Better Together: Utility Coordination on Next Generation Decarbonization Solutions

Randy Opdyke, Nicor Gas
Mehmud Iqbal, FortisBC Energy Inc.
Jaclyn Kahn, Resource Innovations

ABSTRACT

Next generation energy-efficient technologies often struggle to gain market share. With advancing baselines and traditional energy efficiency measures sunsetting, emerging solutions for customers need support to meet increasing energy efficiency and decarbonization targets. Gas heat pumps (GHPs) will accelerate the decarbonization of space conditioning and water heating technology for residential and commercial customers. While commercial-sized products have been available for over a decade, residential equipment has just entered the market in 2024. The North American Gas Heat Pump Collaborative (the NAGHPC, the Collaborative) is a group of gas and dual-fuel utilities and energy efficiency program administrators working together in thoughtful and innovative ways to successfully launch and support GHP technology in the U.S. and Canada.

This paper is focused on describing how collaboratives, like the NAGHPC, are a market transformation tactic that can be used by utilities to coordinate, pool resources, maximize activity impact and create clear support for product launch, while reducing individual participant cost and risk. This paper uses GHPs as an example to demonstrate the power of the collaborative approach. As utilities across the U.S. and Canada work to meet ever-increasing energy efficiency targets and associated policy goals, the Collaborative's efforts to support GHPs are more important than ever.

Introduction

The North American Gas Heat Pump Collaborative (the NAGHPC, the Collaborative) is made up of 15 gas and dual-fuel utilities and energy efficiency program administrators in the U.S. and Canada who recognize the important role of gas heat pumps (GHPs) in decarbonization. Gas heat pumps are a highly efficient technology solution for space and water heating in commercial and residential buildings. They are compatible with fuels of the future like renewable natural gas (RNG) and hydrogen blends.

The combined territories of Collaborative members represent more than one-third of all Canadian and U.S. households that use natural gas. In 2020, Collaborative members came together with the common goal of improving market acceptance and adoption of highly efficient gas technologies. The group's current focus is on ramping up the adoption of GHPs, which dramatically improve residential and commercial gas heating equipment from historical efficiencies of less than 100% to efficiencies that are well above 120%. This collaborative serves as a mechanism to advance this innovative technology.

This paper will review the importance of collaboratives and explore how utilities can use collaboratives as a market transformation strategy to augment their specific activities that would otherwise be unfeasible alone. Using GHPs as an example, this paper will demonstrate how collaboratives work to advance utility goals and new technology deployment.

Gas Heat Pumps & Decarbonization

What are GHPs?

GHPs are a highly energy-efficient technology used for space heating and cooling, ventilation and water heating in commercial and residential sectors. While products for the commercial sector have been in the market for more than 10 years, the residential product has just become available in North America in 2024. GHPs operate using heat pump technology. A common example of heat pump technology is a refrigerator which moves heat from inside the refrigerator ("the source") to outside the refrigerator ("the sink") by using refrigerants and heat exchangers. Like electric heat pumps, gas heat pumps efficiently move heat from one place ("the source") to another place ("the sink"). GHPs differ from their electric counterparts in the fuel they use and in how they pressurize refrigerant (ammonia). The refrigerants used by GHPs are climate friendly with low to no Global Warming Potential (GWP), unlike other refrigerants.

Figure 1 shows how GHPs extract heat from surrounding air and transfer it to heat or cool buildings in a simple three-step process:

1. Outside air is pulled into the system. Fans pull warmth out of the air from the "source" into the heat pump.
2. Heat from natural gas combustion is added to ambient heat. Heat from the air and a gas burner is transferred to the refrigerant.
3. Heated air is pumped into the home.

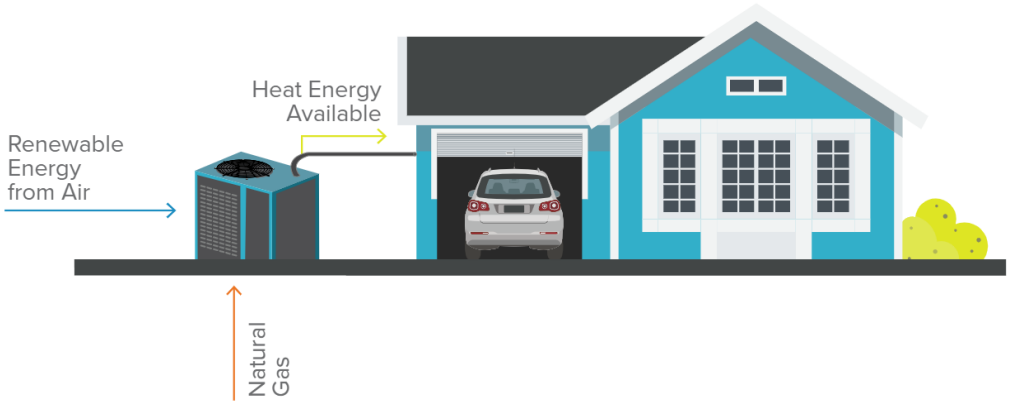

Figure 1. Overview of how GHPs work. *Source*: NAGHPC 2024.

Manufacturers have three types of GHP technologies currently available: engine-driven vapor compression, sorption (absorption/adsorption), and thermal compression. Each type uses different refrigerants and pressurization methods. To delve deeper into one example, there are three energy inputs required to run an absorption cycle used by GHPs. First, a renewable heat source from the environment is extracted from the surrounding ambient air. Second, combustion heat is needed from natural gas. Then, the refrigerant-water solution that is separated into water and refrigerant by introducing thermal energy is carried by the generator. GHPs can also capture additional heat from the combustion process which improves the overall system efficiency. Third, the absorption cycle is run by using a low amount of electricity. Instead of a compressor,

the refrigerant is cycled between the evaporator and condenser using an absorber, a pump and a generator. Since liquid is pumped instead of vapor, the electrical work required for pumping in the absorption systems is minimal (CLEAResult 2023).

What are the benefits of GHPs?

GHPs have a variety of benefits. First, GHPs have fuel efficiencies above 100%. Manufacturers presented Coefficient of Performance (COP) settling around 1.4, meaning that the GHP can deliver 1.4 units of energy output for every unit of energy that they consumed (Brio and GTI 2019).[1] The efficiency is above 100% because the unit is a heat pump and therefore uses energy from ambient air. This is far superior to the less than 100% efficiencies of conventional gas heating. As a result, GHPs lead to substantial GHG reductions compared to more traditional gas heating options. Unlike most electric heat pumps, most GHP systems use refrigerants with low or no global warming potential (GWP), like ammonia or helium.[2] Given refrigerants are one of the largest contributors to climate change, this fact is key to GHP sustainability. GHPs are also compatible with other fuels beyond natural gas. GHPs can run on RNG, which is biogas made from landfills, livestock operations, wastewater treatment plants and other venues with organic waste (DOE 2024). GHPs are being developed to run on hydrogen blends as well.

GHPs can also aid in increased grid reliability. When the electric grid reaches its limit, it must rely on high-cost peak loads while increasing marginal emissions, especially during cold days. This causes price spikes and heating challenges for electric utility customers. GHPs require very low levels of electricity to run, which includes compression cycle and the fans. Instead, GHPs use natural gas to run the refrigerant cycle of the heat pump in addition to using the waste heat from natural gas combustion. GHPs can offer a demand response (DR) solution to help offset marginal emissions. Therefore, GHPs can aid in electric grid reliability, especially during energy events requiring high electricity use.

GHPs also offer an option for customers that can be lower-cost compared to other heating products, which is especially important for low- and moderate-income consumers. Households that use natural gas for heating, cooking and clothes drying save an average of $1,068 per year compared to homes using electricity for those applications (AGA 2023). While energy costs differ in different jurisdictions, GHPs can offer a lower monthly energy cost which can support equity and affordability.

Manufacturers have also designed GHPs to work with existing building infrastructure, including their ductwork and piping for homes that already use natural gas. For example, GHPs do not require new electrical panels or larger gas lines for water heating to be installed (NAGHPC 2024). GHPs do require the heat pump component of the system to be installed outside the home, which brings the combustion outside the home.

How do GHPs help reach decarbonization goals?

Gas decarbonization is important to understand before delving into how GHPs can help reach decarbonization goals. Gas decarbonization is defined as leveraging the capacity of

[1] COPs are how heat pump efficiency is measured, where the higher the COP the more efficient the product is.
[2] CO2e emissions are a way to standardize the impacts of emissions; in this study they include the 100-year Global Warming Potential (GWP) of methane (CH4), nitrous oxide (N2O), and carbon dioxide (CO2).

existing gas networks to store and deliver lower carbon energy through renewable fuels such as RNG and hydrogen blends and increasing efficiency in order to decrease gas usage. GHPs have been designed to run on fuels like RNG and hydrogen blends in addition to natural gas and are highly energy efficient at well over 100% efficiency, significantly decreasing natural gas usage.

Gas decarbonization can be understood through both site emissions and source emissions. Site emissions are produced on-site at a home or business when a consumer uses an appliance such as a furnace or water heater or potentially a GHP. Source emissions include site emissions plus emissions resulting from converting raw fuel to electricity, and emissions from the transmission and delivery of energy to a site.

Gas decarbonization at the site level includes various demand-side activities including seasonal storage, high-temperature heat for industry and winter heating for buildings – which are difficult to realize with renewable options, especially at a lower price point (IEA 2019).

GHPs support gas decarbonization because they significantly reduce the volume of natural gas a customer would use in comparison to an existing natural gas furnace or boiler. Additionally, GHPs require very low levels of electricity to run, and therefore do not increase electric load or burden on the electrical grid significantly, which is especially important during peak periods (ESC 2021). When factoring in source emissions, studies show that in some regions GHPs produce fewer emissions than other decarbonization strategies such as electric heat pumps and high-efficiency gas furnaces (NAGHPC 2024).

Nearly all decarbonization scenarios being pursued or considered by utilities include demand side reductions. One member of the Collaborative, Northwest Natural (NW Natural), has framed various decarbonization scenarios which illustrate the significant opportunity represented by demand side reductions, one of which is shown in Figure 2. The high energy-efficiency offered by GHPs makes them a key measure that NAGHP Collaborative members are planning to use to achieve demand side reductions as represented in the burnt orange “Residential Reduction” section below.

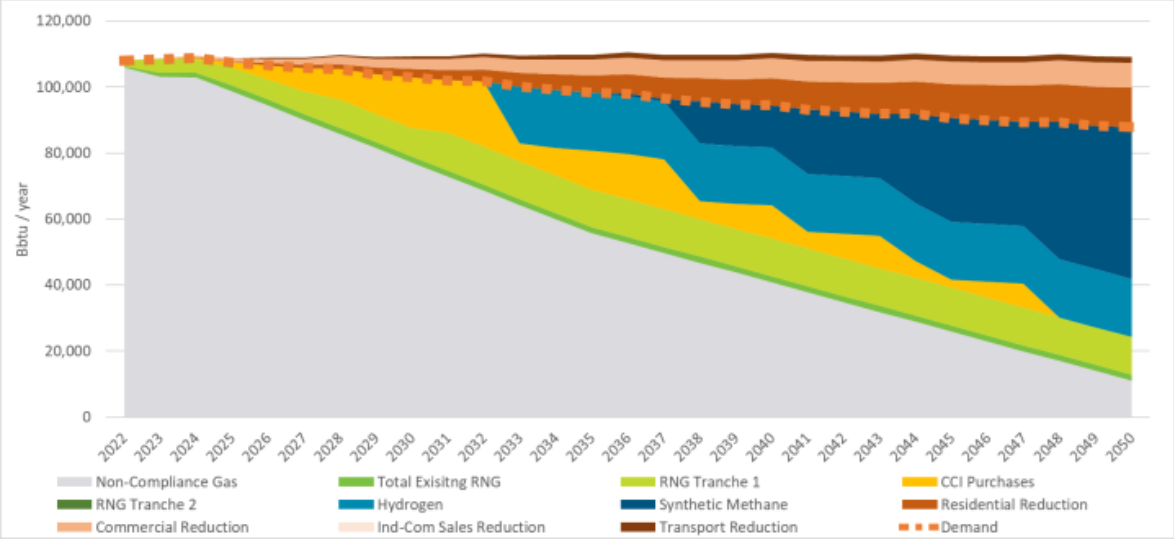

Figure 2. Decarbonization scenarios from 2022 NW Natural Integrated Resource Plan. *Source*: NW Natural (2022).

North America can achieve collective climate goals sooner and cheaper by pursuing gas decarbonization in parallel with electrification and electric grid decarbonization. While the grid

slowly incorporates more renewable sources, using highly efficient gas technologies can make sizeable impacts on GHG emissions now. The importance of high-efficiency natural gas heat pump technology is a prime product to assist in this effort.

Collaboratives & the NAGHPC

What are Collaboratives?

Collaboratives are an MT strategy that serve three primary functions: stakeholder alignment, increased scale and amplified market demand. The Illinois Technical Resource Manual (IL-TRM) describes MT as "the strategic process of intervening in a market to create lasting change that results in the increased and/or accelerated adoption of energy efficient products, services and practices (SAG 2022)."[3] Collaborative are therefore important for serving the express purpose of MT— creating lasting change in the market.

First, collaboratives create awareness and alignment between organizations so they can engage the market with a single voice and a consistent message. A strong consistent voice is key because it limits market confusion and contradictory requests from stakeholders. With new products and technologies, alignment on messaging is particularly challenging as there is often a lack of knowledge both within important stakeholder groups and the broader market. To attain alignment and drive effective market transformation, active input, engagement and support must come from all of the different stakeholder groups — utilities, manufacturers, distributors, retailers, trade groups, professional organizations, consumer groups, etc. (York 2022). Thus, a collaborative serves as the prime vehicle to both establish message alignment and dissemination of that message to the market at large.

Second, collaboratives allow for increased scale. Collaboratives can leverage funding and absorb risk so that no single organization carries the risk burden alone. This is especially important for nascent product categories that lack significant market data. While there is confidence in the product or technology, new product launches always experience some level of risk. In the case of the NAGHPC, for approximately every dollar members spend with the Collaborative through the various activities and Committees, members are able to get at least double the value in return. This multiplier effect is an essential benefit of a collaborative as dollars are able to go further collectively. Not only is there a reduction of cost, but there is also a mitigation of risk with fewer resources going towards new technologies. The scale of a collaborative therefore allows for greater influence to maximize market impact. Scale is especially important because the broader market is not distinguished by separate utility service territories. Instead, markets are broader regions and may span countries, demonstrating the higher level of scale that is required to transform a market (Harris 2019).

Lastly, groups of similarly minded stakeholders, like utilities and organizations that represent utilities, can band together to signal clear market demand, which is essential for a new product launch to be successful. Manufacturers, especially in the HVAC space, heavily rely on industry partners like utilities to drive product demand through incentive programs and outreach

[3] The Illinois Energy Efficiency Stakeholder Advisory Group (SAG) is an advisory body established by the Illinois Commerce Commission focused on educating Illinois energy efficiency stakeholders about the various energy efficiency portfolios administered by Illinois utilities as well as technical and policy topics related to energy efficiency.

to customers. Collaboratives provide a clear platform for manufacturers to engage with multiple utilities simultaneously in order to accomplish this important step in market demand creation. Collaboratives also signal wide reaching support to the market which can be key for manufacturers and other trade allies who are developing and launching the product. Without demand, there are no purchasers of new equipment, causing the new product category to fail. Collaboratives therefore save time, which is especially important for a new product that is aiming for a rapid launch. This is a huge mutual benefit to utilities, manufacturers and the customers who will also reap the rewards of a new highly efficient product.

In order for a collaborative to realize these intended goals, collaboratives must have strong governance, thought leadership and dedicated coordination. Strong thought leadership builds the foundation of intent behind MT programs, and collaborative members must be fully aligned on the vision to create a transformed market. Collaboratives also require dedicated administration and coordination to facilitate group efforts such as charter development, product alignment, and creating a market-facing voice. Dedicated coordination is crucial to help highly efficient products in MT initiatives overcome market complexity inherent in the energy efficiency market (York 2022).

Collaboratives are also not a new approach. They have been used for decades with different technologies, including high-efficiency lighting, refrigerators, washing machines and others. One current example is the Partnership for Advanced Window Solutions (PAWS), which is a collaborative that promotes cost-effective, high-performance window solutions for new and existing building stock in the U.S. (NEEA 2022). Their work focuses on transforming the window market through sharing research and news with stakeholders, developing and maintaining resources for partners and identifying research gaps that would assist in the advanced window market. This is an example of another collaborative in the energy efficiency space.

Only with strong organization and clear communication can the many advantages of collaboratives delineated above come to fruition. The execution of the NAGHPC is therefore key to understanding how it can be a successful approach.

The NAGHPC Execution

The Collaborative was developed because a group of utilities and energy efficiency program administrators wanted to accelerate energy efficiency program offerings and identified a critical need to go beyond traditional thinking to address decarbonization in North America. Member organizations embraced greenhouse gas (GHG) reduction goals and identified the NAGHPC as a valuable forum through which to coordinate, share best practices, and bring the weight of their combined markets. Working together requires a robust structure and execution in order to be successful.

Collaborative membership is structured into three different tiers, with each tier increasing membership due contributions and associated leadership benefits. Some examples of benefits are access to research and materials, company recognition and access to certain group meetings. The Collaborative is run by a Board of Directors which includes four Board Officers. The Board Officers are comprised of a Chair, Vice Chair, Treasurer and Secretary. These four individuals are all members who are elected by the Board. The Board is comprised of one member from the top two tiers of members. The Board Officers and Board Members work together to drive the overall vision of the organization. This includes annual goal setting, overall operational optimization and feedback on overarching activities. The Board meets monthly. Since other

groups of Collaborative members (described below) meet at more infrequent intervals, Board meetings are a key source of information sharing amongst members.

The Collaborative also has committees: the Residential HVAC GHP Committee, the Commercial GHP Committee, the GHP Water Heater (GHPWH) Committee and the Communications Committee. All Committees are active except the GHPWH Committee, which has paused until a viable GHPWH comes to market. Each Committee is driven by two Committee Chairs who are elected by Committee members. All Collaborative members are welcome to join the Committees. If the member is interested in having the various projects customized to their specific service territory and have a greater voice in leading scope of work development, an additional fee is added to the overall Collaborative membership fee. The Communications Committee, however, is included in overall membership dues and is not an additional fee. Committees typically meet quarterly to discuss on-going work for the Committee, and Committee Chairs meet more frequently to move Committee initiatives forward.

The Committee scopes are developed to drive the priorities members are focused on. Initial market characterization research efforts determined market intervention strategies to identify scopes of work that target what both members and the market or manufacturers need to drive the specific technology forward. For example, the Residential HVAC GHP Committee's activities involve manufacturer engagement, value proposition creation, supply chain education, technical reference manual (TRM) development and alignment in program design. All efforts are focused on increasing residential GHP adoption throughout the U.S. and Canada. Scopes of work for these efforts are decided by the full Committee before splitting the cost among the funding members. Splitting the cost of work and maximizing impact is a key benefit to working as a collaborative.

Facilitation of the Collaborative is also key to the successful execution of the group. The Collaborative's third-party administrator, Resource Innovations, assists in the everyday management of all aspects of the Collaborative's functioning, including supporting the Board and the Committees.

NAGHPC Examples

Below are some examples of how the NAGHPC has advanced GHPs in the market more efficiently than any single utility could have done on its own.

Technical Reference Manual Workpaper Development

The Residential HVAC GHP Committee came together to fund the development of a TRM workpaper with eight utilities. The TRM workpaper is a tool that documents the inputs and assumptions used to develop residential GHP energy saving values for input in the TRM. A TRM provides a prescriptive way of looking at energy savings to increase market adoption of products. Many utilities are mandated to submit a TRM or provide supporting documentation for savings calculation for new measures to utility regulators or provide supporting documentation for savings calculations for new measures to, stakeholder groups and/or consultants supporting the TRMs in their state or province. Since submittal is mandated in many jurisdictions, utilities need defensible assumptions that stand up to the rigor of the stakeholder or regulatory process in each state or province. It is therefore important to have not only defensible data, but also have that data for a wide variety of NAGHPC utility service territory characteristics (e.g., climate

zones, different savings baseline scenarios, etc.). The TRM workpaper therefore provides the savings assumptions and baseline scenarios that each utility member can adapt to their specific territory. The inputs from the workpaper are also highly defensible because they are derived from modeled data, lab testing and pilots. This TRM workpaper will therefore be able to stand up to the scrutiny of regulatory bodies that approve new measures like GHPs to state or province TRMs. The overarching goal of the TRM workpaper is to help enable future GHP adoption by validating residential GHP energy savings so utilities are able to incorporate the savings assumptions into their demand-side management (DSM) program planning and resource stack.

This workpaper and hopefully the inclusion of residential GHPs in different state and province TRMs will build off the momentum from commercial GHPs being added to TRMs. For example, Illinois was able to include commercial GHPs in their TRM due to the leadership of the Illinois-based Collaborative members Nicor Gas, Peoples Gas and North Shore Gas (SAG 2023). Illinois using this momentum to hopefully be one of the first states that is set to include residential GHPs in any TRM. The goal of using the TRM workpaper to get residential GHPs accepted into the IL-TRM will be a success not only in Illinois but serve as a case study for other members in different jurisdictions.

Nicor Gas has been able to leverage work completed through the Collaborative's Residential HVAC GHP Committee to enhance its portfolio by assisting with residential GHP implementation in the Nicor Gas service territory. One example is working through the established Illinois MT framework, whereby Nicor Gas presented a logic model at a February 2024 Stakeholder Advisory Group (SAG) meeting. A logic model identifies barriers, opportunities, intervention strategies, and short- and long-term outcomes of an initiative. The Nicor Gas logic model for residential GHPs was completed in March 2024 (Nicor Gas 2024). This will lead to implementation of residential GHPs in 2024, demonstrating traction for the product in the state. Following completion of the TRM workpaper template the Collaborative is developing, Nicor Gas will customize the template for its territory and use this template to incorporate residential GHPs into the IL-TRM.

Member Policy and Codes and Standards Support

The Collaborative is able to create a clear and consistent voice for a variety of members' policy needs in support of GHP adoption. This benefits not only members with immediate need for support, but potentially other Collaborative members that will encounter similar policy needs in the future. For example, the Collaborative has assisted with writing public comments at the federal and state level. This includes a response to the potential sunset of traditional and efficient gas products from ENERGY STAR® certification, as well as comments to the state of New Jersey's Future of Natural Gas proceedings.[4]

The Collaborative has also supported codes and standards assistance. A Market Transformation Summit hosted by Navigant (now Guidehouse) in 2019 noted that stretch code adoption is a prime action of a collaborative because stretch codes reach outside of utility service territories and can be more easily adopted with regional or national efforts (Harris 2019). One prime example is the Collaborative's efforts toward getting GHPs accepted into the Illinois Residential Stretch Code (IL Residential Stretch Code).

[4] The New Jersey Future of Natural Gas proceedings can be viewed via this docket number GO23020099, which can be reviewed here: https://publicaccess.bpu.state.nj.us/CaseSummary.aspx?case_id=2111748.

In 2022, the Illinois Capital Development Board's (CDB) Energy Codes Advisory Council began developing the new residential stretch code. In 2023, the Collaborative submitted a proposed amendment to the IL Residential Stretch Code to include GHPs. The Collaborative supported members from Peoples Gas and North Shore Gas, who also submitted a similar proposed amendment. The Collaborative and its members presented to the CDB to review with leadership in consideration of revised IL Residential Stretch Code language that would include GHPs. After presentations and fielding questions, the council voted to amend the code language to include GHPs in the 2024 IL Residential Stretch Code. The amendment adds two tiers of residential credits:

- Option 1: Greater than or equal to 1.2 COP gas heat pump
- Option 2: Greater than or equal to 1.4 COP gas heat pump

Starting in 2024, Illinois municipalities can adopt the IL Residential Stretch Energy Code for single-family homes and/or the Commercial Stretch Energy Code for multi-family and commercial buildings (CDB 2024). This is important because the stretch codes give municipalities the opportunity to require more efficient buildings in a consistent way throughout the state. Once adopted, the stretch code sets the minimum energy efficiency requirements for new construction and major renovations.

The Collaborative shared key strategies and successes from the IL Stretch Code adoption to membership. Not only were the steps laid out for Illinois, but the calculations and methodology used were shared as well. This serves as a technical resource for other members that may face similar challenges in getting residential GHP adoption in their own territories' stretch codes in the future.

GHP Information Sharing

A common demand-side barrier to MT is market actors' and consumers' lack of information and awareness about an energy-efficient product or service (CalMTA 2024). MT aims to overcome barriers to market adoption, so information sharing is a key part of MT strategy. In fact, a 2022 ACEEE paper notes "as with any product or service, effective marketing is vital to promoting and increasing customer demand for targeted products or services. Market transformation programs employ a full array of marketing approaches, including utility bill inserts, in-store displays, demonstrations, social media campaigns, mass marketing, customer incentives, labeling and midstream or upstream incentives (those paid to retailers, distributors or manufacturers) (York 2022)." The Collaborative engages in a variety of these information-sharing and marketing activities, including a GHP website with consolidated public information, collateral development, conference attendance via presentations and booths, and LinkedIn page management.

The Collaborative website serves as an external central repository for information regarding GHPs. The website houses Collaborative-authored fact sheets and collateral including two-pagers on residential and commercial GHPs and high-level installation guides intended to educate contractors on installation considerations. Members are free to use the collateral with their internal account representatives, trade allies and customers. They can make materials available at conference booths, which fosters conversations about GHPs. Collateral development is another example of maximizing dollars and scale. The website also contains modeling studies, field demonstration project explanations and webinars on GHPs from utility members.

The Collaborative hosts an internal SharePoint site, which is available to its members. The site houses additional information that members can access and use at any time with a

variety of audiences. Example materials include presentations, GHP graphics and committee-developed reports on specific topics, such as manufacturer engagement, residential GHP program design options, and market research on potential early adopter trade allies for GHPWHs.

Speaking and attendance at trade shows and conferences are also important Collaborative activities. Speaking to stakeholders at industry events offers a crucial opportunity to speak to stakeholders, raising their awareness and helping to move the market for a new technology. The Collaborative submits abstracts to conferences for members to attend as well. The Collaborative has previously spoken at the Midwest Energy Efficiency Alliance's Midwest Energy Solutions (MES) Conference, the New England Regional Home Performance Conference, the Consortium for Energy Efficiency's Winter Program, E Source, the Energy Solutions Center's Technology & Market Assessment Forums, the ACEEE Hot Air & Hot Water Forum and ACEEE Summer Study. The Collaborative also has begun hosting Collaborative booths at select conferences, including the 2024 MES conference in Chicago and 2024 Retrofit Canada in Vancouver.

The Collaborative also manages a LinkedIn page aimed at industry stakeholders to further increase awareness of GHPs. The LinkedIn page focuses on GHP information while highlighting speaking engagements and event attendance. Members are able to repost content to their own networks, serving as an easy way to engage with their own staff and further expanding overall GHP awareness. The Collaborative LinkedIn page launched in January 2024, and it already has over 2,000 organic impressions as of May 2024. This has been achieved through weekly LinkedIn posts and various reposts from member utility accounts. The Collaborative is excited to drive growth through LinkedIn in 2024 and beyond to better engage with the energy efficiency industry and all relevant stakeholders.

GHP Acceleration through Investment

The Collaborative has also coordinated the pooling of individual utility investment. More specifically, Southern Company Gas (Nicor Gas, Atlanta Gas Light, Chattanooga Gas, Virginia Natural Gas) worked closely with the Southern Company New Ventures organization and Energy Impact Partners to add Stone Mountain Technologies, Inc. (SMTI) to their portfolio. They did this with a Series-A investment of $15 million USD (SMTI 2022; Southern Company Gas 2023). Enbridge Gas and Southern California Gas, also Collaborative members, were instrumental in Energy Impact Partners providing direct investments to SMTI.

The investment enabled SMTI to commercialize their GHP product faster. SMTI estimates that this investment accelerated commercialization by multiple years. Other GHP manufacturers have not received a similar investment and are not yet commercialized. This demonstrates the power of utilities coming together to advance new technologies like GHPs.

Member Utility Pilots

Collaborative Activities to Support Pilots

Pilots are a key step toward a wide-reaching rollout of new technology like residential GHPs. The ultimate goal of pilot activity is to create suitable program design for utilities. Therefore, activities that help develop pilots are also helping to create strong programs in the future. The Collaborative's Residential HVAC GHP Committee has helped support residential

GHP pilot development in member service territories through a variety of activities. These activities include:

- Collaboration with, and support of, manufacturers and manufacturer representatives
- Engaging and supporting the supply chain (installers, distributors and retailers)
- Building customer awareness and demand
- Validating energy savings, safety, reliability, total cost and installation requirements

Residential HVAC GHP Committee efforts in both 2022 and 2023 included residential GHP manufacturer coordination. Manufacturer engagement is not only beneficial for members to gather information on new products and timelines, but it also provides manufacturers the opportunity to engage with a large number of utilities at the same time. This type of forum helps manufacturers better understand the barriers, opportunities and intervention strategies associated with the advancement and adoption of high-efficiency GHP technology.

Large-scale pilots for residential GHPs are currently being rolled-out with the support of Collaborative members, residential GHP manufacturers (with units commercially available) and GTI Energy, an emerging technology (ET) partner. Pilot efforts include a rollout of more than 100 newly commercialized 80,000 BTU residential GHP space and water heating units across seven states and various Canadian utilities which cover the majority of Canada. The case studies below will demonstrate the pilot processes from the perspectives of Nicor Gas and FortisBC Energy Inc. (FEI).

Nicor Gas Residential GHP Pilots

Illinois-based Nicor Gas is supporting residential GHP pilot efforts in multiple ways. They have an award-winning Emerging Technology (ET) program and are leveraging $1.3 million of approved funding that will support up to 30 residential GHP units to be installed in customers' homes. After a lab performance testing (Phase 1) target is achieved in August 2024, a green light will be given for field demonstrations and early adopter pilots that will continue through the 2024-2025 winter season.

The Nicor Gas pilot is a multi-phased approach starting with a lab performance and reliability evaluation, controlled demonstrations and then moving on to early adopter field pilots. GTI Energy, based in Des Plaines, IL, began lab performance testing in December 2023 with ANSI and ETL-certified units for quality control and assurance. This process will consist of two phases:

Table 1. Nicor Gas Pilot Phases

Phase	Description
Phase 1 Lab Testing	• Virtual Test Home: Quantify system performance in forced-air and combi configuration with 24-hour load profiles associated with one cold climate region of North America • Pre-production Reliability Issue Testing (PRIT): Cold start, high temperature, lockout conditions • Accelerated Life Testing (ALT): 500 hours of extended operation at high temperature and pressure conditions.

	• Timeline: December 2023 to August 2024 for Go/No Go decision point for Controlled Demonstrations
Phase 2 Lab Testing	• Virtual Test Home: Two additional cold climate regions of North America • Continued Accelerated Life Testing (ALT): 500 additional hours. • Durability Evaluation: Demonstrate system reliability over six months of operation and develop high-resolution system performance curves for energy modeling • Timeline: 7 months after phase 1 decision point

To summarize the timeline of pilot activities are already underway to support a residential GHP launch and transform the market:

- Residential GHP units are commercially available and currently going through performance reliability (May 2024).
- Ongoing manufacturer engagements with SMTI, Manufacturer Representatives, GTI Energy and Nicor Gas for alignment on ET pilot efforts and training. (September 2023 thru 2024).
- Manufacturer (SMTI) training has been successfully completed with nine contractors interested in participating in the Nicor Gas Emerging Technology large-scale pilot (February 28, 2024).
- Manufacturer representative residential GHP purchase for the Nicor Gas "Gas Town" training center unit, now targeted to delivery in August 2024 after reliability testing is complete. (March 2024).
- Coordinated effort with Nicor Gas, Peoples Gas and North Shore Gas, the NAGHPC, GHP manufacturers, and IL distributors to present to the Illinois Capital Development Board to include the GHP technology in the Illinois Stretch Codes for municipalities if they choose to adopt the stretch code (December 2023).
- Residential GHP Market Transformation Logic and Market Progress Indicators presented to the Illinois Stakeholder Advisory Group (February 28, 2024).

Pilot efforts will start off as controlled demonstrations with extra evaluation monitoring for the first 3 residential GHP units at customer sites. Then field installations will shift to demonstrate more real-world GHP installations with contractors. Both quantitative and qualitative assessment information will be gathered to document lessons learned and continuous improvement for the early adopter customer field installation. Results will help in validating energy savings, safety, reliability, total cost and installation requirements. The IL-TRM workpaper can then be developed and submitted for inclusion in the IL-TRM.

Nicor Gas has prioritized a variety of activities to ensure successful residential GHP pilots, including customer engagement and trade ally training. First, Nicor Gas has prioritized customer satisfaction because buy-in is critical for new technology acceptance and adoption. Customer success is predicated on a skillfully trained and proficient trade ally network that can react quickly to the customer's needs. Nicor Gas, along with GTI Energy, are leveraging the Nicor Gas Energy Efficiency Program's Contractor Circle network of more than 2,400

contractors to recruit for GHP installation training.[5] They are also performing contractor outreach that includes building awareness of and interest in GHPs.[6] This larger scale ET pilot will allow utilities to understand the barriers and challenges the contractor may face and collaboratively share lessons learned to overcome the barriers in a controlled setting. Several contractors that have enrolled in the pilot will have opportunities to perform multiple site installations, allowing them to build proficiency and continuously improve in a setting where they can share their challenges with each other, with the manufacturer, and with the utilities.

Nicor Gas, along with fellow Collaborative members and Illinois utilities Peoples Gas and North Shore Gas, are supporting additional contractor education and training by leveraging their Gas Town Training Centers to install the residential GHP units. This training center provides another layer of trade ally and contractor support because it allows contractors to interact with the new technology firsthand. This experience is augmented with manufacturer and/or manufacturer representatives onsite to assist as well. The training center aims to build residential GHP best practices and customer support by ensuring a skilled and well-trained contractor network.

Nicor Gas will continue to accelerate pilot development in Illinois to better understand residential GHP products and deliver this technology to market.

FortisBC Residential GHP Pilots

FortisBC Energy Inc. (FEI), the largest energy provider in the province of British Columbia, Canada, launched a residential GHP pilot with SMTI. The pilot project involved the installation of the ANESI gas heat pump system and ancillary equipment at 10 residential test sites in the Lower Mainland and Interior regions of British Columbia, Canada. The units installed in this pilot are pre-production units. One of the objectives of this pilot is to move the pre-production unit to a final production-ready product (the “production unit”).

FEI installed sub-metered equipment at all 10 sites to measure the system performance and energy savings associated with the pre-production unit and started to monitor the data beginning in March 2023. The data collection process will continue for a full season to thoroughly collect the data during various seasons. Preliminary data showed a maximum Gas Utilization Efficiency (GUE) of 129.2%. It is important to note that the data collection process is still ongoing and will be subject to further analysis and refinement as more information becomes available.

Throughout the pilot, the participants provided valuable feedback to the manufacturer to improve the system performance and equipment reliability in the production unit. The pilot also provided a practical experience to engineering consultants and HVAC contractors to gain hands-on experience with designing, installing, commissioning and troubleshooting with GHP technology.

FEI collaborated with SMTI and GTI Energy to develop the test protocol as mentioned in Table 1 to benchmark the performance of the production unit. Below are the upcoming milestones planned by FEI for this segment:

[5] More information on the contractor circle here: www.nicorgas.com/business/ways-to-save/trade-allies/contractor-circle.html.

[6] Nicor Gas trade ally website includes GHP literature, reports, recorded trainings and webinars which can be found here: www.nicorgas.com/business/ways-to-save/trade-allies.html.

1. Receive Go/No-Go decision from the lab testing with the production unit at GTI Energy facility.
2. Replace the 10 currently installed pre-production units at British Columbia with production units before the 2024-25 heating season starts.
3. Measure system performance and energy savings associated with the production unit during the 2024-25 heating season.

Based on the performance, FEI plans to develop an early adopter offer for customers to encourage installation of more GHPs.

Conclusion

New technologies face significant hurdles in market adoption. Collaboratives are a market transformation strategy that deploys activities to overcome the obstacles the technologies face. The NAGHPC is an example of a collaborative that is focused on a successful GHP product launch in the U.S. and Canada. As discussed in this paper, the barriers to market adoption are noteworthy, including limited number of manufacturers and products in the market, policy headwinds and overall lack of awareness. These roadblocks are a prime reason why creating an organization with a national and international voice has a powerful impact on generating momentum and accelerating uptake of this new product.

With significant progress already made, NAGHPC expects to see positive impacts in 2024 and beyond, effectively increasing awareness among trade allies and customers. The Collaborative plans to target their recommendations regarding customer adoption as well as engage the residential market via social media campaigns. As more member utilities offer residential incentives, outreach efforts will only become more important. The Committees are planning to create direct-to-customer marketing strategies highlighting GHPs and other collateral for members to use as residential GHPs launch in individual member service territories. The ultimate goal of these activities is to accelerate the installation of GHPs.

The Commercial GHP Committee also plans to dig into the various barriers that have prevented commercial GHPs from successful market penetration. The Committee plans to support a market characterization report on the commercial GHP market, influence plans for developing commercial GHP incentives within member territories and identify additional barriers for members that the Collaborative can work to overcome. The Committee also plans to work with key manufacturers to build partnerships and a long-term engagement to coordinate on future activities, encouraging further production and advancement of commercial GHPs.

The Collaborative will work to deploy all of these activities throughout 2024 that we are confident will lead to a material increase in GHP installations for years to come.

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