com ASHP_Com_Space Heat_Early	20	1.6564	29.810	2574.31	400.15	312873	$198,882
Com ASHP_Com_Space Heat_ROB	20	1.6529	29.810	2574.32	400.34	312873	$81,450
Com Gas Condensing Boiler_Com_Space Heat_Early	20	0.2518	4.534	391.56	0.00	0	$85,807
Com Gas Condensing Boiler_Com_Space Heat_ROB	20	0.2523	4.534	391.56	0.00	0	$38,137
Com Gas Furnace_Com_Space Heat_Early	20	0.2617	4.704	406.28	0.00	0	$38,137
Com Gas Furnace_Com_Space Heat_ROB	20	0.2619	4.704	406.28	0.00	0	$38,137
Com Load Shedding_Com_DR_Retrofit	1	4.5771	82.375	4.58	0.00	0	$51,492
Com VRF_Com_Space Heat_Early	16	1.6544	29.811	2574.32	159.99	312873	$781,580
Com VRF_Com_Space Heat_ROB	16	1.6622	29.804	2574.30	160.03	312871	$661,475
Commercial Roof Insulation_Com_Space Heat_Retrofit	20	0.2897	5.240	452.36	0.00	0	$77,865
Commercial Wall Insulation_Com_Space Heat_Retrofit	20	0.9447	17.076	1474.61	0.00	0	$407,791
Commercial Windows_Com_Space Heat_Retrofit	20	0.9247	16.654	1438.48	0.00	0	$348,762
Gas Process Condensing Boiler_Com_Process_ROB	20	0.0000	0.113	57.22	0.00	0	$5,587
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_Early	20	1.6440	29.584	2543.86	158.29	187787	$1,994,371
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_ROB	20	1.6829	30.241	2619.90	162.79	193400	$1,960,382
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_Early	20	1.6451	29.578	2543.86	158.12	187787	$1,994,373
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_ROB	20	1.6785	30.241	2619.93	162.68	193402	$1,960,405
HPWH_Com_Water Heat_ROB	15	0.0830	1.572	415.69	2.57	30663	$15,836

Table 6-6: Transport Multifamily Weighted Average Measure Characteristics

NPA Measure Name	Measure Life (years	Peak hour demand reduction per unit (mscfh)	Peak day demand reduction per unit (mscfd)	Annual mscf reduction per unit	Electric peak demand impact per unit (winter kW) - increase/(decrease	Electric energy load impact per unit (kWh) - increase/(decrease	NPA incentive strategy cost per premise ($)
Com Air Sealing_Com_Space Heat_Retrofit	20	0.2271	4.104	326.36	0.00	0	$347,084
Com ASHP_Com_Space Heat_Early	20	1.3156	23.701	1737.51	270.23	211171	$134,234
Com ASHP_Com_Space Heat_ROB	20	1.3095	23.698	1737.51	270.26	211171	$54,974
Com Gas Condensing Boiler_Com_Space Heat_Early	20	0.1991	3.605	264.28	0.00	0	$57,915
Com Gas Condensing Boiler_Com_Space Heat_ROB	20	0.2002	3.605	264.28	0.00	0	$25,740
Com Gas Furnace_Com_Space Heat_Early	20	0.2065	3.740	274.21	0.00	0	$25,740
Com Gas Furnace_Com_Space Heat_ROB	20	0.2083	3.741	274.21	0.00	0	$25,740
Com Load Shedding_Com_DR_Retrofit	1	3.0868	55.598	3.09	0.00	0	$34,727
Com VRF_Com_Space Heat_Early	16	1.3173	23.700	1737.51	108.07	211171	$527,520
Com VRF_Com_Space Heat_ROB	16	1.3094	23.697	1737.50	108.62	211170	$446,457
Commercial Roof Insulation_Com_Space Heat_Retrofit	20	0.2246	4.160	305.31	0.00	0	$52,554
Commercial Wall Insulation_Com_Space Heat_Retrofit	20	0.7471	13.588	995.28	0.00	0	$275,234
Commercial Windows_Com_Space Heat_Retrofit	20	0.7348	13.233	970.89	0.00	0	$235,393
Gas Process Condensing Boiler_Com_Process_ROB	20	0.0000	0.000	0.00	0.00	0	$0
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_Early	20	1.5033	27.186	1966.23	121.48	145147	$1,541,516
Ground Source Heat Pumps (Specific Location) Boiler baseline_Com_Space Heat_ROB	20	1.3558	24.298	1741.19	108.16	128534	$1,302,878
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_Early	20	1.5118	27.187	1966.23	121.93	145147	$1,541,517
Ground Source Heat Pumps (Specific Location) Furnace baseline_Com_Space Heat_ROB	20	1.3620	24.300	1741.27	109.23	128539	$1,302,919
HPWH_Com_Water Heat_ROB	15	0.0382	1.039	745.26	3.39	54972	$28,391

6.2 Residential Customer Survey Questionnaire

Introduction

Thank you for providing feedback to help Xcel Energy develop rebate programs. The information you provide will help Xcel Energy improve offerings to help your household and others better manage their energy consumption.

This survey should take approximately 10-15 minutes to complete.

If you have any questions about this research effort or technical difficulties completing the survey, please contact [**Contact name**] at [**email address and/or phone number**].

Q1. Do you own or rent this home at **<premise address>**?

[SELECT ONE]

Own

Rent

Other, please specify: [OPEN-ENDED RESPONSE]

Q1a. [If Q41=b] As a renter, how much influence do you have with the landlord for decisions about heating and water heating equipment in your home?

a. A lot of influence

b. Some influence

c. Minimal influence

d. No influence

e. Not sure

Awareness & Barriers

[ASK ALL]

Q2. How do you heat your home at **<premise address>**? Please put a check by the type of heating systems used at this home.

[RANDOMIZE LIST]

Heating Equipment	**Check if applicable.**
a. Gas Furnace	
b. Gas Boiler	
c. Electric Furnace	
d. Electric Resistance Heat	
e. Ducted Air Source Heat Pump	
f. Ground Source Heat Pump	
g. Ductless Heat Pump	
h. Electric or Oil Space Heaters	

i. Wood Boiler, Fireplace or stove	
j. Gas Fireplace or stove	
k. Pellet stove	
l. Other (specify)	

Q3. [if Q2 has more than one response] Which of these is the primary source of heat for your home and what is the age of that equipment? Please choose the equipment that serves most of your heating needs and note the approximate age.

[FILTER LIST WITH A CHECK FROM 0]

Heating Equipment	**Q1a. Check One**	**Q1b. Approximate Age of Equipment** (Years)
a. Gas Furnace		
b. Gas Boiler		
c. Electric Furnace		
d. Electric Resistance Heat		
e. Ducted Air Source Heat Pump		
f. Ground Source Heat Pump		
g. Ductless Heat Pump		
h. Electric or Oil Space Heaters		
i. Wood Boiler, Fireplace or stove		
j. Gas Fireplace or stove		
k. Pellet stove		
l. Other (specify)		
m. Don't know		

Q4. How do you heat your water? Please put a check by the type of water heater in the home at **<premise address>**. [RANDOMIZE LIST]

Water Heating Equipment	**Check if applicable**
a. Gas Storage Water Heater	
b. Gas Tankless Water Heater	

c. Electric Storage Water Heater	
d. Electric Tankless Water Heater	
e. Gas Boiler	
f. Electric Boiler	
g. Wood Boiler	
h. Electric Heat Pump Water Heater	
i. Other (specify)	

Q5. What other natural gas-fueled equipment is in your home at <premise address>? Please mark the number of each gas-fueled equipment type in the home.

Other Natural Gas-Fueled Equipment	**Number**
a. Stove	
b. Oven	
c. Snowmelt system	
d. Fire pit	
e. Fireplace	
f. Dryer	
g. Grill	
h. Other (specify)	

Q6. Which of the following best describes how well sealed and insulated your home is against outside air leaks at **<premise address>**?

[SELECT ONE]

Very well sealed and insulated, we have high levels of insulation and no drafts.

Somewhat well sealed and insulated.

Not well sealed insulated, we have little insulation and significant drafts.

Don't know.

Q7. Are you familiar with any Xcel Energy rebate or incentive programs?

[SELECT ONE]

Yes

No

Q8. [IF Q58=1] Have you previously participated in an Xcel Energy program where you received a rebate or incentive or free items for installing energy efficient equipment or modifying your household's energy use?

[SELECT ONE]

Yes

No

Don't know

Q9. Which of the following, if any, local, state or federal incentives are you familiar with that encourage energy efficiency and electrification?

[SELECT ALL THAT APPLY]

Federal tax credits

Upcoming federal rebates

Colorado state tax incentives

Rebates offered by some city or county governments.

Q10. Xcel Energy offers multiple programs to save natural gas. Please indicate your level of willingness to participate in each of the types of savings opportunities listed below. [IF Q1a=a or b, ADD "As a renter, when deciding your level of willingness to participate, please also consider your landlord's potential willingness".]

[If Q1a=c OR d, SKIP Q61a, b, d, f, i]

Savings Opportunity	Display Logic	1. Very interested, depending on the details	2. Possibly interested, depending on the details	3. Not at all interested	4. Would not be applicable to this home
Q61 a. [If 0a or 0b = 1] Replacing your working gas heating equipment with an electric heat pump or a combination of heat pump with wood, pellets or additional electric resistance heat.	Primary gas heat Either own OR rent and have some/a lot of influence				
Q61b. [If 0a or 0b=1] upgrading your gas heating equipment to a more efficient version (AFUE 97% furnace or 95% boiler)	Primary gas heat Either own OR rent and have some/a lot of influence				

Savings Opportunity	Display Logic	1. Very interested, depending on the details	2. Possibly interested, depending on the details	3. Not at all interested	4. Would not be applicable to this home
Q61c. [If Q2a or 0b = 1] reducing your thermostat setting by up to 4 degrees on the coldest days in exchange for an incentive or rate reduction.	Primary gas heat				
Q61d. [If 0 =1 for a, b, or e] replacing your gas water heating equipment with an efficient electric version	Gas water heating Either own OR rent and have some/a lot of influence				
Q61 e. [If 0=1 for a, b, or e] reducing your gas water heating usage on the coldest days in exchange for an incentive or rate reduction.	Gas water heating				
Q61f. [If Q55=1 for a-g] replacing any of your other gas appliances or equipment with an efficient electric or other fuel version [repeat for each Q55a-h=1].	Either own OR rent and have some/a lot of influence				
Q61g. [If Q55=1 for a-h] Not using any of your other gas appliances or equipment on the coldest days in exchange for an incentive or rate reduction. [repeat for each a-h>1]					
Q61h. Incentives to add insulation and air sealing.					
Q61i. [(If 0a or b=1 and [0=1 for a or b or Q55=1 for any of a-h)] incentives to replace all the gas equipment in my home with equipment using alternate fuels.	Primary gas heat Gas water heating OR other gas appliance Either own OR rent and have some/a lot of influence PRIMARYGASHEAT = TRUE AND NONHEATINGGASAPPLIANCE = TRUE				

Q11. [If all responses to Q61a-i=3 or 4 (but at least one of them is a 3] Why would you not be interested in any incentives to replace or reduce gas usage?

[OPEN-ENDED RESPONSE]

Q12. Does your home <at premise address> currently have an air conditioning system?

a. Yes

b. No

Q13. [If Q12=2] If you were to upgrade your heating system, how likely would you be to [if Q1a=a or b, insert "ask your landlord to"] add air conditioning?

a. Very likely

b. Somewhat likely

c. Not very likely

Not at all likely

Don't know

[IF Q10a=a or b]

Q14. [IF Q1a=a,b ADD "For the next several questions we are going to ask about specific scenarios for you to consider financial incentives to participate in a program. As a renter, when deciding your level of willingness to participate, please also consider what you think your landlord's potential willingness would be". [IF 0 0=1 or 2] Replacing a working gas heating system with an electric heat pump that includes a backup electric or pellet stove heater for very cold days may cost around $16,000 and can provide air conditioning. Assuming, no change to your combined gas and electricity bills, if the net cost to you was $8,000, how likely is it that you would convert your system?

a. Very likely

b. Somewhat likely

c. Not very likely

d. Not at all likely

[If Q14=a] Q654a**.** And how likely would you be to convert if your net cost was $11,200.

[If Q654=b, c, or d] Q654b. How likely would you be to convert it was free to you?

[If Q14b = b, c, or d] Q14c. How likely would you be to convert if it was free to you and Xcel Energy paid an additional incentive of $2,000.

Q15. [If Q654, Q654a, Q14b or Q14c= a or b] In this scenario, assume your annual heating costs increase with the new system and are now $1,000 more per year than they were with the old system. If the net cost of the system was free to you, how likely is it that you would convert your system?

a. Very likely

b. Somewhat likely

c. Not very likely

d. Not at all likely

[If Q66 = b, c, or d] Q66a. How likely would you be to convert in this scenario if it was free to you and Xcel Energy paid you an incentive of $2,000 on top of the free equipment?

Q16. [If Q61a=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to convert your system? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q17. [If Q61a=1 or 2] Replacing a working gas heating system with a higher efficiency furnace or boiler may cost around $6,000. Assume this upgrade saves approximately $250 per year on your gas bill. If the net cost to you was $3,000, how likely is it that you would upgrade your furnace or boiler?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q17 = a] Q17a. And how likely would you be to convert if the net cost to you was $4,200?

[If Q17 = b, c, or d] Q17b. How likely would you be to convert if it was free to you?

Q18. [If Q17, Q17a, or Q17b = a or b] In this scenario assume that furnace or boiler upgrade to a higher efficiency model costs around $6,000 and saves about $100 on your monthly heating costs. If the net cost to you was $3,000, how likely is it that you would upgrade your furnace or boiler?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q18 = a] Q18a. And how likely would you be to upgrade if the net cost to you was $4,200?

[If Q18 = b, c, or d] Q18b. How likely would you be to upgrade if it was free to you?

Q19. [If Q61a=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to upgrade your system? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q20. [If Q61c=1 or 2] Reducing your gas use for heating on the coldest days would require lowering the thermostat setting in your home. Xcel Energy could connect a device to automatically adjust your thermostat setting to a lower level by a maximum of 4 degrees for up to 4 hours per day and up to 20 days per year. If Xcel Energy paid you $250 per year to join this program and provided one day notice to connect to your thermostat, how likely is it that you would participate?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q69=a] Q69a. And how likely would you be to participate if the incentive were $125 per year?

[If Q69 = b, c, or d] Q69b. How likely would you be to participate if the incentive were $350 per year?

[If Q69b. = b, c, or d] Q69c. How likely would you be to participate if the incentive were $500 per year?

Q21. [If Q61c=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

WATER HEATING

Q22. [If Q61d=1 or 2] Replacing a working gas water heating system with an electric heat pump water heater may cost about $5,000. Assuming no change to your combined gas and electricity bills, if the net cost to you was $2,500, how likely is it that you would convert your system?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q72= a] Q72a. And how likely would you be to convert if the net cost to you was $3,500?

[If Q72 = b, c, or d] Q72b. How likely would you be to convert if it was free to you?

Q23. [If Q61d=1 or 2] In this scenario, assume your energy costs increase with the new system, by about $100 per year. If the net upfront cost to you was $2,500 how likely is it that you would convert your system?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q73 = b, c, or d] Q73a. How likely would you be to convert if it was free to you?

[If Q73c. = b, c, or d] Q73b. How likely would you be to convert if it was free to you and Xcel Energy paid you an additional incentive of $500?

Q23c. Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe:

a. [Open Ended Response]

b. No

Q24. [If Q61e=1 or 2] Reducing your gas use for water heating on the coldest days would require Xcel Energy to connect a device to cycle your water heater so that it heats less often and effectively reduces the amount of hot water available on a given morning. If Xcel Energy paid you $50 for each year to connect to your water heater with one day notice and reduce the amount of time it was heating for up to 10 days per year, how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q24= a] Q24a. And how likely would you be to participate if the incentive were $35 per year.

[If Q24a= a] Q24b. And how likely would you be to participate if the incentive were $20 per year?

[If Q24= b, c, or d] Q24c. How likely would you be to participate if the incentive were $75 per year?

[If Q24c= b, c, or d] Q24d. How likely would you be to participate if the incentive were $100 per year?

Q25. [If Q61e=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

SHELL MEASURES

Q26. [If Q61h=1 or 2] Depending on your existing home's condition, adding insulation and air sealing for a typical 2,250 square foot home could cost around $2,200. Assuming you save approximately $120 per year on your energy bill, if the net upfront cost to you was $1,100 how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q84 = a] Q84a. How likely would you be to participate if the net cost to you was $1,540?

[If Q84 = b, c, or d] Q84b. How likely would you be to participate if the net cost to you were $440?

[If Q84b = b, c, or d] Q84c. How likely would you be to participate if it was free to you?

Q27. [If Q61h=1 or 2] In this scenario, assume that adding insulation and air sealing saves $35 per year on your energy bills and the costs of adding insulation and air sealing for a typical 2,250 square foot home are around $1,600. If the net cost to you was $800, how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q27=a] Q27a. How likely would you be to participate if the net cost to you was $1,120?

[If Q27= b, c, or d] Q27b. How likely would you be to participate if the net cost to you was $320?

[If Q27b. is still b, c, or d] Q27c. How likely would you be to participate if Xcel Energy it was free to you?

Q28. [If Q61h=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

WHOLE HOME

Q29. [If Q61a=1 or 2] Converting your entire home from gas heating and water heating to heat pump technologies [if any of Q55 a-h=1 insert “and <technologies from a-h>] plus adding insulation and air sealing may cost around $24,000 and. provides air conditioning. Assuming your combined gas and electricity bills do not change, if the net cost to you was $12,000, how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q29= b, c, or d] Q29a. How likely would you be to participate if the net cost to you was $4,800?

[If Q29a. = b, c, or d] Q29b. How likely would you be to participate if it was free to you?

Q30. [If Q61a=1 or 2] In this scenario, assume that converting your entire home from gas to electric increases your combined gas and electric bills by around $1,000 per year. The new heating, water heating systems [if any of Q55 a-h=1 insert “and <technologies from a-h>] plus added insulation and air sealing may cost around $24,000 and also provide air conditioning. If these whole home improvements were free to you, how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

[If Q30= b, c, or d] Q30a. How likely would you be to participate if it was free to you, and you received an additional incentive of $2,000?

Q31. [If Q61a=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

DEMOGRAPHICS

[ASK ALL]

Q32. Thank you for your responses so far. We just have a few more questions that will help us ensure Xcel Energy's program offerings reach all its customers.

Which of the following best describes your home?

[SELECT ONE]

1. Single family, detached (does not share any walls with another home)

2. Single family, attached (shares one or more walls with another home)

3. Unit in a multifamily building with three or more units

4. Manufactured/mobile home

96. Other, please specify: [OPEN-ENDED RESPONSE]

98. Prefer not to answer

[IF Q32=3 (live in a multifamily building)]

Q33. How many units are in the building where you live?

Enter number of units: [NUMERIC RESPONSE]

98. Prefer not to say

[ASK ALL]

98.

[ASK ALL]

Q34. [If Q41=b] Which of the following most closely matches your household's situation?

[SELECT ONE

My household pays Xcel Energy directly for all the electricity and natural gas used in the home.

My household pays Xcel Energy directly for only the natural gas used in the home.

My household pays an Xcel Energy bill for some of the energy used in the home, but the bill for energy used by some equipment (e.g. heating, hot water) is included in our rent or otherwise covered by the landlord.

96. Other, please specify: [OPEN-ENDED RESPONSE]

99. Prefer not to answer

Q35. [If Q41=a] Do you rent this home to others?

Yes

No

Q36. [If Q35=a] About what percentage of the year is this home occupied by….

Occupants	Percentage of Time
You or your family members	
Others outside your family	
Vacant	
Total	100%

Q37. How many people live in the home at <Address> for more than half of the year?

[SINGLE RESPONSE MATRIX]

	Number of people in age group						
	0	1	2	3	4	5 or more	Prefer not to answer
Number of people							

[ASK ALL]

Q38. What is the approximate heated square footage of your home at **<premise address>**? Select the best estimate of home size.

Less than 500 square feet

501 to 1000 square feet

1001 to 2000 square feet

2001 to 3000 square feet

3001 to 4000 square feet

4001 to 5000 square feet

5001 to 8000 square feet

8001 to 10000 square feet

> 10,000 square feet

98. Prefer not to answer

[ASK ALL]

Q39. What is the highest level of education you have achieved?

[SELECT ONE]

Less than high school graduate

High school graduate (includes equivalency)

Some college or associate's degree

Bachelor's degree

Some post-graduate study

Post-graduate degree

98. Prefer not to answer

[ASK ALL]

Q40. Which of the following ranges include your total household income in the past year, before taxes?

[SELECT ONE]

Less than $20,000

$20,000 to $49,999

$50,000 to $74,999

$75,000 to $99,999

$100,000 to $149,999

$150,000 to $199,999

$200,000 or more

97. Don't know

98. Prefer not to answer

That's all our questions.

6.3 Commercial Customer Survey Questionnaire

Introduction

Thank you for providing feedback to help Xcel Energy improve offerings to help your business and others better manage their energy consumption.

This survey should take approximately 10-15 minutes to complete.

If you have any questions about this research effort or technical difficulties completing the survey, please contact Andrew Mielcarek at Apex Analytics at andrewm@apexanalyticsllc.com.

Q41. What is your occupational title within your company? (ASK OPEN END, PROBE FOR SPECIFICS / VERIFY SELECTION AS NEEDED)

1. President / CEO
2. Proprietor / Owner
3. Chief Financial Officer
4. Vice President / Director / Assistant Director / Department Head
5. Other financial / administrative position
6. Facilities Manager
7. Energy Manager
8. Other facilities management / maintenance position
9. Other Manager / assistant manager
10. Other ____

Q42. Please briefly state your role at <business name> located at <premise address>? We are specifically interested in your role related to equipment upgrade decisions.

[OPEN-ENDED RESPONSE]

Q43. How much influence do you have regarding decisions about upgrading equipment or operations that use natural gas at <premise address>?

A lot of influence

Some influence

Minimal influence

No influence

Not sure

Q43a. [If Q43 = c, d, or e] Can you please enter the contact details of a person with influence regarding decisions about upgrading equipment that uses natural gas at <premise address>? (Please also forward the original email to them).

a. Yes, there is a more appropriate person: [once response a) complete, direct to TERMINATE message A]

1) Name

2) Email [email validate]

3) Phone [phone validate]

c. I am the most appropriate person to respond to this survey [continue with survey]

c. Refused [Direct to TERMINATE message B]

Firmographics

Q44. First, we'd like to gather some information about your organization that will help us craft our focus for the remainder of survey. How would you describe the primary business activity at <premise address>?

1. Multifamily or Apartment Building
2. Lodging
3. Restaurants and Bars
4. Retail (Non-food or beverage)
5. Food and Beverage Stores
6. Schools or Educational Services
7. Administrative and Support Services
8. Health Care
9. Manufacturing
10. Wholesalers
11. Warehousing and transportation
    Professional, Scientific, and Technical Services
12. Real Estate
13. Religious, Grantmaking, and Civic, and Nonprofits Organizations
14. Recreation and entertainment
15. Government
16. Other (Specify: _____)

Q45. What is the approximate total square footage of all the building space occupied by your organization at <premise address>?

1. [NUMERIC] square feet

Q46. Does your organization own, lease, or rent your facility at <premise address>?

1. Own
2. Lease / Rent
3. Other _____

Q47. What days of the week is your facility open?

1. Days A Week Buildings Open (click all): Mon, Tues, Wed, Thurs, Fri, Sat, Sun
2. Refused

Q48. During what hours is this facility occupied? [add option to refuse, add option to click 'same for all remaining' after completing one row]

Day	Facility Operating Hours
Monday	[time start and stop validate]
Tuesday	
Wednesday	
Thursday	
Friday	
Saturday	
Sunday	

Q49. Which option best describes the facility at <premise address>? (select all that apply)

1. <premise address> is the only facility associated with this business or organization
2. <premise address> is part of a campus of buildings at the same location under the same ownership / management
3. <premise address> is one of multiple facilities in different locations within the state of Colorado under the same ownership / management
4. National / International chain or franchise

[If Q49 = 2, 3 OR 4] Q9a. Approximately how many different business locations are there? [Allow multiple response]

1. Within the State of Colorado [numeric]
2. Nationally [numeric]
3. Internationally [numeric]
4. Refused

[If Q49 a= a] Q9b. Please answer the following questions regarding your business' facilities within Mountain communities in Colorado:

1. How many facilities in Mountain communities are there under the same financial or operational management?
2. What is the approximate total square footage of your facilities within Mountain communities in Colorado? [Numeric Open End]]

Q50. Does your organization pay your Xcel Energy bill, or does someone else (e.g., a landlord or building manager)?

1. Yes, we pay the bill for just this facility at <premise address>?
2. Yes, our corporate office pays the bill. [Follow-up "Please note location of your corporate office" [city, state verification]
3. Someone else pays the bill [Follow-up "Please note who pays the bill" [open end]]

Existing Equipment

Q51. How do you heat the space at <premise address>? Please put a check by the type of heating systems used:

Heating Equipment	**Check if applicable.**
a. Gas Furnace	
b. Gas Rooftop Unit	
c. Gas Boiler	
d. Electric Furnace	
e. Electric Resistance Heat	
f. Ducted Air Source Heat Pump	

g. Ground Source Heat Pump	
h. Ductless Heat Pump	
i. Electric or Oil Space Heaters	
j. Wood Boiler, Fireplace or stove	
k. Gas Fireplace or stove	
l. Pellet stove	
m. Other Gas Heat (specify) [OPEN END]	
n. Other Electric Heat (specify) [OPEN END]	
o. Other Fuel Heat (e.g. propane, oil, wood) [OPEN END]	

Q52. [If Q51 has more than one response]. Which of these is the primary source of heat for your business? [allow only one selection]

[Import rows from Q51 where checked]

Heating Equipment	**Primary Heat Source (check one)**
[Import each row from Q51 where checked]	

Q53. [Ask all] What is the approximate age of your primary source of heating equipment?

[numeric 1-200 validate] years

Q54. How do you heat your domestic water (for kitchen, cooking or restroom use)? Please put a check by the type of water heater in your business at <premise address>:

Water Heating Equipment	**Check if applicable**
j. Gas Storage Water Heater	
k. Gas Tankless Water Heater	
l. Electric Resistance Storage Water Heater	
m. Electric Tankless Water Heater	
n. Gas Boiler	
o. Electric Boiler	
p. Wood Boiler	
q. Electric Heat Pump Water Heater	
r. Other Gas Water Heat (specify) [OPEN END]	
s. Other Electric Water Heat (specify) [OPEN END]	

t. Other Fuel Heat (e.g. propane, oil …) [OPEN END]	

Q55. Do you have any of the following natural gas-fueled equipment at <premise address>?

Other Natural Gas-Fueled Equipment	**Check if applicable**
b. Commercial Cooking Equipment (please note types of equipment) [Describe]	
c. Snowmelt system tied to a boiler	
d. Outdoor Fire pit	
e. Indoor Fireplace	
f. Processing Equipment [Describe]	
g. Natural Gas Vehicles	
h. Other (specify)	

Q15a. [If Q15=c, d, or e] How many [insert c, d, or e] are located at <premise address>?

Q56. Which of the following best describes how well sealed and insulated your business is against outside air leaks and thermal losses at <premise address>?

[SELECT ONE]

Very well sealed and insulated, (e.g. we have high levels of insulation, efficient windows and no drafts).

Somewhat well sealed and insulated with windows less than 20 years old.

Not well sealed or insulated windows are greater than 20 years old; and / or significant drafts present.

Don’t know

Q57. Which types of thermostats are present at <premise address>? (select all that apply)

Manual

Programmable

Smart

Don’t know

Awareness & Barriers

Q58. Are you familiar with any Xcel Energy rebate or incentive programs? [SELECT ONE]

Yes

No

Q59. [IF Q58=a] Have you previously participated in an Xcel Energy program where you received a rebate or incentive or free items for installing energy efficient equipment or modifying your facilities energy use? [SELECT ONE]

Yes

No

Don't know

Q60. Which of the following, if any, local, state or federal incentives are you familiar with that encourage energy efficiency and electrification? [SELECT ALL THAT APPLY]

Federal tax credits

Colorado state tax incentives

Rebates offered by some city or county governments.

Not familiar with any

Willingness To Participate (EE/Electrification)

Q61. [If Q51 = b and single response, OR if Q51= b AND Q52b selected b; OR **If** Q54 =**1 for a, b, or e; OR** If Q55 = b] How familiar are you with the following type of electric heat pumps?

	a. Very familiar	b. Somewhat familiar	c. Not at all familiar
[If Q51 = b and single response, OR if Q51= b AND Q52b selected b] Rooftop air source heat pump			
[If Q51 = c and single response, OR if Q51= c AND Q52c selected] Variable refrigerant flow heat pump			
[If Q54 =1 for a, b, or e] Heat pump water heater			
[If **Q55 = b]** Air to water heat pump			
[If **Q55 = b]** Geothermal heat pump			

Q62. Please indicate your level of willingness to participate in the following types of savings opportunities listed below.

Savings Opportunity	1. Very interested, depending on the details	2. Possibly interested, depending on the details	3. Not at all interested	4. Would not be applicable to this business
Q61a. [If Q51 = a or b and single response, OR if Q51= a or b AND Q52a selected] Replace your gas furnace with a high efficiency gas furnace.				
Q61b. [If Q51 = b and single response, OR if Q51= b AND Q52b selected] Replace your gas rooftop unit with a rooftop air source heat pump.				
Q61c. [If Q51 = c and single response, OR if Q51= c AND Q52c selected] Replace your gas boiler with an efficient gas condensing boiler.				
Q61d. [If Q51 = c and single response, OR if Q51= c AND Q52c selected] Replace your gas boiler with a variable refrigerant flow heat pump.				
Q61e. [If Q51 a, b or c=1] Reduce your thermostat setting by up to 4 degrees on the coldest days in exchange for an incentive or rate reduction.				
Q61f. [IF Q44 = 1, 2, OR 8] Update your existing climate control in [If Q4=1 “residential”, if Q4 = 8 “patient”, if Q4=2 “guest”] rooms with occupancy controls to the heating thermostat, so heaters are not heating unoccupied spaces.				
Q61g. [If Q54 =1 for a, b, or e] Replace your gas water heating equipment with an efficient electric version.				
Q61h. [If Q54 =1 for a, b, or e] Replace your gas water heating equipment with a heat pump water heater.				
Q61i. [If Q54 =1 for a, b, or e] Reduce your gas water heating usage on the coldest days in exchange for an incentive or rate reduction.				
Q61j. [If Q44 = 3, OR IF Q55 = a] Replace your gas cooking equipment with induction and / or electric cooking equipment.				

Savings Opportunity	1. Very interested, depending on the details	2. Possibly interested, depending on the details	3. Not at all interested	4. Would not be applicable to this business
Q61k. [IF Q55 = b] Update your snowmelt system with an electric source such as an air-to-water heat pump or geothermal heat pump.				
Q61l. [If 0 = b, c, or d] Add insulation and air sealing, and/or update windows				
Q61m. [IF Q55 = 1 for c, d, e, f, or g] Replace your [c-g] with an efficient electric or other fuel version [repeat for each Q55 c-g = 1]				
Q61n. [(If Q51 a, b or c=1 and [Q54=1 for a, b, or e OR Q55=1 for any of a-e)] Replace all the gas equipment in my business with equipment using alternate fuels.				
Q61o. Close your building and/or minimize gas usage on the coldest days in exchange for an incentive or rate reduction				
Q61p. Eliminate all gas consumption on days when requested by Xcel Energy in exchange for a significant rate reduction				
Q61q. [IF Q55 = b] Turn off your snowmelt system on the coldest days in exchange for an incentive or rate reduction.				

[INTRO] For the next several questions we are going to ask about specific scenarios for you to consider financial incentives to participate in a program. [IF Q50 = 2 or 3 ADD “Since you don’t directly pay your bill on premise, when deciding your level of willingness to participate, please also consider what you think the decision maker’s potential willingness would be”.]

Willingness To Pay (Conversion and DR) [ASK ALL]

HVAC

Q63. Does your business at <premise address> currently have an air conditioning system?

a. Yes

b. No

Q64. [If Q63=2] If you were to upgrade your heating system, how likely would you be to add air conditioning?

a. Very likely

b. Somewhat likely

c. Not very likely

d. Not at all likely

HVAC Conversion WTP [If Q61 =1OR 2 for a, b or d,]

Pipe in Reference	Source System Pipe In	Conversion Measure Pipe In
If Q61 d = 1 or 2	Gas boiler heating system	Variable refrigerant flow (VRF) Heat pump
If Q61b = 1 or 2	Gas rooftop unit heating system	Rooftop air source heat pump
If Q61a = 1 or 2	Gas furnace heating system	Electric heat pump

Q65. **[If** Q61 =**1OR 2 for a, b OR d]** Replacing a <source measure> with an <conversion measure> can reduce your natural gas consumption. Assuming no change to your combined electric and gas bills, if the net installed cost to you was **half the market cost** of the new system, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q65a**.** [If Q65=a or b] And how likely would you be to convert if your net cost was **75% of the market cost** of the new system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q65b. [If Q65a = c or d] How likely would you be to convert if the system was **free** to you? [Very likely, somewhat likely, not very likely, and not at all likely]

Q65c [If Q65b= c or d] How likely would you be to convert if it was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q66. [If Q65, Q65a, Q65b, Q65c = a or b] Assume your energy costs increase 5% with the new system. [Alternate question wording based on responses to Q65]

[if Q65 = a or b] If your net cost was **half the market cost** of the new system, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

[if Q65a = a or b] If your net cost was **75% of the market cost** for the new system, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

[if Q65b = c or d] If the new system was **free** to you, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q66a. [If Q66 = c or d] How likely would you be to convert in this scenario if the new system was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q67. **[If Q61 =1 or 2 for a, b, c, OR d, e, or f] Other** than cost, do you have any other concerns that the program would need to address to encourage you to convert your heating system? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q68. [If Q49 = 2 OR 3] **You mentioned earlier this business has multiple facilities in Mountain communities.** Would your answers above related to space heating apply to all these facilities under the same financial management?

Yes, all facilities within Mountain communities of Colorado

Yes, a certain portion of facilities within Mountain communities Colorado [% of total 0-100] of facilities

No, these answers are unique to <premise address>

HVAC DR WTP [If Q61 =1 OR 2 for a, b, c, d, e, f, g, l]

Q69. **[If Q61 =1OR 2 for c, d, e, j, k, or l]** Reducing your gas use for heating on the coldest days would require **lowering the thermostat** setting in your business. Xcel Energy could connect a device to automatically adjust your thermostat setting to a lower level by a maximum of 4 degrees for up to 4 hours per day and up to 20 days per year. If you participate in this program Xcel would provide a one-day notice to connect to your thermostat. What amount of incentive would persuade your business to enroll in a program like this?

[Numerical entry] a year

Other [amount]

Not Interested

Q70. **[If Q61 =1OR 2 for a-g]** Other than cost, do you have any other concerns that the program would need to address to encourage you to participate in a program like this? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q71. [If Q49 = 2 OR 3] **You mentioned earlier this business has multiple facilities across Mountain communities.** Would your answers above apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities within Mountain communities [% of total 0-100] of facilities

No, these answers are unique to <premise address>

WATER HEATING

WH Conversion WTP [If Q61h=1 or 2]

Q72. [If Q61h=1 or 2] Replacing a gas water heating system with an electric heat pump water heater can reduce your natural gas consumption. Assuming no change to your combined gas and electricity bills, if the net cost to you was **half the market cost** of a new system, how likely is it that you would convert your system?

Very likely

Somewhat likely

Not very likely

Not at all likely

Q72a. [If Q72= a or b] And how likely would you be to convert if your net cost was **75% of the market cost** of the new system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q72b. [If Q72 = c or d] How likely would you be to convert if the system was **free** to you? [Very likely, somewhat likely, not very likely, and not at all likely]

Q73. [If Q72, Q72a, or Q72b =1 or 2] In this scenario, assume your energy costs increase 5% with the new system. [Very likely, somewhat likely, not very likely, and not at all likely]

[Alternate question wording based on responses to Q72 as shown:]

[If Q72=a or b AND Q72a= c or d] If your net cost was **half the market cost** of the system, how likely is it that you would convert your system?

[If Q72a = a or b AND Q72a=a or b] If your net cost was **75% of the market cost** of the system, how likely is it that you would convert your system?

[IF Q72b = a or b] If the system was **free** to you how likely is it that you would convert your system?

Q73a. [If Q73 = c or d] How likely would you be to convert if the system was **free** to you [If Q72b "and Xcel Energy paid an additional **10% bonus above the market cost** of the system?

Q74. [ASK ALL If Q51 **a, b or c=1**] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate in a program like this? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q75. [If Q49= 2 OR 3**] You mentioned earlier this business has multiple facilities across Mountain communities.** Would your answers above related to water heating apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities within Mountain communities [% of total 0-100] facilities

No, these answers are unique to <premise address>

Snowmelt [If Q61k OR q = 1 or 2]

Conversion WTP

The following questions will discuss your opinions on converting your snowmelt system tied to a natural gas boiler with snowmelt electrification options such as an air-to-water heat pump or geothermal heat pump.

Q76. [Q61k OR q =1 or 2] Replacing a **natural gas snowmelt system** with an **electrical snowmelt system** can reduce your natural gas consumption. Assuming no change to your combined electric and gas bills, if the net cost to you was **half the market cost** of the new system, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q76a**.** [If Q76=a or b] And how likely would you be to convert if your net cost was **75% of the market cost** of the new system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q76b. [If Q76a= c or d] How likely would you be to convert if the system was **free** to you? [Very likely, somewhat likely, not very likely, and not at all likely]

Q76c [If Q76b= c or d] How likely would you be to convert if it was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q77. [If Q76, Q76a, Q76b, Q76c = a or b] Assume your energy costs increase 5% with the new system. [Very likely, somewhat likely, not very likely, and not at all likely]

[Alternate question wording based on responses to Q76 as shown:]

[If Q76 = a or b] If your net cost was **half the market cost** of the new system, how likely is it that you would convert your system?

[IF Q76b = a or b] If the new system was **free** to you, how likely is it that you would convert your system?

Q76a. [If Q76 = c or d] How likely would you be to convert in this scenario if the new system was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q78. [Q61k OR q=1 or 2] **Other** than cost, do you have any other concerns that the program would need to address to encourage you to convert your system? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q79. [If Q49 = 2 OR 3**] You mentioned earlier this business has multiple facilities across Mountain communities of Colorado.** Would your answers above related to snowmelt apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities [% of total 0-100] within Mountain communities

No, these answers are unique to <premise address>

Cooking [Q61j =1 or 2]

Cooking Conversion WTP

The following questions will discuss your opinions on converting your existing commercial natural gas cooking equipment to induction and /or electric cooking equipment.

Q80. [Q61j =1 or 2] Replacing **natural gas cooking equipment** with an **induction and / or other electric systems** can reduce your natural gas consumption. If the net cost to you was **half the market cost** of the new system, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q80a**.** [If Q80=a or b] And how likely would you be to convert if your net cost was **75% of the market cost** of the new system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q80b. [If Q80a = c or d] How likely would you be to convert if the system was **free** to you? [Very likely, somewhat likely, not very likely, and not at all likely]

Q80c [If Q80b= c or d] How likely would you be to convert if it was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q81. [If Q80, Q80a, Q80b, Q80c = a or b] Assume your annual energy costs for cooking increase 5% with the new system. [Very likely, somewhat likely, not very likely, and not at all likely]

[Alternate question wording based on responses to Q80]

[if Q80 = a or b] If your net cost was **half the market cost** of the new system, how likely is it that you would convert your system?

[if Q80a = a or b] If your net cost was **75% of market cost** for the new system, how likely is it that you would convert your system?

[if Q80b = a or b] If the new system was **free** to you, how likely is it that you would convert your system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q81a. [If Q81 = c, or d] How likely would you be to convert in this scenario if the new system was **free** to you and Xcel Energy paid an additional **10% bonus above the market cost** of the system? [Very likely, somewhat likely, not very likely, and not at all likely]

Q82. **[**Q61j =1 or 2**] Other** than cost, do you have any other concerns that the program would need to address to encourage you to convert your system? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q83. [If Q49 = 2 OR 3**] You mentioned earlier this business has multiple facilities across Mountain communities of Colorado.** Would your answers above related to cooking apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities [% of total 0-100] within Mountain communities

No, these answers are unique to <premise address>

SHELL MEASURES [If Q61l=1 or 2]

Q84. [If Q61k=1 or 2] Depending on your existing buildings condition, adding insulation, air sealing, and updated windows can reduce your natural gas consumption. If the net cost to you was **half the market cost and it brought the payback period to 5 years**, how likely is it that you would participate in the program?

Very likely

Somewhat likely

Not very likely

Not at all likely

Q84a. [If the Q84. is b, c, or d] How likely would you be to participate if it was **free** to you? [Very likely, somewhat likely, not very likely, and not at all likely]

Q85. [If Q61l=1 or 2] Other than cost, do you have any other concerns that the program would need to address to encourage you to participate? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q86. [If Q49 = 2 OR 3**] You mentioned earlier this business has multiple facilities across Mountain communities of Colorado.** Would your answers above related to building shell improvements apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities [% of total 0-100] within Mountain communities

No, these answers are unique to <premise address>

Interruptible Rate WTP

Q87. [If Q61=1 or 2 for o OR p] In exchange for a reduced rate, would your business be willing to have their gas service temporarily interrupted when called upon to do so by the Company?

Yes, I would like more information

Unsure, I would like more information

No

Q88. **[If** Q61 **=1OR 2 for o, or p]** Other than the amount of rate reduction, do you have any other concerns that the program would need to address to encourage you to participate in a program like this? If yes, please describe.

Yes, describe [OPEN-ENDED RESPONSE]

No

Q89. [If Q49 = 2 OR 3**] You mentioned earlier this business has multiple facilities across Mountain communities of Colorado.** Would your answers above apply to all facilities under the same financial management?

Yes, all facilities within Mountain communities

Yes, a certain portion of facilities [% of total 0-100] within Mountain communities

No, these answers are unique to <premise address>

TERMINATE MESSAGE A [Thank you for your willingness to participate in this survey. We will contact the staff you have provided that will be better able to answer questions regarding energy upgrade decisions.]

TERMINATE MESSAGE B [We are sorry, you do not meet the qualifications for this survey. We sincerely thank you for your time and willingness to participate.]

6.4 Contractor/Builder Interview Guide

Introduction

Thank you for taking the time to speak with me today. As I mentioned in my email, we are interviewing contractors to assess the opportunities for increased adoption of heat pumps and heat pump water heaters.

Do you have any questions before we begin?

I'll be taking notes as we talk, but would you mind if I also record our conversation? The recording is just to help with my notetaking. We won't share it with anyone, and we won't report anything in a way that would identify individual respondents.

Background and Portfolio

Q1. What's your name and position?

a. How long have you been at ____? How long have you worked in the HVAC industry?

Q2. Do you primarily serve residential or commercial customers or both?

a. If commercial – what type of businesses do you serve?

Q3. This research effort is focused on customers within Summit and Grand counties in Colorado and the potential for Xcel Energy incentives for heat pumps and heat pump water heaters.

a. How familiar are you with heat pump heating technologies such as ducted or ductless heat pumps? [if some familiarity] How familiar are you with cold climate heat pumps?

b. And how about heat pump water heating technologies?

Q4. I'd like to ask about your awareness of some of the incentives already available and some that are planned. Are you aware of

a. Xcel Energy incentives for heat pumps and heat pump water heaters?

b. [if Q2=residential] Federal tax incentives for heat pumps, heat pump water heaters, efficient equipment, and home envelope improvements?

c. [if Q2=commercial] Federal tax incentives for reduced energy use intensity in commercial buildings?

d. [if Q2=residential] State tax incentives for heat pumps?

e. [if Q2=residential] Upcoming federal rebate programs for electrification and energy efficiency?

Q5. [if Q4a=YES] What proportion of your [insert either residential or commercial from Q2] equipment installations in the past year qualified for heat pump or heat pump water heater rebates from Xcel Energy?

a. How effective are Xcel Energy's incentives along with federal and state tax incentives in encouraging customers to opt for heat pump technologies in new buildings? Why do you say that?

b. How effective are Xcel Energy's incentives along with federal and state tax incentives in encouraging customers to opt for heat pump technologies in existing buildings? Why do you say that?

Q6. [If yes to any in Q5] Have these incentives and programs influenced your recommendations to customers at all? [probe for how]

Q7. About what proportion of your new heating projects are

a. replacing working equipment ___%,

b. replacing non-working equipment ____%,

c. or new construction? ___%

Q8. What percentage of your portfolio are projects with the following technologies?

a. Heat pumps ____% What share of these are specifically cold climate technology? ____%

b. Heat pump water heaters ____%

Q9. About how much does it cost [if commercial insert “per ton”] to purchase and install a new air source heat pump in [if commercial “commercial business”, or if residential “an average size home”] in Summit or Grand counties? And comparatively, how much would it cost to purchase and install a new comparably sized gas furnace? How about a gas boiler?

a. How often do you typically install air conditioners in Summit or Grand Counties? How much does it typically cost to install an air conditioner in [if residential “an average size home”] [if commercial “per ton in a commercial business”?

b. About how much does it cost to purchase and install a new heat pump water heater [if residential “in an average size home” or if commercial “per gallon or kBtu/hr”] in Summit or Grand counties?

c. And how about a similarly sized gas water heater?

Q10. How confident do you feel explaining heat pump technologies to customers?

Q11. Have you observed any changes to customer interest in heat pump heating equipment over the past several years?

a. [If yes, more] What are the primary reasons customers are more interested?

Q12. How do you personally receive education or keep up with new efficient heating and water heating technologies?

Q13. Are you aware of training that Xcel Energy has provided related to heat pump technologies for heating and water heating?

Q14. Could you benefit from any training around heat pump technologies for heating and water heating? What specifically would you be interested in?

Contractor Recommendations

Q15. In what situations would you recommend replacing an existing gas heating system with a heat pump versus replacing with the same technology? [Probe to understand customer types (e.g. bill savings) as well as project types (e.g. type of equipment being replaced, home or business characteristics, etc.)]

a. How frequently do these situations or projects occur in your work?

Q16. In what situations would you recommend a heat pump water heater upgrade to a customer? [Probe to understand customer types (e.g. bill savings) as well as project types (e.g. type of equipment being replaced, home or business characteristics, etc.)]

Q17. How frequently do these situations or projects occur in your work? For customers with existing gas heating, how often, if at all, do you recommend changing the heating system to a heat pump? And what about specifically cold climate heat pumps?

a. How do you decide that this would be a good fit for their building? (e.g., interest, ability to fit in space, etc.

b. How often do you incorporate a backup system for heating on very cold days?

c. What type of backup heating system do you typically recommend? Why? What temperature do you typically program the system to switch from heat pump to the backup system?

Q18. What are some reasons you haven't recommended heat pumps to customers? (e.g., lack of ductwork, very cold climate conditions/no need for cooling in summer (?), change in customer energy costs)

Q19. Is it any easier or more difficult to add a heat pump to a gas system, versus replace a gas heating system with something similar? If it is more difficult, why?

Q20. Are certain types of customers more likely to be aware of heat pumps? What are their characteristics?

Customer Decision Making

Q21. What are the primary benefits a customer sees in converting their system to a heat pump?

Q22. Generally, what questions or concerns do customers have about choosing heat pump heaters or water heaters?

a. What, if any, differences are there in customer concerns for retrofit projects versus new construction?

Q23. Have you encountered any concerns specific to customers in the mountain communities?

Q24. [If Q2= residential and if Q4e=YES] To what extent do you think customers in Summit and Grand counties are aware of the federal rebates that will be available for heat pump and water heater options?

Q25. [IF Q4a or b=YES] To what extent do you think customers in Summit and Grand counties are aware of federal tax incentives? [if Q4d=YES] How about State of Colorado tax incentives? [If Q4a=YES] How about Xcel Energy rebates?

Q26. In general, for customers who could be interested in investing in this equipment, what barriers prevent them from doing so? (e.g., high upfront costs)

Q27. What strategies or information, if any, do you use to overcome those barriers? (e.g. cost payback over time)

Influence of Incentive

Q28. To what extent would an Xcel Energy rebate help ease those barriers to adoption?

Q29. Other than incentives, what could Xcel Energy do to encourage more customers to choose heat pump technologies for heating and water heating?

Q30. If an incentive for a high efficiency heater or heat pump was developed, how would it best be designed to serve the needs of mountain communities?

Q31. Similarly, how could it be best marketed to reach those in mountain communities? (e.g., mailers, contractor education, etc.)

Closing

Q32. Thinking about everything we discussed this evening, what do you think is the most important thing Xcel Energy can do to support contractors in your efforts to promote heat pumps and heat pump water heaters?

Q33. Those are all the questions I have prepared. Is there anything we haven't discussed that you think I should know about your experience with heat pumps and heat pump water heaters.

Great, thanks so much for your time.

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