Natural Gas Advisory Committee
Q4 2023 Dec 7 Webinar (Virtual)

DATE: December 7, 2023

TIME: 1:00-2:00 pm Pacific

WEBINAR: MS Teams – See link in calendar invite or register here

AGENDA (All Times Pacific)

1:00-1:05	**Welcome and Quick Introductions**	Alisyn Maggiora
1:05-1:50	**Advanced Commercial Gas Water Heating** • Program Review + 2024 Focus Areas • NGAC Feedback Themes • ***VOTE*** *Desired Outcome: NGAC understands proposed next steps for efforts on the program and supports advancing it into the Program Development phase in NEEA's initiative lifecycle process.*	Peter Christeleit Neil Grigsby
1:50-2:00	**Housekeeping, public comment, wrap up and adjourn**	All

Advanced Commercial Gas Water Heating

Concept Advancement Proposal

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Executive Summary

The Advanced Commercial Water Heating program will focus on stimulating market conditions that accelerate technological advancements and generate demand for gas heat pump (GHP) water heating systems. The program will transform the commercial and multifamily water heating retrofit and new construction market to increase the adoption of GHP water heating systems, resulting in reduced gas consumption and carbon emissions in these sectors. GHP water heating systems work by using a combination of natural gas and electricity to extract heat from the surrounding air or water and transferring it to the water that needs to be heated. This process is more efficient than directly generating heat using only gas combustion, as it leverages the principles of heat transfer and thermodynamics.

Gas heat pump water heating systems can be designed and configured in various ways that are appropriate to meet the heating needs of commercial and multifamily building types. This program centers on utilizing GHPs as the primary heat source in commercial and multifamily central water heating systems, which may be joined by additional key components of the water heating system, depending on design requirements and the type of heat pump technology being used. In the Program Development phase, NEEA will identify which gas heat pump technology and design configuration is optimal for different buildings based on the type of existing water heating system, consumption demand, and hot water usage by building occupants. The GHP is anticipated to enable water heating applications to achieve efficiencies greater than 1.0 Thermal Efficiency (TE) and holds the technical potential to save the Northwest region more than 42 million annual therms over a 20-year projection.

There is currently low adoption of gas heat pump water heating primarily due to high first cost, design complexity, and lack of a clear value proposition to building owners, developers and designers. Decarbonization policy is also pushing HVAC and water heating fuel choices toward electric equipment, however, efficient gas technology can also provide significant gains in efficiency and carbon reduction and may be preferred in existing and new buildings. In the Program Development phase, NEEA will focus on developing draft intervention strategies to remove identified barriers and validating the gas saving and carbon reduction potential of commercial GHP water heating systems, in addition to building a value proposition for decision makers in the commercial and multifamily sectors. Because of the complexity of commercial water heating systems, NEEA will look to establish best practices in water heating system design and installation, and develop recommendations based on building types and use cases through pilot project findings and lab/field testing results.

There is an opportunity in the Program Development phase to collaborate with extra-regional partners with a shared interest in increasing the market adoption of GHP water heating systems. NEEA will attempt to leverage funding from national and regional organizations to increase the number of demonstration projects that will provide learnings from a greater number of system designs and applications in commercial and multifamily buildings. Co-funding lab testing to validate energy savings and product performance will also benefit partnering organizations as savings estimates are refined from Technical Potential to Economic/Achievable potential during this phase. NEEA anticipates a budget requirement of $360k - $580k during the Program Development phase.

The Program Development phase allows NEEA to learn more about the GHP technology and market conditions through product testing and validation and market research. NEEA will monitor progress and

share results with NGAC members in real time, encouraging NGAC members to ask questions, express concerns, and voice support for product testing results and market characterization findings.

Specific information and areas of interest will include:

- GHP product performance in lab testing conditions.
- GHP product performance in field tests, which will include various climate zones, building types, and design configurations.
- GHP cost information collected through the market characterization research and pilot projects.
- New GHP product developments and availability in U.S. markets.
- Feedback from market actors on product and market barriers that allows NEEA to refine market intervention strategies.
- Collaborative opportunities with members from the North American Gas Heat Pump Collaborative.

NEEA will use Quarterly Meetings and the Quarterly Portfolio Progress Report to share GHP Program Development progress and welcomes any interest for one-on-one funder check-ins and ad hoc discussion.

1 - Background

Gas savings and reduced carbon impact in commercial and multifamily buildings can be achieved by installing gas heat pump water heating systems instead of traditional systems. Through lab testing and demonstration projects during the Program Development phase, NEEA will determine the optimal retrofit application for gas heat pump water heating systems and develop guidelines and best practice resources that encourage widespread adoption of these heat pump technologies.

Commercial and multifamily water heating systems have a level of complexity to allow for safe, reliable operation, sustainability, and efficiency. The current market landscape includes boilers, tankless (instantaneous water heaters), and storage water heaters (Residential-duty commercial water heater and storage water heater). Tankless and storage water heaters can typically be described as condensing and non-condensing. Boilers are available in a water-tube or fire-tube configurations, which can be further subcategorized into condensing and non-condensing. There are many hot water system configurations utilizing these different technologies. Water heating system design need to address building environment, load requirements (design, minimum, and partial), space requirements, redundancy, and in closed-loop hydronic systems water chemistry needs. The main goal for each configuration should be a design system which meets hot water needs for building occupants and achieves the design efficiency.

To date, NEEA has conducted a GHP pilot, technical research and savings estimate assessments to gain a better understanding of the savings and market potential for GHP water heating systems. A 2023 analysis from Energy350 provides building types in the commercial sector that have the greatest savings potential for GHP water heating systems. Those building types include, Healthcare, Multifamily, Lodging, and Restaurants due to their significant domestic hot water loads. The analysis also provides NEEA with criteria to identify buildings that are the best fit for a GHP water system retrofit. NEEA will refer to findings and recommendations from this analysis, along with market characterization findings during

Program Development, to narrow the target market to building types that are best suited for GHP water heating system installations and offer the greatest savings potential.

The complexity of commercial and multifamily water heating systems requires that NEEA explore multiple building types and water heating configurations to determine optimal solutions. There are currently 12 manufacturers with commercialized gas heat pump products utilizing three different types of gas heat pump technology; engine-driven vapor compression, sorption (which includes absorption and adsorption), and thermal compression. While commercial GHP water heating systems exist, barriers exist around first cost, installer awareness, and market demand. In the Program Development phase, NEEA will validate the energy savings of the GHP technologies in multiple configurations and start to develop and socialize best practice for system selection, installation, and operation.

2 - Program Concept

2.1 – Preliminary Market Transformation Theory

A gas heat pump (GHP) functions by transferring heat from one area to another while intensifying the heat during this process. This program centers on utilizing GHPs as the primary heat source in commercial and multifamily central water heating systems. The GHP is anticipated to enable water heating applications to achieve efficiencies of greater than 1.0 Thermal Efficiency (TE) and holds the technical potential to save the Northwest region more than 42 million annual therms over a 20-year projection.

Despite notable performance improvements in electric water heaters over the past two decades, enhancements in gas water heater efficiency have been limited due to challenges in design complexity, high first costs, and a limited understanding of the value proposition to building owners, developers and designers for efficient gas water heating solutions. At present, three GHP water heating technologies exist that can bring about substantial efficiency improvements.

NEEA is well positioned to create enduring changes in multifamily and commercial water heating by uncovering and enhancing the efficiency and decarbonization value proposition for efficient GHP water heating systems. NEEA anticipates leveraging existing relationships with energy efficiency organizations that support product specifications to create widespread adoption of best practice and design and operational guidelines that reduces complexity challenges for designers, installers, and operators, while ensuring design efficiency is achieved. As product development continues and new products enter the market, NEEA's best practice guidance will ensure reliable product performance, energy savings and decarbonization benefits.

These intervention strategies will help position gas heat pump water heating as the efficient gas option in commercial and multifamily buildings that offers the greatest value to building owners and occupants. The increased market adoption of efficient commercial GHP water heating systems will provide the data necessary to influence federal standards that mandate progressively higher efficiencies for gas water heating equipment. Eventually, Thermal Efficiency values exceeding 1.0 will become the minimum standard for commercial gas water heaters.

2.2 – Preliminary Product Definition

A gas heat pump (GHP) operates by transferring heat from one space to another while increasing the heat's intensity during this process. It differs from its electric counterparts in terms of the fuel used and the method of pressurizing the refrigerant required for the process. There are three distinct types of GHP technologies: engine-driven vapor compression, sorption (which includes absorption), and thermal compression. Each of these types utilizes different refrigerants and pressurization techniques, suitable for various applications involving space and/or water conditioning.

This specific product instance focuses on utilizing GHPs as the primary heat source within a commercial central water heating system. These GHPs achieve an efficiency rating of 1.0 Thermal Efficiency (TE) or higher. In this application, the GHP is powered by a heat source, commonly natural gas, but also including options like propane, hydrogen, renewable natural gas, biomethane, and other viable fuels. The pump then transfers the generated heat to a storage tank.

Commercial water heating systems can be designed in various configurations, allowing for adaptability at different building sites. Depending on the chosen configuration, the commercial water heating system may comprise the following sub-systems and components:

- Primary heating source: Boiler(s)
- Storage of primary hot water: Storage tank
- Temperature maintenance system (if applicable): Temperature maintenance storage tank(s), temperature maintenance heat source(s), hot water circulation pump, thermostatic mixing valve, heat exchangers, pumps, pipes, valves, pressure regulators, air separators
- Controls and sensors: Central controller (The strategic control of the system is crucial for effectively balancing energy savings from the gas heat pump, occupant comfort, and system reliability)

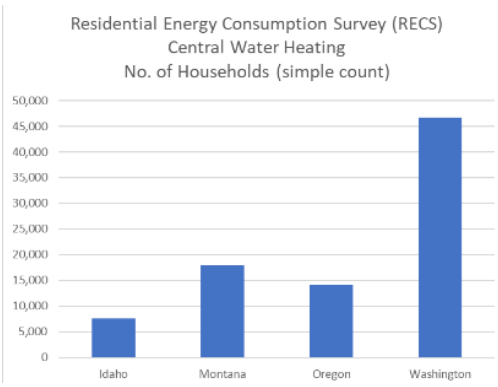
For a detailed explanation of each of the GHP technologies, please refer to the Product Plan.

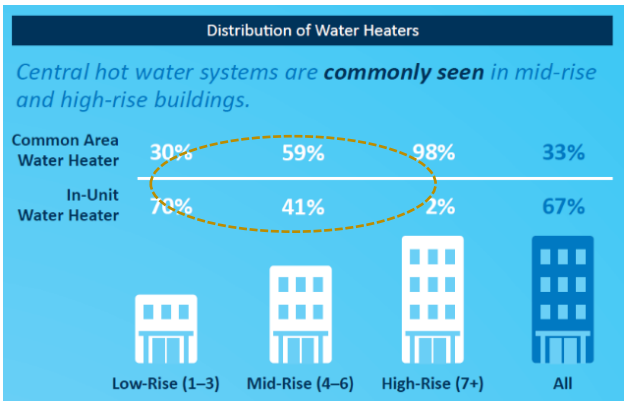
2.3 – Preliminary Target Market

The target market for this opportunity comprises new and existing commercial and multifamily sites served by a central water heater and having high daily water consumption. During the Program Development phase, the program will utilize market characterization findings to gather insights about key market actors and influencers within these sectors.

Multifamily:

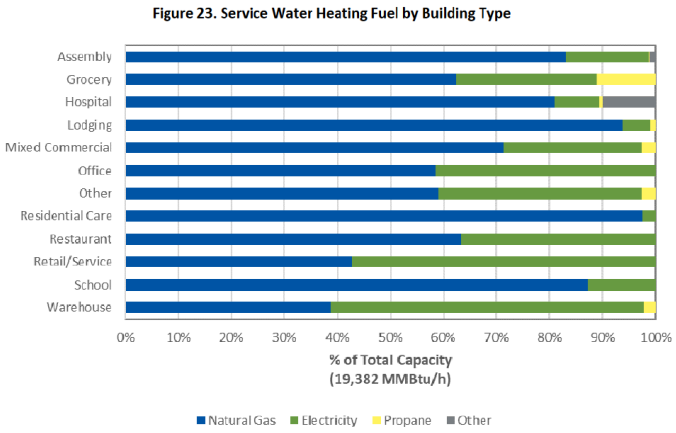
According to the 2017 Residential Building Stock Assessment II (RBSA II), central hot water systems are prevalent in mid-rise and high-rise buildings. These multifamily (MF) residences constitute 12% of the Northwest MF market, which translates to approximately 87,000 households in the region. Interestingly, 2019 Commercial Building Stock Assessment (CBSA) data indicates that large MF and Commercial buildings are well-equipped to harness natural gas for hot water, with a distribution of 78% Gas, 21% ER (Electric Resistance), and 1% HP (Heat Pump). Since the Great Recession, mid- to high-rise multifamily buildings have gained popularity, as highlighted by the United States Census Bureau's data showing that the most common MF building type completed in the last decade contained 50 units or more.





Commercial Buildings:

Natural gas stands out as the predominant energy source for commercial buildings in NEEA's region, accounting for 74% of the building stock according to the 2019 CBSA data. Commercial buildings exhibit a wide range of consumption profiles for water heating, often consuming 10-100 times more hot water than a typical residential home. Furthermore, unlike single-family and low-rise multifamily buildings, commercial mid and high-rise buildings typically rely on multiple commercial water heaters or intricate water heating systems. Among the various segments in the commercial water heating market, the greatest opportunity lies in hotels, hospitals, and food services buildings, primarily due to their high consumption patterns.



One example with a high and fluctuating load is restaurants (food service establishments), where there can be a significant variance from day to day. A restaurant may consume an estimated 2,000+ gallons of hot water per day, with much of it being used during specific hours (e.g., kitchen clean-up). Many water heating systems in such establishments employ multiple boilers operating in series, using high and low-efficiency boilers strategically. Hotels and motels also account for a substantial portion of energy usage, with an ASHRAE study revealing that a hotel used approximately 2.6 million gallons of hot water over a 13-month period, averaging around 6,600 gallons per day. To put this in perspective, a single-family

home typically uses 46 gallons per day for hot water, as per data from the regional technology forum (RTF) based on the Residential End Uses of Water Study (REUWS2) conducted in 2014.

During the Program Development phase, NEEA will evaluate a range of gas heat pump technologies and design configurations to meet the hot water demand of specific commercial building types. The choice of gas heat pump technology and necessary system components will be determined by factors such as the type of system being replaced, usage patterns, and the specific commercial building type. The Market Characterization process will also guide decisions about which water heating systems are most prevalent in existing buildings and which building types should be included in the demonstration projects.

2.4 – Next Phase: Planned Activities for Program Development

Activity	Desired Outcomes	Expected Timeframe
Assess and validate gas heat pump water heating product performance. - Conducting lab testing of GHP water heating technologies. - Supporting demonstration projects incorporating GHP water heating technology.	- Identify barriers to product development and performance optimization for commercialized product and new product coming to market. - Determine solutions for technologies meeting specific commercial water heating needs (i.e. solutions for high temperature applications). - Ensure GHP technologies perform as expected to provide adequate water heating needs for end users in different building types and applications. - Identify existing product specifications in the market where NEEA can incorporate	Q1 2024 – Q2 2025

Activity	Desired Outcomes	Expected Timeframe
	product and operational guidelines.	
Refine gas heat pump water heating savings potential estimates. - Conducting lab testing of GHP water heating technologies. - Supporting demonstration projects that incorporate GHP water heating technology. - Collecting cost data to inform economic potential.	- Validate gas savings over baseline technologies. - Refine technical potential savings estimates.	Q4 2024 – Q2 2025

Conduct a Market Characterization study and develop a report with key findings.
- Collecting insights on current water heating systems (both gas and electric) in existing buildings with the highest hot water usage (mid and high-rise multifamily, hospitality, hospitals, food service, etc).
- Identifying and surveying key market actors in the supply chain and decision makers in commercial buildings and multifamily developments:
  ○ Gaining understanding of decision making criteria when selecting water heating systems and barriers to GHP adoption.
  ○ Discovering the value proposition for these market actors and decision makers.
	- Understand water heating systems in current multifamily and commercial buildings to inform baseline assumptions, which is critical for forecasting and reporting savings.
	- Refine the target market to prioritize building types with greatest savings potential and compatibility with GHP water heating systems.
	- Inform market potential for GHP water heating systems.
	- Identify leverage points in the supply chain and with end-user decision makers.
	- Refine barriers to GHP water heating adoption.
		Q1 2024 – Q4 2024

Activity	Desired Outcomes	Expected Timeframe
Support demonstration projects incorporating gas heat pump water heating systems. - Partnering with market actors and decision makers to integrate GHP water heating systems in real world demonstration projects. - Coordinating with members from the North American Gas Heat Pump Collaborative to co-fund demonstration and provide project incentives.	- Learn about installation challenges/best practice/cost data. - Understand the decision-making process for multifamily and commercial developers, building owners, facility managers, etc. - Identify current supply chain conditions and the support needed to make GHP water heating technologies more readily available. - Collect first cost estimates of qualifying product and baseline technologies.	Q1 2024 – Q2 2025
Define value proposition for multifamily and commercial building decision makers. - Using the Market Characterization study to gather feedback from key decision makers and market actors who influence water heating design and system selection. - Developing a gas heat pump water heating system value proposition using demonstration project and Market Characterization Study findings.	- Identify what decision makers value most when determining water heating solutions. - Craft value proposition messaging promoting use of GHP water heating technologies.	Q1 2024 – Q4 2024 (demonstration projects will likely extend into 2025. We will continue refining value proposition based on market actor feedback).

3 - Milestone Decision

3.1 – Concept Advancement Criteria

The Concept Advancement milestone represents a decision to allocate resources to define if the MT opportunity is worth pursuing and what the role for NEEA is. In the Program Development phase, we conduct research to understand and inform the product opportunity, market conditions, and define the MT program logic and intervention strategy. The internal stage gate go/no go criteria for Concept Advancement that NEEA uses include:

- **Preliminary Market Transformation Theory:** The market transformation theory represents a reasonable hypothesis, and it includes hypothesized barriers, interventions, how it diffuses, leverage points, and outcomes.
- **Product:** We have a reasonable product definition and clear product assessment/validation objectives.
- **Savings:** The energy savings potential is worth the anticipated cost/effort to intervene in the market, and we anticipate a viable way to measure savings.
- **Market:** We have reasonable preliminary target/defined market, as well as application.
- **Portfolio:** This program supports short-term and long-term portfolio needs, and there are available resources.

3.2 - What does the transition to Program Development entail?

The transition to Program Development presents an opportunity to accomplish several important activities and objectives, including:

Demonstration Projects: To gain insights into real-world scenarios, we will conduct product demonstrations in pilot projects and attempt to leverage existing projects using GHP technology. These projects will allow us to test and monitor energy savings and product performance. Demonstration projects will also provide us with qualitative feedback from decision-makers and installers and satisfaction among end-users. This feedback will help us uncover decision-making criteria for both existing and new construction applications, identify installation best practices and challenges, and understand the value proposition for designers, installers, and property owners.

Lab Testing: In controlled laboratory testing, we will explore how these products respond to various installed conditions. This controlled environment will provide valuable insights.

Data Collection: Extensive metering and monitoring of demonstration projects will yield performance data. This data will enable us to compare energy use with baseline technologies and address performance issues or challenges encountered in real-world applications. The Market Characterization will also gather data from existing multifamily and commercial buildings to gain a better understanding baseline conditions and market potential.

Validation of Market and Product Barriers: Findings from demonstration projects will help confirm or refute hypothesized barriers to market adoption. This information will guide the refinement of market intervention strategies, ensuring successful adoption during the Market Development phase.

Engagement with Key Market Actors: Engaging with influential market players and key stakeholders will occur through demonstration projects and the Market Characterization process. Their feedback will shape the value proposition for commercial gas heat pump water heating and fine-tune our Market Development strategies.

Furthermore, NEEA will leverage existing partnerships with organizations beyond our region, such as Minnesota Center for Energy and the Environment (MNCEE), Nicor Gas, and the North American Gas Heat Pump Collaborative, exploring co-funding opportunities for essential Program Development activities. The budget estimates provided below consider assumptions regarding potential co-funding opportunities.

3.3 – Investment

Proposed Investment for Program Development (Q1 2024 – Q4 2025) *[Should align with table 2.4 above and note the key activities that require investment; e.g., Market Characterization & Research, Data Acquisition & Analysis, Product Development & Research]*	
Activities	Amount (Direct Costs)
GHP water heating pilot projects (3-5)	$120k - $200k
Lab testing GHP water heating products	$120k - $200k
Market Characterization	$120k - $180k (Market Characterization will include gas and electric fuels in existing buildings. Funding will be split between gas and electric budgets.)
Total	$360k – $580k

Total Proposed Program Investment – Direct Costs Only			
Phase	Investment to Date	Future Estimated Investment	Total
Scanning	~$650K		
Concept Assessment			
Program Development	$0	$360k - $580k	
Market Development	N/A	TBD	TBD
Long-Term Monitoring and Tracking	N/A	TBD	TBD
Total Investment			

3.4 – Value Proposition

3.4.1 – Estimated Technical Potential

The target market for this program is broadly defined as mid and high-rise multifamily and commercial buildings. The target application is an existing natural gas central water heating system, with a thermal efficiency (TE) lower or equivalent to federal standards. The key drivers of the forecast may be characterized by continued large water use applications, operational cost reduction, and environmental friendliness. RBSA and CBSA have informed an analysis that identifies school (College), school (k-12), healthcare, lodging, restaurants, and mid and high rise multifamily as the commercial segments with the

highest consumption. Market research during Program Development will provide additional data that will further inform the market penetration, target market size, and ramp rate for this technology.

20-Year Savings Potential- Natural Gas		Low Case	Base Case	High Case
Technical Achievable Potential	Therms Savings	18,689,000	21,025,000	22,193,000

3.4.2 – Other Program Benefits

Influencing Residential Gas HPWH Manufacturers: Accelerating market adoption of commercial gas heat pump water heating technology may encourage manufacturers to continue developing gas heat pump water heating solutions for residential use. Despite NEEA's previous efforts to support manufacturers in the product development process, residential gas HPWHs have not been commercialized. By showcasing the success of NEEA's Market Transformation efforts in the commercial sector, potential manufacturers in the residential market can gain insight into the potential for success.

Potential Co-funding Program Development with NEEA's Electric Portfolio: As NEEA explores electric water heating solutions for multifamily and commercial applications, there may be an opportunity for joint funding during the Program Development phase. In the near term, this joint funding can support the creation of the Market Characterization study. Both the electric and gas Water Heating teams will actively seek co-funding opportunities benefiting both portfolios during Program Development and while developing the Market Development strategy.

Influencing Electrification and Decarbonization Policies: By showcasing the technology's efficiency and emission-reduction benefits, the program will support the integration of efficient natural gas technologies in policy development.

Providing Energy Efficiency Solutions for Limited Income Customers: The commercial GHP water heating program targets mid and high-rise multifamily buildings, often housing limited-income residents. This initiative potentially helps to alleviate the energy burden for these customers, offering utilities the opportunity to provide equitable energy efficiency benefits to this customer segment.

Fostering National Partnerships and Co-funding Opportunities: Regional and national partners who have previously engaged with the North American Gas Heat Pump Collaborative will be invited to participate in the product testing and validation phase. These partnerships may yield co-funding opportunities, potentially reducing NEEA's budget requirements for completing the product testing and validation phase.

Reducing Carbon Emissions: While natural gas remains a fossil fuel and emits carbon when burned, gas heat pump systems have a lower overall carbon footprint because they use less gas to achieve the same heating effect compared to traditional gas equipment.

3.5 – Portfolio Fit

This initiative offers efficient gas water heating solutions for multifamily and commercial buildings, which is an area that is not currently addressed in NEEA's portfolio. The initiative supports NEEA's Water Heating product group strategy by increasing the customer base that benefits from efficient water heating solutions. With a technical savings potential of 42 million annual Therms, commercial gas water heating will be a significant savings contributor to NEEA's gas portfolio. The 42 million annual Therms is the total technical potential of this product in the market, and a high percentage of buildings in this sector are deemed technically feasible for this product. Over the 20-year time horizon we expect to be able to access approximately 50% of this total potential. The actual program forecast will be refined once we have market research and program plans drafted in the next phase.

3.5.1 Risk

Based on current assumptions this initiative has an average risk level of 3.8 across NEEA's five risk categories (out of 6 where 6 is the highest risk). The highest risk category is in 'Ramp Speed' as our current assumption is that multifamily and commercial water heating carries a long equipment lifecycle and high first replacement cost. NEEA will attempt to identify market leverage points that could move savings opportunities to near term.

3.5.2 Regional Equity

With the target market being mid and high-rise multifamily and commercial buildings, this program will impact areas with the highest commercial gas sales. The equity benefits are greater in WA and OR, based on the share of commercial gas sales provided by the Energy Information Administration (EIA) Commercial Sales Data for current gas funders.

3.6 – Utility Role

In the Program Development phase, NEEA will engage utilities when there are opportunities to support local GHP water heating demonstration projects. NEEA will provide savings estimates for GHP water heating systems in demonstration projects, allowing the Regional Technical Forum to begin development of measure workbooks and/or utilities to develop pilot rebate programs using a custom program approach. Utility incentives for demonstration projects will help offset the incremental cost of upgrading from the baseline technology to a GHP water heating system and show market actors that local utilities are interested in increasing adoption of this technology. Utilities may also have existing relationships with key market actors and decision makers in multifamily and commercial development that NEEA can leverage to recruit demonstration project participants.

Longer term, NEEA will work with natural gas utilities and the Regional Technical Forum to refine savings values for gas heat pump water heating systems. NEEA will support utility program development efforts to provide incentives for commercial gas heat pump water heating solutions.

4 - Program Risk Summary

4.1 – Risk and Response

Risk Event		Probability (H/M/L)	Impact (H/M/L)	Risk Response (Accept, Avoid, Mitigate, Transfer)	Response Plan
"IF" this happens	"THEN" this will occur (impact)				
IF installing GHP water heating systems are not cost effective for multifamily and commercial developers...	THEN Multifamily and commercial developers will choose less expensive competing products over GHP water heating systems.	M	H	Mitigate	Work with natural gas utilities to offer incentives on GHP water heating systems. Identify and highlight value proposition for GHP technology.
IF product performance does not meet occupant needs...	THEN Multifamily and commercial building owners will not choose GHP water heating systems if they do not provide adequate hot water for building occupants.	L	H	Mitigate	Monitoring product performance in demonstration projects will allow NEEA to provide manufacturers and installers with performance data. If issues are discovered, NEEA will work with the market to overcome technical challenges ensuring there are no occupant issues.
IF sales data on component level installations is not readily available...	THEN NEEA will have difficulty tracking program influence and attribution.	M	M	Mitigate	Work with Planning Analyst and MRE Scientist to ensure measurable MPIs are developed, and key savings model data inputs are identified during Program Development. Consider offering a data incentive to track GHP installations.
IF decarbonization policy eliminates natural gas technology as a replacement option in retrofit applications. ..	THEN Target market and MT opportunity decrease.	M	H	Accept	NEEA will monitor decarbonization policy efforts and provide technical data/research when possible to inform policy and code development.

