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High Efficiency Gas Water Heater Research

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ILLUME Advising, LLC is a forward-thinking consulting company at the rare intersection of insight and execution. Founded in 2013, the company has quickly grown to include a deep bench of quantitative and qualitative research experts. ILLUME uses cutting edge research strategies to help build a resilient energy ecosystem to enrich lives, improve global health, and ensure a more secure and sustainable future.

For this effort, we would like to acknowledge, first and foremost, Anu Teja at NEEA. We would also like to recognize the dedicated work of Strategic Research, who were integral in recruiting participants and coordinating the focus groups we ran. Finally, we would like to acknowledge the ILLUME team members Dr. Liz Kelley, Maass, Kristen Dong, and Krista Mobley.

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Executive Summary

The Northwest Energy Efficiency Alliance (NEEA) contracted with ILLUME Advising, LLC (ILLUME) to improve understanding of the current residential gas water heater market, identify purchase motivators for people with high-efficiency gas equipment, and see if and where there is a market for a commercialized gas heat pump water heater (GHPWH).

NEEA hypothesized that there was potential to utilize the existing condensing gas storage water heater market (CGSWH) as a beachhead for early GHPWH adoption by converting sales that would have been a condensing water heater into a gas heat pump water heater. Through this work, we found that the residential CGSWH market is smaller than initially expected; it is unclear whether there are enough homeowners who purchased a CGSWH to serve as a proxy product for a GHPWH. Accordingly, this research pivoted to explore whether there are other gas water heater owners who might act as a beachhead for a GHPWH product.

From the 129 respondents in the screener survey, we recruited people for four focus groups with 22 total participants. We organized the respondents into groups according to the following characteristics:

1) The Tankless but Open to Tanks Group: A group of tankless water heater owners who said they would be interested in going back to a tank if the tank were more efficient. This was the only group with tankless water heater owners.
2) The Dedicated to Gas Group: A group who said they were not considering electrifying any of their appliances.
3) The Electrification Curious Group: A group of people who were interested in electrifying some of their appliances.
4) The General Group: A general group who was not considering electrifying their home, had purchased a water heater in the last five years, and for whom energy efficiency was one of the top three considerations when making their choice of water heater.

These groups had notable differences in their priorities and definitions of energy efficiency:

Group	Differences in Energy Efficiency Priorities
Tankless but Open to Tanks	This group was the only group to identify energy efficiency as a top priority. This group's definition of energy efficiency was most like the industry's definition.
Electrification Curious	This group focused on cost savings, not energy usage. Their definition of efficiency was primarily oriented to cost considerations.
Dedicated to Gas	This group defined efficiency in terms of speed, not energy used. In some cases, they prioritized speed (ex: faster laundry drying time) over operating cost.
General	For this group, efficiency was a byproduct of reactive home upgrades, for example, installing LEDs when previous bulbs burnt out

Market Findings for Future Consideration

Based on the challenges with recruiting CGSWH owners, we concluded that this may not currently be a viable proxy product for a future GHPWH. However, some current gas water heater owners may be interested in one dependent on their dedication to gas and their technology acceptance, or willingness to try new technologies. We recommend considering future product-focused research to deepen the understanding of customers' decision-making, such as if EHPWH and GHPWH were the only two options.

Should such a product be introduced, we identified **educational opportunities to support customers looking for efficient equipment**. One participant struggled to understand the possibility of a GHPWH, assuming it was a technology exclusive to electric appliances. Other participants mentioned difficulty finding the true cost comparison between gas and electric, and without better information, they chose the gas water heater as it was the most familiar. Educating both contractors and retailers on efficient gas water heater options will increase the likelihood of purchasers considering new technologies.

Customer Orientations to Fuel

Across groups, many participants expressed a preference for natural gas appliances due to its reliability and performance. However, some participants in the Tankless and General groups had **mixed feelings about natural gas, citing environmental and safety concerns**. Interestingly, these concerns did not come up in the Dedicated to Gas or Electrification Curious groups. This attitude also split survey respondents with half (53%) responding that they were not interested in electrification at all and the other half (48%) saying they were considering or in the process of electrifying some or all of their appliances. As seen in previous research, attitudes toward natural gas appliances are quite nuanced and depend on a variety of factors. A GHPWH product would most likely appeal to those whose attitudes align with the Dedicated to Gas group, as they indicated they prefer gas for their appliances and are willing to pay more for its performance compared to electric in some instances.

Product Findings

With regards to form factors, we found that **some tankless owners were willing to return to a tank** if that meant more efficiency. Relatedly, we found that brand familiarity can be a proxy for quality and reliability even across shifts in form factors. Two participants in the Tankless group purchased the same brand as their previous storage water heater when switching to tankless, as purchasing a trusted brand meant that they were more willing to try out new technologies. Partnering with known North American manufacturers may aid in the adoption of a new technology such as a GHPWH.

Additionally, focus group participants largely **saw additional features,** such as Bluetooth or Wi-Fi on higher-end, more efficient water heater models, **as unnecessary** and creating additional opportunities for things to break. Those that were interested in higher-end models focused on practical features like leak detection and did not prefer it for energy efficiency alone. Any additional features a GHPWH may have should focus on its core functionality to increase its likelihood of adoption.

Introduction and Methods

We began this research on residential gas water heating market transformation by focusing on three primary areas:

- Exploring opportunities for and the value of increasing the adoption of currently available efficient gas water heaters.
- Driving development and commercialization of GHPWH products.
- Collaborating with utilities throughout North America to enact a mass deployment of GHPWH through a combination of traditional programs and innovative strategies.

To achieve this, we planned to run focus groups with CGSWH owners. NEEA hypothesized that this type of water heater, the most efficient currently available gas tank water heater on the market, would have a similar form factor to a future GHPWH and potentially serve as a proxy product. However, finding people who owned a CGSWH proved to be very challenging. After extensive recruitment efforts, including 3,792 texts and emails and 346 screener responses, we determined it was highly unlikely that any owned a CGSWH. While this does not preclude research with CGSWH owners in the future, we found that the market for residential CGSWH is smaller than anticipated and that focus groups with this market were not feasible at this time.

We then refocused the research on the purchase behavior and attitudes for households that had recently installed a gas water heater to understand if there are other potential proxy products for a GHPWH. We revised the screener instrument into a survey that focused on recent gas water heater purchasers and explored purchase motivations, equipment considerations and preferences, and attitudes toward electrification and fuel sources. The survey acted as both a large-scale data collection and a tool for finding individuals to participate in the focus groups. The screener survey questions asked respondents about decision-making factors for their recent gas water heater purchases, such as if they went with their contractor's recommendation, if energy efficiency was a key consideration, and if they were considering electrification for any of their gas appliances.

Research Questions and Activities

The research questions for the refocused second phase of this research, the screener survey and focus groups with recent gas water heater purchasers, and their corresponding research activities are below.

Table 1. Research Questions by Activity

RESEARCH QUESTIONS	RESEARCH ACTIVITY
Why did the homeowner choose to install their water heater?	Survey and focus groups
What was the homeowner's path to buying this product? Did they seek it out specifically or did their installer sell them on it?	Survey and focus groups

Who were the key market actors they interacted with in making this decision and subsequently installing the equipment?	Survey and focus groups
What resources, if any, did they look at to understand or learn more about this product?	Focus groups
What is their orientation toward efficient equipment in general? What is their orientation to efficient natural gas equipment?	Survey and focus groups
Were there any barriers or challenges they faced in buying this product, such as up-front costs or annual maintenance requirements?	Focus groups
Did they have any issues finding an installer or with the installation process?	Focus groups
What is the current experience of living with their chosen water heater?	Focus groups
How often do homeowners interact with their water heater?	Focus groups
What might homeowners do the next time they need to replace their water heater (e.g., consider fuel switching, plan the replacement, or wait for total failure then install same/similar product)?	Focus groups

Whom We Spoke to

The survey received 129 responses, above its goal of 70 responses. To qualify for the survey, all respondents had to be homeowners with gas, or in a few instances propane (five respondents)—water heaters and who had replaced their water heater in the last five years. While the survey was available nationwide, most respondents were from Northwest states (Washington, Montana, Idaho, and Oregon, 89%). Most respondents had traditional storage tank water heaters (84%, n=108), and the remainder had tankless water heaters (16%, n=20).

To create our online focus groups, we filtered survey responses for the follow criteria:

1) Primary or joint decision-makers who did most of the work (ex. planning, research, scheduling) to replace their water heater.
2) Those who indicated that energy efficiency was a priority when purchasing their new water heater by either saying they:
    a. Replaced their water heater because they wanted a more efficient water heater, or
    b. Selected energy efficiency as one of the top three reasons they chose the water heater they installed.
3) Those who did not say they were currently considering fully electrifying their home.

From the subset of customers who met the above criteria, we created four groups:

1) The Tankless but Open to Tanks Group: A group of tankless water heater owners who said they would be interested in going back to a tank if the tank were more efficient. This was the only group with tankless water heater owners.
2) The Dedicated to Gas Group: A group who said they were not considering electrifying any of their appliances.
3) The Electrification Curious Group: A group of people who were interested in electrifying some of their appliances.
4) The General Group: A general group that met the above criteria.

Across the four groups, we had 22 participants. We believed these groupings would give insight into a potential future market for GHPWHs as we sought to validate, update, or challenge findings on dedication to gas and technology acceptance from previous ILLUME research. These research efforts include the Natural Gas Segmentation Study (2016), the Efficient Water Heater Pricing Research (2021), and the Gas Tankless Water Heater Combined Research (2020).

Focus Group Summaries

The following are summaries of focus group members, their demographics, and notable responses during discussion. Although we had a small sample size with four to nine participants per group, we found that there were some meaningful differences in attitude toward energy efficiency in their homes.

Tankless but Open to Tank

Table 2: Tankless but Open to Tank Group Demographics

Participant	State	Community	Age	Household Income	Replacement Reason(s)
1	WA	Urban	25-34	$25K-$50K	Age, tank size, efficiency
2	CO	Urban	45-54	<$25K	Showed signs of failing
3	FL	Suburban	45-54	$100K-$150K	Age, efficiency
4	WA	Suburban	65+	Prefer not to answer	Failure

The Tankless but Open to Tank group spoke about efficiency in a way that most aligned with the industry's definition, understanding that it refers to an appliance that uses less energy to accomplish the same task. This group emphasized the importance of this concept for their decisions.

The participants in this group described making **proactive upgrades,** such as switching out appliances for more efficient ones or insulating pipes. They also described **behavioral changes** they made to lower their water and energy usage, like decreasing the temperature of their water heater, not watering their lawn and letting it go "dormant" in the summer, or purchasing an electric vehicle.

> *"Energy efficiency is the number one thing we're going for."*
>
> *– Tankless participant*

> *"I became really motivated to try to save… I got really conscious about it when gas prices went crazy when the Ukrainian war broke out and we were still getting oil from Russia. And I thought, okay, how can I use less fuel? What can I do?"*
>
> *– Tankless participant*

Two participants from this group explicitly voiced concerns about **the environment**, specifically the impact of fossil fuels on climate change, explaining that these concerns motivated their actions related to energy efficiency. These were the only two out of the 22 participants who expressed climate concerns during the focus groups. Another participant also expressed concern about **global conflicts** and their effects on energy independence.

The attitudes of this group most closely align with the "Kyle: The Young Urban Traditionalist" segment from the 2016 Natural Gas Segmentation Study. Like this study's Tankless group, these respondents were interested in new technologies and the environment. However, the demographics of the Tankless group had a wider age range and the participants were entirely female as opposed to the previously segmented late 20s to 30s and mostly male demographic of the "Young Urban Traditionalist." While the sample size for this focus group is very small, it indicates that both technology acceptance and environmental concerns may have become more widespread in the past eight years.

Electrification Curious

Table 3: Electrification Curious Group Demographics

Participant	State	Community	Age	Household Income	Replacement Reason(s)
5	WA	Suburban	55-64	$150K-$200K	Showed signs of failing
6	WA	Suburban	65+	Prefer not to answer	Age
7	GA	Suburban	55-64	$100K-$150K	Showed signs of failing
8	WA	Urban	35-44	$100K-$150K	Failure
9	WA	Suburban	65+	$75K-$100K	Failure
10	WA	Urban	35-44	$100K-$150K	Failure
11	PA	Suburban	35-44	$200K-$250K	Age
12	WA	Urban	65+	$75K-$100K	Age
13	WA	Suburban	45-54	$75K-$100K	Failure

Like the Tankless group, the Electrification Curious group had a **proactive attitude** toward energy efficiency and home upgrades. Several participants mentioned preemptively replacing windows and adding attic insulation.

This group was also mindful of their overall energy and water consumption, and these respondents made **behavioral changes,** like decreasing the temperature of their water heater. Participants in this group also reasoned that installing more energy efficient equipment proactively would recoup savings later. This group also discussed how expensive it was to install their water heaters, and many agreed that they spent more time finding an installer than selecting the water heater due to the **installation cost**.

While all participants in this group said that energy efficiency was a decision-making factor for their water heater replacement, none had noticed differences in their bills since installing the new equipment. **This suggests that one way this group thinks about energy efficiency is directly related to costs and savings, both on installation and on an ongoing basis.**

In relation to the 2016 Natural Gas Segmentation Study, this group's priorities most closely align with that of "Rose: The Day-to-Day" segment. The Electrification Curious group also did not have strong fuel preferences and let installation cost dictate their water heater purchase choice. While the Electrification Curious group has a higher household income than the "Day-to-Day" group, they did not indicate that they were willing to invest more in their water heater for the sake of energy efficiency.

Dedicated to Gas

Table 4: Dedicated to Gas Group Demographics

Participant	State	Community	Age	Household Income	Replacement Reason(s)
14	WA	Suburban	25-34	$75K-$100K	Failure
15	WA	Suburban	35-44	$100K-$150K	Failure
16	WA	Suburban	35-44	$25K-$50K	Age, efficiency, showed signs of failing
17	WA	Rural	35-44	$75K-$100K	Tank size
18	WA	Urban	55-64	<$25K	Failure

This group, which happened to be comprised entirely of Washington state residents, **defined efficiency in terms of speed and perceived gas to be a more efficient fuel** for space and water heating and for

cooking. The individuals in this group, compared to other groups, were also very **detail-oriented and approached product research differently than other groups**. They described comparing energy guides of different water heaters and explained how they researched and compared gas and electric models.

They were mindful of operating cost and discussed their bills more than other groups, whose cost discussions largely focused on the installation cost. Several participants also noted that their gas bills have more than doubled over the past few years.

> *"I believe that in my experience, for example, with the water heater… when we use it up, it heats up quickly. … I haven't done it scientifically but anecdotally; it seems to recover much faster."*
>
> *- Dedicated to Gas participant*

However, in some instances, they **prioritized speed over operating cost.** For example, one participant had a choice between running their dryer on gas and electric and chose to run it on gas because it was faster, despite it costing more than electric.

> *"Our cost per therm was 72 cents, so our average cost per year would be about a $190. Now, our average therm is $1.55. It's a 114% increase in less than 3 years … which is still less expensive than what the electric water heater would be."*
>
> *– Dedicated to Gas Participant*

This group had a **mix of proactive and reactive** replacements related to energy efficiency. Participants described upgrading appliances to more energy efficient ones and adding insulation, as well as choosing more efficient appliances if the previous ones failed. They also described **behavioral changes** like decreasing the temperature of their water heater and **monitoring their energy usage closely** with smart thermostats.

This group's attitudes somewhat aligned with "Doug: The Natural Gas Pragmatist" from the 2016 Natural Gas Segmentation Study. The Dedicated to Gas group similarly preferred the speed and reliability offered by gas appliances. While the "Natural Gas Pragmatist" segment preferred gas due to low cost, the Dedicated to Gas group indicated that cost was not their only decision-making factor and were willing to pay more to use gas appliances. Since this Dedicated to Gas group's preference for gas appliances generally extended beyond the cost of natural gas, it may indicate that they are less sensitive to rate changes and possibly more interested in a high-efficiency gas water heater than the "Natural Gas Pragmatist" segment.

General

Table 5: General Group Demographics

Participant	State	Community	Age	Household Income	Replacement Reason(s)
19	WA	Suburban	55-64	$100K-$150K	Failure
20	WA	Rural	35-44	$50K-$75K	Failure
21	WA	Suburban	45-54	$100K-$150K	Failure
22	OR	Suburban	35-44	$75K-$100K	Age

Although the General group responded in the screener survey that energy efficiency was an important factor to them, that priority was not necessarily reflected in their actions. Instead, **efficiency tended to be a byproduct of their updates**. Most of the participants in this group also tended to assume that ***new* meant *efficient.*** Because of this, when they described repairing something that broke, the participants of this group viewed that repair as an action to improve the home's efficiency, even if the action or product mostly brought their home to the current baseline. For example, one person described their energy efficiency action as installing LEDs when their old bulbs burnt out. Another participant explained that they were primarily looking for a new water heater that could be installed easily in the same place as the old tank rather than considering energy efficiency specifically.

> *"It's like when things start failing or they need to be replaced. At that point I choose to go with the energy efficient option. But it's not the energy efficiency that is prompting the repair."*
>
> *– General Participant*

This group made **reactive upgrades**, as shown by most of them replacing their water heater only upon failure. All participants also had self-installed their water heaters and purchased whatever was readily available from big box stores or, in one instance, what was available via a family member who was a plumber. This was unlike other groups, who mostly hired contractors to install their water heaters.

The General group had similarities to "Erica: The Middle American" segment identified in the 2016 Natural Gas Segmentation study. Both relied on big box stores for appliance purchases and prioritized easy decision-making and installation over optimizing choice. Our past research identified this segment as possibly difficult to market toward for future high-efficiency gas water heaters but also highlighted an opportunity to intervene with program materials at big box stores. However, since a GHPWH would be unlikely to be carried by a major retailer, this group may not be an ideal market for such a product.

Key Findings and Recommendations

In each of the four focus groups, we explored participants' water heater purchase and installation journeys, including what prompted their replacement, if they ran into any difficulties during the process, and what it was like currently living with their water heater. We also ran a "Good, Better, Best" exercise, which asked participants to choose from three models of water heaters with increasing features and quality to understand what they would do for future replacements.

The findings below include both the attitudes of the current efficient gas water heater market and what this might mean for a future GHPWH product. There are detailed findings by research question in the Appendix.

Market Findings and Recommendations for Future Consideration

The following findings are forward-looking and address the potential for a future beachhead market for a GHPWH product.

The residential CGSWH market is smaller than initially expected, and it is unclear whether there are enough homeowners who purchased a CGSWH to serve as a beachhead market for a GHPWH.

Based on recruitment efforts from this research, it does not appear that there is currently a widely available product that could serve as a proxy for potential future GHPWH purchasers. The market of residential CGSWH owners is very niche and thus unlikely to be a possible proxy product for GHPWHs. As described above, the extensive recruitment efforts (more than 3,500 outreach messages) did not identify any residential homeowners with a CGSWH. Of the 346 who filled out the screener survey and shared photos, several had power vents that are not unique to CGSWH and are often installed as a solution for venting and code compliance rather than an energy efficiency solution. (The team was able to recruit one owner of a power vent gas water heater and conducted an interview with them prior to recognizing that he had a power vent, rather than a condensing gas water heater.) At this time, the team concludes that the current market of CGSWH is smaller than initially anticipated.

However, some current gas water heater owners could have interest in a future GHPWH product depending on a person's dedication to gas and technology acceptance. Those with similar dispositions to those in the Dedicated to Gas group are the most likely market for an efficient gas product as most members of this group preferred gas in all instances and were less cost-sensitive, even opting for it if it cost them more to operate. Those like participants in the Tankless but Open to Tanks group may also be a potential market for a GHPWH as these respondents have already proven their willingness to adopt new technologies for sake of efficiency.

Customers like those found in the Electrification Curious and the General group may be more difficult to persuade as they prioritized cost and easy decision-making over an interest in efficient technologies or a commitment to gas. A GHPWH would need to be the clear, cost-effective option to sway those in these markets.

These insights may help gauge the market's commitment to gas and efficient gas technologies in anticipation of future codes that could potentially require high UEF, regardless of energy source. In such

a situation, neither conventional storage gas water heaters nor tankless models would be an option, and a GHPWH would be one of the few gas water heating products available.

RECOMMENDATION:

Consider conducting future research to deepen understanding of customers' decision-making, exploring situations such as if EHPWH and GHPWH were the only two options.

There are educational opportunities to support customers looking for efficient gas equipment. Customers familiar with heat pumps may assume it is a technology exclusive to electric appliances.

Some customers noted that they investigated the cost comparison between gas and electric systems and found limited information from their utility. Outside of the attitudes found in the Dedicated to Gas group, who were willing to pay more for the functionality and speed of gas, participants seemed more fuel neutral than they were in the 2016 Natural Gas Segmentation study. Decisions were based on practicality and cost, rather than an attachment to gas as their water heater fuel source.

> *"We decided to grab or to purchase a water heater that would match the intakes and outtakes. So there wasn't much of a looking for the most efficient. All of them look to be newer technologies."*
>
> *– General Participant*

> *"I had inquired with our utility company [about] prices between electric and gas… 'If a person were to switch from one to the other, on a long-term basis, what would that look like?'… One had said, 'Well, you know, electric is definitely the way to go.' And then the other one came back and said, 'Well, no gas is the way to go.' And so, there was even differing opinions within the utility company I was talking to."*
>
> *– Electrification Curious Participant*

In lieu of better information, participants discussed sticking to what was familiar to them and made like-for-like replacements. This highlights an opportunity to intervene with educational materials on high-efficiency technologies. In fact, some participants assumed that newer models automatically meant that they were more efficient without necessarily looking at their efficiency ratings. They saw the newness of the model as a proxy for efficiency, even though the water heater they chose did not feature any particular new technologies that would increase its efficiency.

In addition to experiencing confusion on the costs, another participant was confused by the idea of gas heat pump technologies. They were familiar with heat pumps but assumed they were only available for electric appliances.

> *"I don't know how a gas heat pump would work … I'm not sure that's a technology that's out there."*
>
> *– Electrification Curious Participant*

RECOMMENDATION:

If GHPWHs come to market, encourage their adoption with educational campaigns and disrupt the assumption that heat pump technologies are exclusive to electric appliances. While not every customer

is interested in learning about the functionality of their water heater, providing retailers and contractors with educational materials on new high-efficiency technologies can support sales of such units.

Customer Orientations to Fuel Type

The findings in this section detail the various orientations that customers had toward the fuels in their homes, including what fuel their water heater used.

The Dedicated to Gas group preferred gas due to its performance and reliability. While gas was the cheaper option for most participants, their commitment to gas went beyond cost effectiveness.

In the Dedicated to Gas group, three of five participants in this group said they would use gas for all their appliances if they could but also knew that Washington state regulations limited what they could install. This group also spoke more than other groups about the sensory experience of living with gas-fueled equipment, such as the experience of cooking with gas and the feeling of warm air from a forced air furnace. (We note, however, that there is not a similar sensory experience that differentiates a gas water heater from an electric water heater).

> *"I love having the gas dryer, it dries so much quicker. My furnace, my gas water heater… they're all gas. So, it definitely runs us higher in bills, but overall, it's much more efficient."*
> *– Dedicated to Gas Participant*

> *"When I went to buy the gas water heater, they're like 'Do you want electric?'… No, I don't. It's gonna burn out faster. That's my experience so far."*
> *– Dedicated to Gas Participant*

This dedication to gas outweighed operation costs in some instances. One participant, who had a choice between running their dryer on electric or gas, knowingly chose the more expensive gas option due to its speed.

The Dedicated to Gas group also described gas as consistent and reliable in direct comparison to its electric appliance counterparts. For example, one participant in this group had an interesting water heater configuration prior to replacement, with one gas and one electric water heater side by side. The electric water heater failed first, followed by the gas water heater. This participant chose to replace them with a single gas water heater since the old electric water heater failed first and that gave them the impression that a gas water heater would last longer. In this case, both water heaters were both over 20 years old at the time of failure and beyond the typical lifespan of a water heater.

RECOMMENDATION:

Consider marketing GHPWHs or other high-efficiency gas water heater technologies toward customers who align with the Dedicated to Gas group's attitudes, particularly due to their preference for gas appliances and willingness to choose comfort and performance over cost in some instances.

The Electrification Curious group had similar sensory preferences to the Dedicated to Gas group but were more fuel neutral. They focused on bottom-line cost and stuck to their gas water heaters due to expensive electrification costs.

Like the Dedicated to Gas group, participants in the Electrification Curious group mentioned their preference for how gas stoves cook, and two mentioned enjoying their gas fireplaces. Despite their response to the screener survey stating their interest in electrifying some of their appliances, no one in the Electrification Curious group noted during the discussion that they were looking to electrify their water heater. Rather, participants in this group mentioned they preferred gas because it was cheaper for them, consistent with this group's cost-based definition of efficiency.

> *"Having to run extra line, getting an electrician in… that just seemed like it would be very expensive. It would be more cost efficient just to stay with gas."*
> *– Electrification Curious participant*

> *"We did look into [electric] heat pump water heaters, but that was not a direction we decided to go. Performance didn't seem to be terrific; contractors didn't like them."*
> *– Electrification Curious participant*

While several groups mentioned the expense of panel upgrades, the Electrification Curious group in particular spoke about it at length, with several participants noting that they would have to upgrade their electric panel to switch to an electric water heater or add other electric appliances. Ultimately, all nine participants in the Electrification Curious group said they would rather stay with a gas water heater than switch to electric given the expense of upgrading their panel.

One person familiar with heat pumps said an electric HPWH was too expensive to install and had concerns about maintenance, as well.

RECOMMENDATION:

Customers like those in the Electrification Curious group could be interested in a GHPWH if it is a cost-effective choice. Consider conducting future research to deepen the understanding of customer decision-making, for example if 120V HPWH and GHPWH were the only two options.

Participants in the Tankless but Open to Tanks and the General groups expressed mixed feelings about natural gas. There were no concerns about gas voiced in the Dedicated to Gas group, and, interestingly, none in the Electrification Curious group.

Most participants across focus groups expressed a preference for gas appliances based on positive previous experiences. Notably, there were no mentions of environmental or safety concerns around gas from the Electrification Curious or Dedicated to Gas groups. In fact, one participant in the Dedicated to Gas group knew their old water heater had failed due to smelling gas in their home. When asked if they had safety concerns around gas, they said they did not because the smell would always indicate if there was an issue.

> *"It's a fossil fuel industry… are we harming the environment? … I think that you would be helping the environment [by electrifying] as well as saving some money in the long run [by switching to electric]."*
> *– Tankless participant*

However, some participants in the Tankless but Open to Tanks and General groups voiced concerns or mixed feelings about gas. The Tankless but Open to Tanks group had the most fuel-neutral attitudes. Half of the participants said they were fine switching to electric and the other half said they would switch

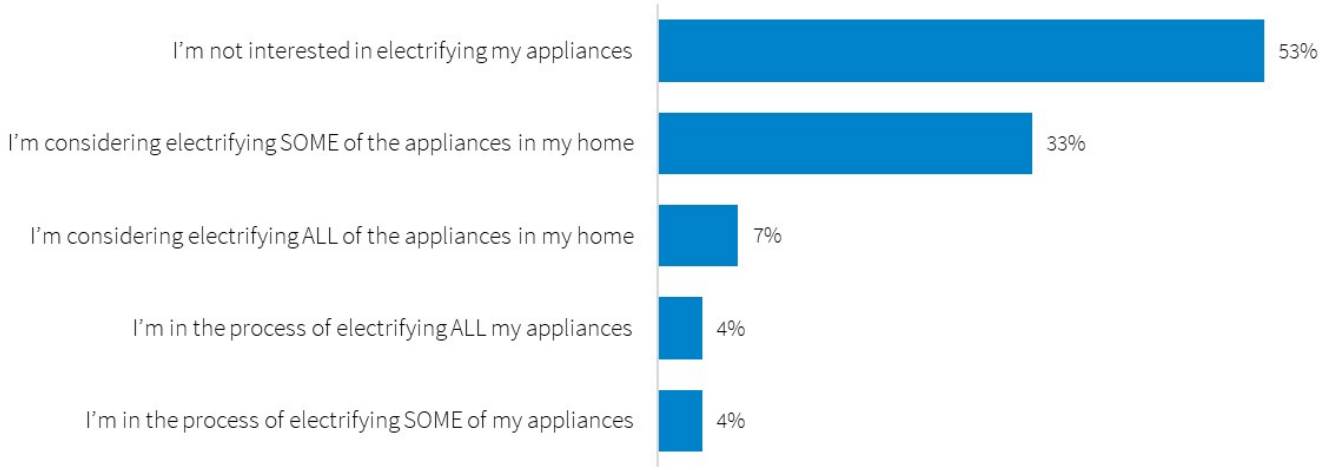
if their overall bills would not increase. This group was also the only group to mention environmental concerns around gas.

In the General group, one Washington state resident mentioned their concerns about safety due to recent explosions. This same person said they would consider an electric water heater, depending on the cost to convert.

> *"Gas makes me a little nervous. Right? I mean, you see, there have been a couple of explosions in some neighborhoods."*
> *– General participant*

Among survey respondents, there was mixed interest in electrification. About half of respondents (53%) were not interested in electrification at all, while 48% were considering or in the process of electrifying some or all their appliances.

Figure 1. Interest in Electrification



Q13 "What do you think about using electricity instead of natural gas to power your home appliances?" n=129, single response

The future of the natural gas appliance market will likely depend on a variety of factors, including shifts in local and national codes and standards as well as consumer sentiment related to fossil-fuel appliances.

RECOMMENDATION:

A market for efficient gas water heaters remains in the short to medium term. Consider future research with larger sample sizes to test if these attitudes are consistent among these focus group demographics.

Product Findings

In addition to the general market findings we provided above, we note that there were additional findings related to a potential future product. These product-level findings focused on specific features or attributes that were either appealing to customers or not appealing to them.

Some tankless owners are willing to return to a tank if that means more efficiency.

Consistent with the Efficient Water Heater Pricing Research conducted by ILLUME in 2021, cost is a primary consideration for most participants and, while most people say energy efficiency is a top priority, it generally does not drive their decision-making.

> *"I replaced my tanked water heater with a tankless water heater. I think that was much more energy efficient."*
> *– Tankless Participant*

However, this research found that there are *some* tankless owners for whom energy efficiency may factor more heavily into their purchase decisions than others. To gauge a person's dedication to tankless gas water heaters, we asked tankless owners in the screener survey if they were willing to switch back to a tank water heater if it offered twice the efficiency of their tankless model. Two-thirds (65%, n=13) would be willing to go back to a tank, while the remaining one third (35%, n=7) would stick to their less-efficient tankless model.

> *"I wouldn't have any issues [going back to tank]. It's all about the efficiency of it… and how much energy is used… it does not necessarily matter the size for me."*
> *– Tankless Participant*

Additionally, in focus groups, the four tankless water heater owners saw energy efficiency as a priority and were willing to take a higher upfront cost for it.

> *"I would consider it. I just have to make sure it is worth my while to lose that premium space in the garage."*
> *– Tankless Participant*

When discussing returning to a tank for sake of efficiency, focus group participants were open to the idea with some caveats. Two of four participants had no issue going back to a tank if it were more efficient, regardless of how much space it would take up. The other two said that the new tank would have to be significantly high quality, very efficient, and worth losing space again.

In other focus groups, some participants were averse to tankless models, citing how a large source of potable water from their water heater could be useful in emergencies for both drinking water and bathing.

RECOMMENDATION:

Consider additional research to see if tankless owners could be a potential market for a new efficient gas water heater product.

Brand familiarity can be a proxy for quality and reliability even across a shift in form factor.

Across groups, those who mentioned their brand of water heater noted their preference to stick with a brand they had experience with. Most opted for a water heater from the same manufacturer as their previous one, especially if their water heater had lasted a long time.

> *"The builder put in an A.O. Smith… it lasted me for over 21 years. And so, when I decided I needed a hot water heater, because it went out, I decided to look for that brand."*
> *– Electrification Curious Participant*

"I know I wanted Rheem, and that was the big thing for me was the brands, because I had always been happy with it."
– Tankless Participant

Brand familiarity even transcended changes in form factor and technology. Two of the participants in the tankless group had opted to stick with the same trusted brand of their storage tank water heater when switching to tankless. Purchasing a trusted brand meant they were more willing to take on the risk of a new type of technology.

RECOMMENDATION:

Future market entrants for a GHPWH may want to partner with (or come from) known and familiar North American manufacturers. NEEA may want to support work across all major North American manufacturers to ensure widespread brand familiarity.

Additional features were a deterrent to choosing higher end, more efficient models across all groups.

Few participants chose the "best" model, but those that did noted the practical features that tipped the balance for them, such as leak detection. By contrast, many participants perceived the additional features in the "best" model such as Wi-Fi or Bluetooth connectivity to be superfluous. They saw these features as additional opportunities for things to break. There was also the perception that more contemporary equipment did not last as long as older models with fewer features.

This sentiment was similar among survey respondents with tank water heaters, as 80% of them (86 of 108) placed "extra features" in the bottom three reasons as to how they chose their water heater.

"When I see things like self-cleaning, when I see things like the smart Bluetooth, vacation mode… More can go wrong… Which then means I have to pay somebody else to fix said things."
– Dedicated to Gas Participant

For the participants that did choose the "best" model, three out of five had experienced damage from water heater leaks in the past, and for these participants, leak detection was viewed positively. Others noted they could save money on routine services if the water heater had a self-cleaning feature. Only one participant in the Tankless but Open to Tanks group said energy efficiency was why they chose the top model.

Table 6: Participants Who Chose "Best" Model During "Good, Better, Best" Activity

Group	Participants that Chose "Best" Model	Reasoning
Tankless but Open to Tank	1 of 4	Energy efficiency, longer warranty, and leak detection. Had a leak in the past and it caused significant damage.
Dedicated to Gas	1 of 5	Wanted to spend more initially to avoid spending more later. Self-cleaning meant they did not have to pay for routine cleanings. Also liked Wi-Fi and longer warranty.

Electrification Curious	2 of 9	Person 1: Had a leak in the past and wanted leak detection. Liked the "bells and whistles," in addition to self-cleaning. Person 2: Self-cleaning, did not want to pay for routine cleanings. "Nice to have" savings from energy efficiency but did not see it as a requirement.
General	1 of 4	Leak detection. Had seen damage from water heater leaks and was worried about collectibles stored near their water heater.

RECOMMENDATION:

Aversion to extra features, coupled with participants' inclination toward what is familiar, may create some limitations in the market for a new efficient GHPWH. Any additional features a future GHPWH may have should focus on its core functionality or maintaining its functionality, such as leak detection or self-cleaning, to increase its likelihood of adoption.

Conclusions

This research effort traveled down an unanticipated path but yielded meaningful findings with respect to any future gas heat pump water heater products. First, the research showed that the initial hypothesis—which was that condensing gas water heaters could be a proxy market for a GHPWH product—may not be viable at this time. Our extensive recruitment efforts did not reveal that such a market currently exists in size or accessibility to serve as a reasonable proxy for a new GHPWH market.

However, the research did find that some gas water heater owners may be interested in a GHPWH, depending on their dedication to gas appliances and their interest in new technologies. NEEA should also consider the possibility of tankless water heater owners' interest in a GHPWH as many surveyed indicated that they would be willing to return to a tank model for the sake of efficiency.

Gas as a fuel source continues to be a nuanced and complicated topic with some participants preferring gas appliances due to their reliability and comfort and others citing concerns around safety or carbon emissions. Regardless, our findings suggest that there is still a market for new gas-powered water heaters in the short- to medium-term future. Working with known North American manufacturers and leaning on brand familiarity can help usher in a GHPWH.

This research has also identified an educational opportunity for customers looking for efficient gas equipment. Information should be readily available to both contractors and big box stores as this could support sales and disrupt the assumption that heat pump technologies are exclusive to electric appliances.

Should NEEA wish to support the introduction of a GHPWH, we recommend future research to explore water heater purchase decision-making when the only options are GHPWH and EHPWH. This could help illustrate how consumers will act if appliance standards remove inexpensive, low efficiency gas products from the market.

Appendix

Findings by Research Question

Research Questions	Finding
Why did the homeowner choose to install their water heater?	As in other research, most participants replaced upon unit failure, when the previous unit was no longer functioning well, or when it was perceived to be struggling to meet demand.
What was the homeowner's path to buying this product? Did they seek it out specifically or did their installer sell them on it?	The market actors and path to purchase that the focus group participants took was like that found in previous research. Specifically, many focus group participants described conducting some research about different water heater units, including internet research and talking to friends or family with experience in plumbing or contracting. Several purchased and installed the units themselves after speaking with someone at a retail (big box) store. Others installed them on the recommendation of their installer.
Who were the key market actors they interacted with in making this decision and subsequently installing the equipment?	As in other water heater research, the key market actors that participants interacted with included contractors, installers, plumbers, and retail store staff, as well as friends, family, and informal networks.
What resources, if any, did they look at to understand or learn more about this product?	Several participants noted that they turned to friends or family who were plumbers or to other installers for support. Several customers described conducting internet research prior to purchasing.
What is their orientation toward efficient equipment in general? What is their orientation to efficient natural gas equipment?	All participants said they valued efficiency, and all valued having access to natural gas equipment. That said, there was nuance in their orientations with some customers emphasizing that they valued the familiarity and reliability of gas equipment, while others expressed concerns about the environmental impacts of fossil fuels or safety of gas appliances in homes. Although some participants said they had considered installing more electric appliances or would consider this in the future, we did not include people who said they were actively looking to electrify their home in this research. Thus, all participants had some preference for gas appliances. Many also expressed that gas appliances were more efficient than electric ones, especially comparing a gas water heater with an electric resistance one.

Research Questions	Finding
Were there any barriers or challenges they faced in buying this product, such as up-front cost or annual maintenance requirements?	Participants purchased their water heaters either from a retail store or through their installer. While some mentioned they would have considered more options had it not been an urgent emergency replacement, everyone was able to find a water heater without much issue.
Did they have any issues finding an installer or with the installation process?	No specific issues. Several participants self-installed, including in the Tankless but Open to Tanks group.
What is the current experience of living with their chosen water heater?	Generally good experiences. Most would repurchase the same unit. For those who switched to a tankless unit, they appreciated the "endless" hot water.
How often do homeowners interact with their water heater?	Rarely, which is as they would like it.
What might homeowners do the next time they need to replace their water heater (e.g., consider fuel switching, plan the replacement, or wait for total failure; install same/similar product)?	The participants in this study had all replaced their water heaters in the past five years; none were currently planning a replacement. As in the pricing research, participants in this research study suggested they would prioritize cost and availability of a product, along with efficiency. However, some participants noted that they would like to avoid waiting for near or total failure of the unit to plan for their next replacement water heater so that they can do additional research and consider different options and models. In the "Good, Better, Best" activity, most customers chose the middle "Better" option, which was moderately efficient and had some additional features above and beyond the base model. Participants mentioned doing online research and talking to friends, family, or neighbors when deciding which water heater to purchase. Some who were considering fuel switching were unable to get clear answers from their utility and/or manufacturer on what total costs would be, indicating an opportunity for customer education or comparison tools.

ILLUME

NEEA High Efficiency Gas Water Heater Research

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Agenda

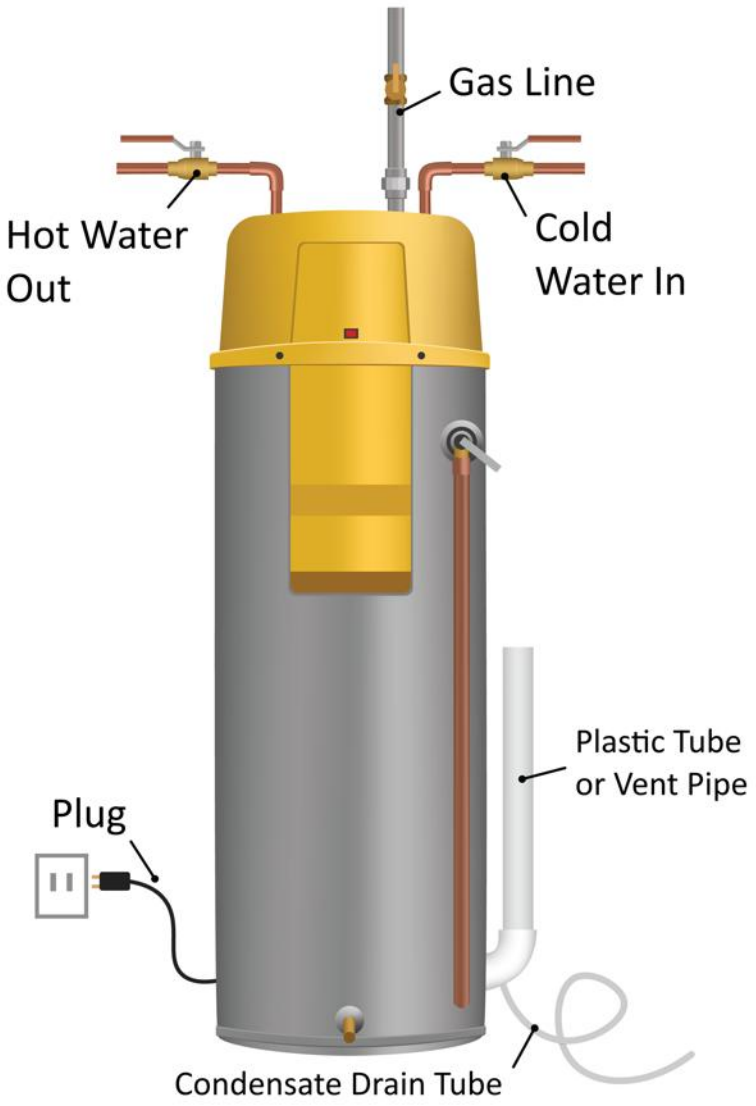
Research Objectives & Methodology

Who We Spoke To

Focus Group Summaries

Key Findings

Conclusions & Recommendations



Condensing Gas Storage Water Heater Recruitment Image

Research Objectives

Primary Focus Areas

- Exploring opportunities to increase the adoption of currently available efficient gas water heaters.
- Driving development and commercialization of gas heat pump water heater (GHPWH) products.
- Collaborating with utilities throughout North America to enact mass deployment of GHPWH through a combination of traditional programs and innovative strategies.

Methodology

Initial Approach

Focus groups with CGSWH owners as a proxy for future GHPWH purchasers

Recruitment efforts of residential CGSWH owners and RBSA data did not yield participants

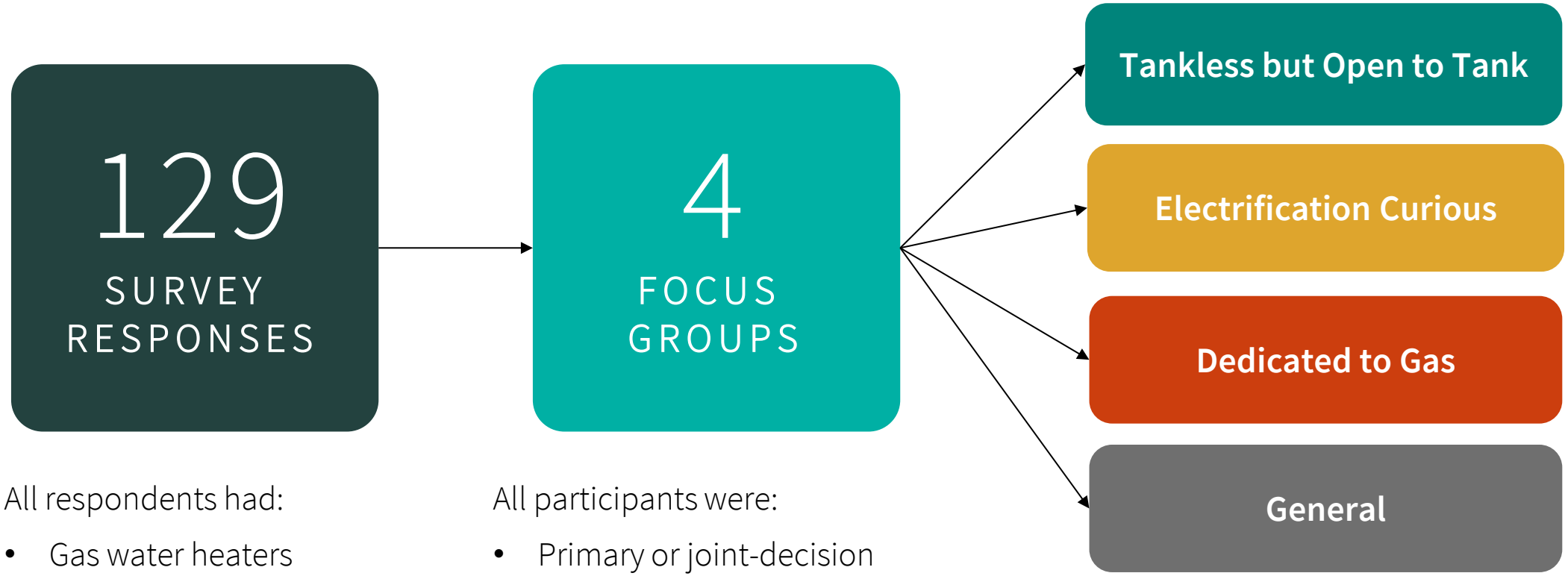
Revised Approach

Pivoted recruitment to households that recently installed a gas WH to determine other potential beachhead markets for GHPWH

Revised screener to also explore GWH owners' purchase motivations, equipment considerations and preferences, and attitudes toward electrification and fuel sources

Recruited subset of survey respondents to participate in focus groups

Who We Spoke To



All respondents had:

- Gas water heaters
- Replaced in the past 5 years

All participants were:

- Primary or joint-decision makers for WH replacement
- Said energy efficiency was a top 3 factor in their replacement

22 total participants amongst 4 groups

FOCUS GROUPS

Tankless but Open to Tank

All participants said they **would consider returning to a tank** if it were more efficient. Only group with tankless water heaters.

- Group's **definition of efficiency largely matched industry's**
- Proactive upgrades
  - Ex. Switching out appliances for more efficient ones
- Behavioral changes
  - Ex. Lowering water heater temperature or purchasing EVs
- 2 voiced concerns on the environment
- 1 voiced concern about global conflicts and energy independence

Electrification Curious

All participants were considering **electrification for some** of their appliances

- Group thought about energy efficiency in terms of **cost**
- Also had proactive upgrades and behavioral changes
    - Ex. Adding attic insulation or decreasing WH temperature
- Reasoned that more energy efficiency now would recoup savings later

Dedicated to Gas

All participants were **not considering electrification** for any of their appliances

- Defined efficiency in terms of **speed and perceived gas to be a more efficient fuel**
- Prioritized speed over operating cost in some instances
- Detail-oriented and approached product research differently from other groups
    - Ex. Comparing energy guides and cost per therm on their utility bills
- Mix of proactive and reactive replacements related to energy efficiency

General

All participants were primary decision makers for their WH purchase and noted energy efficiency in their top 3 reasons why they chose their water heater

- **Efficiency was a byproduct of updates**
  - Ex. Patched holes in roof, installed LEDs when old bulbs burned out
- Prioritized easy decision-making and installation over optimizing choice
- All participants self-installed and purchased their water heater from big box stores

FINDINGS

Finding Categories

Future Market Findings

Findings relevant to future markets and potential future research on high-efficiency gas water heater products

Customer Orientation to Fuel Type

Findings related to customer fuel preferences, both generally and for their water heaters specifically

Product Findings

Findings relevant to future products, including what may help customers choose a future high-efficiency gas water heater product

The residential CGSWH is smaller than initially expected. It is unclear whether there are enough homeowners to serve as a beachhead market for a GHPWH.

- Initial recruiting efforts for CGSWH owners
  - 3,792 texts/emails and 329 screener responses
  - No respondents that met definition of CGSWH
- Some current gas water heater owners *could* have interest in future GHWPH product
  - Dedicated to Gas group members: Strong preference for gas and less cost sensitive
  - Tankless group members: Proven willingness to adopt new technologies for efficiency

Recommendation: Consider conducting future research to deepen understanding of customer decision-making, ex. if EHPWH and GHPWH were the only two options.

There are educational opportunities to support customers looking into efficient gas equipment. Customers familiar with heat pumps may assume it is technology exclusive to electric appliances.

- Participants struggled to find cost comparisons between gas and electric and found limited information
  - Customers were more **fuel neutral** than seen in past research (except for the Dedicated to Gas group)
  - Decided based on **practicality and cost over dedication to a particular fuel source**
- Some assumed newer models were more efficient without looking at efficiency ratings

"I don't know how a gas heat pump would work… I'm not sure that's a technology that's out there."
– Electrification Curious participant who was familiar with heat pumps

Recommendation: Encourage GHPWH adoption with educational campaigns and disrupt the assumption that heat pump technologies are exclusive to electric appliances. Support retailers and contractors with educational materials.

The Dedicated to Gas group preferred gas due to its performance and reliability. While gas was the cheaper option for most participants, their commitment to gas went beyond cost effectiveness.

- 3 of 5 Dedicated to Gas participants said they would use gas for all their appliances if they could
- Many shared a preference for the performance and sensory experience of gas-powered equipment
  - Considered it **more consistent and reliable** than electric
  - Was cost effective for most but **some were willing to pay more for gas in certain instances**

"I love having the gas dryer, it dries so much quicker. My furnace, my gas water heater… they're all gas. So it definitely runs us higher in bills, but overall it's much more efficient."
– Dedicated to Gas Participant

Recommendation: Consider marketing GHPWHs towards customers who align with the Dedicated to Gas group's attitudes, particularly due to their preference for gas appliances and willingness to choose performance over cost in some instances.

The Electrification Curious group had similar sensory preferences to the Dedicated to Gas group but were more fuel neutral. They focused on cost and stuck to their gas water heaters due to expensive electrification costs.

- Some participants in this group also preferred the experience of cooking and heating with gas and reported it being cheaper
- All 9 Electrification Curious participants preferred to stay with a gas water heater to **avoid the costs of panel upgrades**

"Having to run extra line, getting an electrician in… that just seemed like it would be very expensive. It would be more cost efficient just to stay with gas."
– Electrification Curious participant

Recommendation: Customers like those in the Electrification Curious group could be interested in a GHPWH if it is a cost-effective choice. Consider conducting future research to deepen understanding of customer decision-making, ex. if 120V HPWH and GHPWH were the only two options.

Participants in the Tankless and the General groups expressed mixed feelings about natural gas. There were no concerns around gas voiced in the Dedicated to Gas group, and interestingly, none in the Electrification Curious group.

Tankless participants were the only ones to express **environmental concerns** about gas

"It's a fossil fuel industry… are we harming the environment? … I think that you would be helping the environment [by electrifying] as well as saving some money in the long run [by switching to electric]." – Tankless participant

One WA resident in the General group mentioned their concerns about **safety** due to recent explosions

"Gas makes me a little nervous. Right? I mean, you see, there have been a couple of explosions in some neighborhoods." – General participant

Recommendation: A market for efficient gas water heaters remains in the short to medium term. Consider future research with larger sample sizes to test if these attitudes are consistent among these focus group demographics.

Some tankless owners are willing to return to tank if that meant more efficiency.

2 Tankless participants had no reservations about **choosing a more efficient WH if it had a tank**

"I wouldn't have any issues [going back to tank]. It's all about the efficiency of it… and how much energy is used… it does not necessarily matter the size for me." – *Tankless Participant*

The remaining 2 said the WH would need to be very high quality and **worth losing the space again**

"I would consider it. I just have to make sure it is worth my while to lose that premium space in the garage." – *Tankless Participant*

Recommendation: Consider future research with Tankless WH owners, as some are willing to choose greater energy efficiency over space savings.

Brand familiarity can be a proxy for quality and reliability even across a shift in form factor.

Across groups, many opted for water heaters from the same manufacturer as their previous.

Two Tankless group participants **chose the same trusted brand** of their storage tank water heater when switching to tankless.

"I know I wanted Rheem, and that was that was the big thing for me was the brands, because I had always been happy with it." – Tankless Participant

Recommendation: NEEA may want to support work across all major North American manufacturers to ensure widespread brand familiarity and increased adoption of a GHPWH.

Additional features were a deterrent to choosing higher end, more efficient models across all groups.

Many participants did not see the value in the most efficient “Best" model offered during the “Good, Better, Best” activity.

They saw its **additional features**, such as WiFi and Bluetooth, as **additional failure points**.

In total, **only 5 of 22 participants chose “Best”, and none chose it for efficiency alone**. Most had experienced damage from leaks and wanted the high-end model’s leak detection or self-cleaning mode.

Recommendation: Any additional features a future GHPWH may have should focus on its core functionality or maintaining its functionality, such as leak detection or self-cleaning, to increase its likelihood of adoption.

Recommendations Summary

Future Market Findings

- There is no current proxy product for a GHPWH, but some gas water heater owners may be interested in a future HEGWH product
- Support adoption of future high-efficiency products with educational materials
- Disrupt the assumption that heat-pump technology is exclusive to electric appliances

Customer Orientation to Fuel Type

- Those like the Dedicated to Gas participants, with strong preferences for gas even when its more expensive, are the most likely market for a future GHPWH
- Customers like those in the Electrification Curious group could be interested in a GHPWH if it is a cost-effective choice
- Consider future research on customer decision-making, ex. if EHPWH and GHPWH were the only two options.

Product Findings

- Tankless owners may also be a potential market for a new efficient gas water heater product as some were willing to return to tank for sake of efficiency.
- Brand familiarity can encourage adoption of new GHPWH technologies. Support work across major North American manufacturers to ensure widespread familiarity.
- Additional features were a deterrent for most participants. Focus any additional features a GHPWH may have on core functionality, such as leak detection

Questions?

We’ve got answers!

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APPENDIX

Research Questions & Activities

Topic Area	Research Question	Research Activity
Purchase Behavior and Attitudes	Why did the homeowner choose to install their water heater?	Survey and focus groups
	What was the homeowner's path to buying this product? Did they seek it out specifically or did their installer sell them on it?	
	Who were the key market actors they interacted with in making this decision and subsequently installing the equipment?	
	What resources, if any, did they look at to understand or learn more about this product?	Focus Groups
	What is their orientation towards efficient equipment in general? What is their orientation to efficient natural gas equipment?	Survey and focus groups
Barriers and Challenges	Were there any barriers or challenges they faced in buying this product, such as up-front cost or annual maintenance requirements?	Focus Groups
	Did they have any issues finding an installer or with the installation process?	
Current Experience	What is the current experience of living with their chosen water heater?	
	How often do homeowners interact with their water heater?	
	What might homeowners do the next time they need to replace their water heater (e.g., consider fuel-switching, plan the replacement, or wait for total failure, install same/similar product)?	

Focus Group Members

Tankless but Open to Tank

WHO

4 participants from WA, CO, and FL

Mix of urban and suburban residences

Wide range of age and household incomes

Only one participant replaced due to failure, the remainder preemptively replaced

Electrification Curious

WHO

9 participants from WA (majority), GA, and PA

Majority suburban residences

Age group was slightly older, over half were 55+

Most replaced upon failure or near-failure

Dedicated to Gas

WHO

5 participants from WA

3 suburban, 1 urban, and 1 rural participant

Slightly younger demographic, most between 35-44

Majority replaced due to failure

General

WHO

4 participants from WA and OR

3 suburban and 1 rural participant

Wide range of ages

Majority replaced due to failure, only 1 preemptively replaced