Advancing Gas Decarbonization Solutions via Gas Heat Pump Applications

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ABSTRACT

Gas heat pumps offer high-efficiency options for a variety of HVAC and water heating applications, supporting consumer choice, energy affordability, and greenhouse gas emission reduction objectives. US and Canadian energy efficiency program administrators committed to decarbonization seek to leverage the best solutions available, agnostic to technology or energy source, to achieve these goals and at the same time meet customers where they are. While full building electrification may be optimal in some cases, equating electrification with decarbonization can overlook opportunities for cost-effective carbon reductions through high-efficiency gas technologies. Factors such as fuel prices, grid carbon intensity, service upgrade costs, and climate conditions influence the relative effectiveness of different approaches. Broad utility support for higher efficiency equipment drives technology advancement in the market and encourages manufacturers to continue to push performance. Energy efficiency program administrators are piloting demonstrations where high efficiency gas equipment – like gas heat pumps – may provide an effective and affordable decarbonization solution. This paper presents case studies from the US and Canada highlighting end uses and conditions where gas heat pumps are successfully implemented as cost-effective decarbonization solutions and provide customers with reliable, comfortable, and affordable heat and hot water.

Introduction

The Consortium for Energy Efficiency (CEE) is a non-profit binational market transformation organization with a membership comprised primarily of utilities and other regulatorily obligated demand side management (DSM) program administrators. The organization was established by these utilities and similarly obligated entities over 30 years ago to aggregate resources across the US and Canada to create voluntary markets in which energy using equipment can compete based on performance, agnostic to energy source or technology. Performance criteria is developed by the DSM program administrators through a consensus-based process and in consultation with the impacted industries. This framework for market transformation has historically signaled advancing performance trends to industry, providing business certainty and opportunity while pushing equipment OEMs to continuously improve the energy performance and associated capabilities of their respective equipment. Energy efficiency thresholds for many fuel-fired equipment categories are now essentially maxed out, but heat pump technology can also be powered by gas, enabling gas equipment efficiencies beyond one hundred percent.

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CEE members are presently applying this framework for market transformation to gas heat pumps, in conjunction with collaborative partners and manufacturers to address the ongoing market need for more energy efficient HVAC and water heating systems that also help reduce emissions. Continued advances in gas equipment efficiency require a critical mass of market support to create a business case for equipment manufacturers to respond to. Support for new technology by US and Canadian DSM program administrators encourages ongoing advancement, continued R&D, and work toward ever higher performing solutions. Consistent R&D support by utilities contributes to societal gains and ongoing reliability of the energy system, independent of uncertain federal funding. Gas heat pumps (GHPs) provide a highly efficient gas equipment option, but as a nascent technology in north America, it must be proven out. The authors of this paper are actively deploying GHPs in different end uses to demonstrate equipment capabilities, as described further below.

Gas Heat Pump Value Proposition

Load growth and energy affordability are dominating headlines. Maintaining the ability to use different energy sources at a site level supports managed use of electricity and gas as well as supports consumer choice. Beyond the customer, utilities are actively working to mitigate electric and gas demand, especially in grid and distribution constrained locations, and assessing the best solutions across fuel types towards this end. While the benefits of dual fuel scenarios have been understood for decades, their value has become more acute recently due to increasing constraints on the grid and the need to rapidly mitigate loads in specific locations.

Highly efficient gas equipment can also cost effectively enable decarbonization based on efficiency at the site level and the source of electricity from the local grid. To accurately value the impacts, decarbonization comparisons should distinguish between site-based greenhouse gas (GHG) emissions reductions and source-based GHG emissions impacts. GHPs reduce on-site fuel use relative to conventional gas-fired equipment, but the decarbonization value of GHPs versus full electrification depends on the carbon intensity of the electricity used by the electric alternative. Stated differently, electrification should not automatically be treated as synonymous with decarbonization in every region, especially where electricity is still largely generated by fossil-fueled resources. For GHP applications, this means that in regions with a relatively clean grid, electric heat pumps may deliver the largest long-term GHG emissions reductions. However, in regions with a more carbon-intensive grid, higher electricity costs, distribution constraints, or limited building electrical capacity, GHPs can provide a meaningful near-term and practical decarbonization pathway by substantially reducing gas use relative to conventional gas equipment while avoiding the significant electric load growth associated with full electrification. The authors note that field demonstrations showed roughly 40–50% energy savings for GHPs versus conventional gas-fired heating systems, and that GHPs can be especially valuable where service upgrades or all-electric conversion costs are cost-prohibitive (Fridlyand, Glanville, and Garrabrant 2021).

Gas heat pumps are capable of achieving over 100% efficiency, like electric heat pumps, and have the ability to operate at ambient temperatures significantly colder than most air-to-water electric heat pumps. They also provide an economic opportunity in regions where electricity is more expensive than gas, serve as an efficient solution to building owners who do not have the electrical capacity to replace their systems with all-electric equipment, and increase consumer choice for space and water heating retrofit options.

Technology Overview

Gas heat pumps are a class of heating and cooling technologies that, like conventional electric heat pumps, move heat from a low temperature source to a higher temperature sink and can operate reversibly for air conditioning[1]. Many GHPs can also recover internal waste heat to provide domestic hot water. Unlike electric heat pumps, GHPs use thermal energy from fuel combustion to drive a refrigeration cycle, either by mechanically powering a compressor with an engine (work activated systems) or by using heat to drive sorption-based cycles (heat activated systems). While the underlying concepts are historically well established, GHPs remain far less common than electric heat pumps due to lower market maturity, fewer incentives, and greater diversity in designs, working fluids, and applications. This diversity contrasts with the standardized vapor compression technologies and refrigerants typical of electric heat pumps. In addition, the reliability of conventional gas appliances coupled with low natural gas prices has limited consumer interest in GHPs, an issue that similarly impacts the market for electric heat pumps.

As a technology pathway, GHPs offer a significant opportunity for decarbonization by improving the efficiency of combustion-based building equipment. Demonstrations show energy savings of roughly 40–50% compared to conventional gas fired heating systems[2], with corresponding greenhouse gas reductions achieved by delivering heat from both fuel combustion and environmental sources (Glanville et al. 2024). Typically, 25–40% of delivered heating is from the heat pump cycle, with the balance as recovered heat of combustion. In Table 1, the maximum rated efficiencies are shown for water heating and space heating product categories for both residential and commercial solutions (Glanville, 2024). For all product categories, the maximum baseline theoretical efficiency is 99%, with practical limitations on capturing the total heating value of fuel combusted whenever useful. For each of the product categories listed, the demonstrated energy savings of GHP technologies over common fuel-fired baselines in addition to rated performance targets are shown.

Table 1: Maximum Rated Efficiency of Conventional Fuel-Fired North American Equipment compared to GHPs (HHV Basis)

Category		Max. Efficiency Rating[3]	TDHP Field Demo Savings / Performance Target[4]
Residential	Water Heater	0.90 UEF (Storage) 0.96 UEF (Instantaneous)	>50% energy savings over 0.62 UEF baseline, >1.20 UEF target
	Warm-air Furnace	99.0 % AFUE	

[1] Cooling can be achieved by some gas heat pump configurations (e.g., engine-driven vapor compression systems), but most gas absorption heat pumps (GAHP) used for space heating and DHW are heating-only. Reversible cooling applies to specific GHP sub-classes rather than all GAHP applications.
[2] Higher savings are typically observed relative to older or non-condensing equipment and savings versus modern condensing systems are application-dependent.
[3] Maximum efficiencies based on AHRI Certification Directory, inclusive of inactive equipment.
[4] Sources for savings and targets: Glanville, 2024.

	Boiler	96.0% AFUE (Water) 83.4% AFUE (Steam)	>45% energy savings over 92% AFUE furnace baseline, >140% $COP_{seasonal}$ target[5]
Commercial (Non-Residential)	Water Heater	97% TE (Storage) 99% TE (Instantaneous)	>50% energy savings over 82% TE baseline, >130% TE target
	Weatherized Furnace	>90% TE[6]	>40% energy savings over 80% TE baseline, >1.30 $COP_{heating}$ target
	Boiler	99.4% AFUE (Water) 84.2% TE (Steam)	>40% savings over 80% TE baseline, >130% TE target, (N/A for steam)

Additional benefits include the feasibility of ultra-low NOx combustion, frequent use of natural refrigerants with minimal global warming potential, elimination of indoor combustion for many systems, and integrated heat recovery that reduces reliance on auxiliary heating. GHPs are often a good choice for retrofit, as their gas, venting, and power requirements are often comparable to existing equipment, making them a practical option for improving efficiency and reducing emissions in existing buildings.

Market Transformation Strategy Overview

CEE develops voluntary product specifications to signal to the market where more investment and equipment options are needed and help OEMs know what functionality to design into equipment. Specifications also define what qualifies for utility support, via performance criteria that can be assured by recognized test procedures and performance metrics.

Demand side management program administrators seek to accelerate market understanding and adoption of gas heat pumps in HVAC and water heating applications in part by defining technology neutral performance tiers in existing CEE equipment specifications. These specifications employ a tiered approach to define increasingly stringent levels of performance. Gas heat pumps are more efficient than traditional gas equipment and are therefore the only currently available equipment capable of achieving the highest levels of performance within the CEE specifications for residential and commercial HVAC and water heating.

CEE publishes a Gas Heat Pump Qualifying Products List (QPL) that includes commercially available products meeting CEE specifications. The CEE QPL is updated regularly and will evolve as needed to help provide clarity in the market. The CEE specifications and QPL are part of the strategy to encourage OEMs to invest in developing qualifying products and making those products available throughout the US and Canada. Demonstration projects, as described in the following section, contribute to learnings that can be shared and assessed to iterate specification criteria and equipment categories to ensure appropriate equipment receives market transformation support.

[5] Seasonal COP and AFUE metrics are based on the ANSI Z21.40.4 rating method.
[6] "Condensing RTUs" are commonly rated as industrial-type air heating equipment, thus value is based on recent studies of this category: http://betterbricks.org/uploads/resources/CRTU_pilotSummaryReport_3.23.20.pdf

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Gas Heat Pumps Case Studies: Successes and Challenges

The following sections summarize work by individual CEE members to test both gas heat pump equipment capabilities in real world applications and DSM program methods to support customers and contractors interested in installing GHPs. The work characterized below is at varying stages, from early pilots to deployed DSM measures, and includes commercial and residential end uses. By sharing experiences among peers at CEE, DSM program administrators learn from each other to accelerate development of DSM program approaches, which in turn help to accelerate regulatory acceptance and market adoption of new technologies like gas heat pumps.

Enbridge Gas

Enbridge Gas in Ontario, Canada, has completed a series of gas heat pump demonstration projects for both commercial and residential sector applications. These projects have included equipment from four different GHP manufacturers installed in varying configurations based on existing conditions and needed functionality. Highlights include an advanced residential hybrid heating system project and a gas absorption heat pump installation for multifamily domestic hot water (DHW).

Enbridge Gas introduced a first-of-its-kind advanced hybrid heating system to lower residential energy consumption and associated GHG emissions. The innovative advanced hybrid heating system combines a high efficiency gas absorption heat pump (GAHP) and an electrical air source heat pump (eHP) with a dual fuel switching controller that optimizes the system performance. The system was installed in a residential single-family house in Ontario to quantify the energy saving and GHG emission reduction, and to gain installation and operation experiences. Measurement and verification results show that the seasonal gas utilization efficiency (GUE) is 1.2, and the monthly average energy consumption for combined space and DHW heating was reduced in the range of 10–37%. The gas consumption for DHW heating alone in summer months dropped by about 50% as compared to the pre-retrofit system that included a gas furnace, DHW heater and an air-conditioner. These results demonstrate that the advanced hybrid heating system could substantially reduce Ontario's energy consumption and GHG emissions for the residential sector (Sadri, Haung, and Zaidi 2024).

In the multifamily project, Enbridge Gas installed a 65 kW (220 MBH) gas absorption heat pump to supply a portion of a building's domestic hot water heating load. The building was a 50+ year old multi-unit residential building with 10 stories and 55 apartment units located in Toronto, Ontario. It had an existing 600 MBH boiler with three 80- gallon indirect tanks. Based on M&V data, the average gas utilization efficiency ranges from 1.2–1.5 in the heating season. As a result, the efficiency improvement over the boilers (measured at 80%) is significant. Despite a higher incremental cost for the GAHP equipment versus a conventional boiler system, the commercial GAHP system could provide a five-year payback due to sizeable energy cost savings (Zaidi 2024).

Through these demonstrations, along with lab performance testing, Enbridge has evaluated customer benefits including energy savings. Currently, gas heat pumps for commercial applications are incented under Enbridge custom DSM program. Enbridge aims to address sector challenges like a lack of production equipment options, high first cost that contributes to a negative total resource cost test, and the lack of a qualified business partner network.

FortisBC

FortisBC piloted a gas absorption heat pump (GAHP) retrofit in a multi-unit residential building in Vancouver, BC to support its emissions-reduction and energy efficiency goals. The site was selected due to its aging atmospheric boiler nearing the end of life, an owner eager to pursue efficiency upgrades, and an existing hydronic system that provided a straightforward retrofit opportunity.

To evaluate GAHP performance in real-world conditions, the project team installed three 36 kW (123,500 BTU/ hr) GAHPs in a hybrid configuration with high efficiency, condensing boilers serving as backup. The system was integrated into the existing central hydronic infrastructure without requiring modifications to terminal units or in-suite heating equipment, allowing the retrofit to be completed with minimal disruption to occupants. By leveraging the existing distribution system, the pilot avoided intrusive downstream upgrades while demonstrating that GAHPs can be deployed as a central-plant solution in existing multi-unit residential buildings. Advanced control strategies were added to intelligently sequence the GAHPs and boilers based on outdoor air temperature and system demand, ensuring the most efficient heat source was prioritized under varying conditions.

FortisBC collected data from October 2023 to April 2024, capturing a full heating season to assess efficiency, runtime, and overall retrofit viability. During moderate outdoor conditions, the GAHPs carried a substantial portion of the space heating load and demonstrated strong efficiency. Measurement and verification results showed that when operating with sufficient temperature differential between supply and return water – typically greater than about 8°C (46°F) – the GAHPs consistently achieved coefficients of performance (COPs) in the range of approximately 1.2 to 1.4, with peak values approaching 1.5 under favorable conditions. These operating characteristics translated into meaningful reductions in natural gas consumption relative to the pre-retrofit baseline.

Across the 2023-24 heating season, the pilot contributed significant energy savings. Weather-normalized analysis indicated that the hybrid GAHP-boiler system reduced overall site natural gas use by approximately 30% compared to pre-retrofit operation, corresponding to annual savings on the order of 1,300 GJ for space heating. These reductions also delivered associated greenhouse gas emissions benefits. From an economic perspective, the pilot indicated a simple payback of approximately two years with utility incentives[7], and under nine years without incentives, based on annualized energy savings and incremental project costs.

The pilot reinforced several practical lessons for future applications. Proper system sizing was critical to achieving high efficiency and avoiding excessive cycling, particularly in high-temperature hydronic systems. Controls played a central role in performance outcomes: optimized sequencing, flow modulation, and temperature setpoint management enabled the GAHPs to operate efficiently over a wider range of conditions and reduced reliance on boilers during shoulder-season operation. The pilot also highlighted the importance of minimizing heat loss through improved insulation and thermal management, which can extend GAHP operating hours and further enhance savings.

Overall, the pilot results demonstrate that GAHPs, when integrated with high-efficiency condensing boilers and advanced controls, can deliver substantial energy savings in space heating applications within existing multi-unit residential buildings. The ability to achieve these

[7] FortisBC offers an incentive for its commercial customers to cover approximately 75% of total eligible project costs, up to a maximum of $200,000 per project.

savings without modifying end-use terminals strengthens the case for GAHPs as a practical and scalable demand-side management option for retrofits in legacy building stock (Iqbal, Rubinstein, and Kahn 2025).

New Jersey Natural Gas

New Jersey Natural Gas (NJNG) is participating with other North American utilities in a pilot coordinated through GTI Energy to ensure product performance in the commercial rollout of GHPs through the Anesi brand from Stone Mountain Technologies. NJNG sees tremendous potential for implementation of GHPs into DSM programs, but current availability of a North American residential product has been extremely limited. NJNG is partnering with GTI energy to evaluate field performance specific to NJNG's climate zone to create a justifiable TRM calculation for savings performance[8].

The State of New Jersey's climate policy has promoted electrification as a key strategy to meet emission reduction goals. NJNG's evaluation is aimed at proving all technologies can help achieve shared climate goals in a more cost-effective manner for the state's residents. With affordability becoming a central issue in the state, including as it relates to higher energy costs, the state has begun to renew its focus on a more 'all-the-above' approach. Higher wholesale costs, as well as concerns over grid constraints has influenced slight changes in strategy. NJNG hopes to demonstrate that GHPs can provide low operating costs, low emissions, and can reduce grid congestion as a residential heat alternative.

The pilot plan was to install five Gas Heat Pumps (GHPs) at customer locations, serving as the primary heat and domestic hot water, with GTI Energy, performing EM&V (Evaluation, Measurement and Verification). NJNG decided to use employee homes, with one location outfitted with full instrumentation that will communicate back to GTI to monitor system performance. The other locations will be evaluated through monthly billing for pre- and post-performance. Stone Mountain Technologies is the equipment manufacturer of the Anesi brand GHP that will be evaluated. Early field trials and laboratory performance have produced very positive results. The equipment is now being factory-constructed and distributed commercially, and the purpose of the pilot is to ensure performance coming out of scaled production of the units.

Understanding the importance of proper sizing, NJNG recruited and evaluated employee homes that met narrow criteria. After evaluating several willing employee homes, one was selected to move forward. Due to limited commercial availability of products, with only 80,000 units in the market, there were challenges in pairing willing participants with appropriately sized equipment.

NJNG also reached out to ARC, an organization that provides housing for people with disabilities, after previously audited several of their properties. Ultimately, three ARC homes were selected to participate in the program. The objective was to replace the main heating system with the 80kbtu Anesi unit and pair it with a 3-ton AC system. Homes were chosen if they had a heat load of at least 50kbtu according to a Manual J analysis by NJNG.

The first installation, an employee home, was completed in March 2025 and included the outdoor Anesi 80kbtu gas heat pump, an interior air handler, and an 80-gallon indirect water tank. The subject house was built in 2001 with a total of 3581 ft^2. There are two heating and

[8] Results from the New Jersey Natural Gas pilot are not final and have not yet been made publicly available.

cooling systems in the house, an 80kbtu 80 AFUE furnace paired with a 3-ton AC unit as primary in the basement, with a 60kbtu, 80 AFUE unit in the attic and another 3-ton AC. Total heating load for the home is estimated to be 63kbtu at 14°F design temperature. This home operates primary/secondary with the attic system coming on in support of the main unit.

The three ARC properties were all installed over January and February of 2026, and included the outdoor Anesi 80kbtu gas heat pump, an interior air handler, and an 80-gallon indirect water tank. Evaluation of these properties will also incorporate the 2026/2027 heating season. The ARC properties are 2260, 2200, and 1860 ft^2 respectively. All three homes through ARC had heating loads more than 50kbtu and cooling loads within the suggested size range (under 3.5 tons), as determined by Manual J sizing.

Finally, one additional unit was installed by NJNG in one of their commercial training centers. This unit's purpose was to give contractors the ability to interact with the unit and learn proper installation and maintenance.

Nicor Gas

The Nicor Gas Energy Efficiency Program team launched a successful engagement and capacity-building campaign to increase awareness and customer comfort with Commercial Gas Heat Pump (CGHP) technology. This effort culminated in the Northlake CGHP project, a first-of-its-kind installation in the Midwest, showcasing next-generation gas technology designed to improve customer comfort and energy savings while reducing greenhouse gas emissions and energy bills for a hard-to-reach customer segment: income-eligible multifamily[9].

The Northlake multifamily building is a six-story, 60-unit property that was dealing with an aging boiler system. Instead of choosing an inefficient, like-for-like replacement approach, the property owner heeded their contractor's recommendation to try something new – a unique hybrid system that utilizes CGHPs with the existing boilers, designed to maximize the efficiency of the CGHPs. On August 14, 2025, four Robur CGHPs were installed and integrated with the existing boiler system via a water-to-water heat exchanger. This created two hydronic loops that work together to provide heat for both domestic hot water and radiant floor space heating. The CGHP loop is a closed loop containing a glycol water solution that circulates through the GHPs. The GHPs transfer heat from the air and integrated burners to raise the temperature of the solution. Heat from the CGHP loop is transferred via the heat exchanger to the boiler loop, which then circulates the hot water throughout the building. Under normal conditions, the GHP loop provides sufficient heat to maintain the boiler loop at about 150°F (66°C). When outdoor temperatures drop and the system requires higher water temperatures to meet heating demand, the boilers automatically start to boost the temperature in the boiler loop above 150°F. This configuration ensures efficient operation by allowing the gas heat pump system to handle the majority of the heating load, while the boilers provide supplemental heat only during extreme cold conditions where the required water temperatures exceed 150°F (66°C).

The Northlake project confirms that radiant floor-heated buildings are especially well-suited for using CGHPs as an efficiency solution. This installation increased the building's overall system efficiency to 101.3%, an 18.3% improvement over the baseline efficiency. As an income-eligible multi-family property, the project was fully incentivized and marked the first Commercial GHP rebate for a multi-family building under this program. This project

[9] Results from the Nicor projects have not been finalized and are not yet publicly available.

demonstrates the viability of CGHPs in multi-family settings and paves the way for future commercial projects that can build on the learnings from Northlake.

In addition to the successful commercial project, as part of the Nicor Gas Energy Efficiency Program's emerging technology and market transformation efforts, the team is currently observing GHPs in the residential space. For the residential pilot, Nicor Gas installed 15 units into friendly participants' homes in October 2024 for monitoring and evaluation through April 2026. The pilot aims to verify energy savings of the equipment, inform the installation process, better understand contractor costs, and document customer satisfaction. At the conclusion of the pilot, Nicor Gas will have a better understanding of how GHPs can be successfully integrated into their residential energy efficiency offerings and serve as an energy saving technology for their customers.

Northwest Energy Efficiency Alliance

The Northwest Energy Efficiency Alliance (NEEA) is a regional energy efficiency organization (REEO) comprised of utilities from Washington, Oregon, Idaho, and Montana. Its Advanced Commercial Water Heating program aims to transform the commercial water heating market by advancing high-efficiency domestic hot water (DHW) solutions, with a particular focus on gas absorption heat pumps (GAHPs). This focus is grounded in the 2019 Commercial Building Stock Assessment[10], which found that natural gas provides approximately 74% of all commercial service water-heating capacity in the Northwest, indicating a substantial opportunity for gas equipment in commercial water heating applications in the region.

Current high-efficiency gas commercial water heating equipment is limited to condensing water heaters, falling below 100% efficiency. Through NEEA's scanning work of emerging technologies, gas absorption heat pumps were identified as an opportunity to surpass the efficiencies produced by condensing water heaters. To further refine the savings opportunity for GAHPs, NEEA performed an analysis comparing the yearly energy input, energy costs, and emissions of a building for heating water and domestic hot water between five different equipment types given location and building type, including GAHPs, condensing water heaters, and traditional gas equipment[11]. The GAHP results presented significant therm savings (i.e., up to 2,000 DHW therms saved when compared to a boiler in a multifamily application in Seattle, WA) and carbon emission reductions (i.e., over 100,000 emissions [lbs CO_2] reduced when compared to a boiler in a healthcare application in Boise, ID) for GAHPs in commercial building applications when compared to traditional equipment in the Northwest. An additional modeling analysis investigated the potential savings of various water heating systems, including all electric, dual-fuel, and those including a GAHP, compared to baseline technologies in hotel, full-service restaurant, and multifamily applications across the Northwest. The modeling results

[10] The Commercial Building Stock Assessment (CBSA) collects, analyzes, and publishes information on the energy use and characteristics of commercial buildings and their installed equipment in the Northwest. This information is used to advance strategies for a more efficient and resilient energy system in the Northwest by NEEA, its funders, and other regional stakeholders. It supports Market Transformation and energy efficiency programs, energy resource forecasting and planning, utility conservation potential assessments, and utility integrated resource plans. Available: CBSA-4-2019-Final-Report.pdf.

[11] This analysis has not been published publicly.

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found that configurations including a modulating GAHP resulted in the highest annual operating cost savings in every iteration[12].

Having analyzed savings potential, NEEA is currently testing the technology to validate performance and assumed savings and identify system design and installation best practices, in addition to completing market research to further refine engagement and intervention strategy. Program strategy refinement and real-world performance data will signal to the market that gas heat pumps are a reliable and efficient solution for commercial water heating retrofits that result in carbon emission reductions and energy and cost savings.

Southern California Gas Company

Southern California Gas Company (SoCalGas) launched a multi-year, multi-phase emerging technologies initiative to inform the development of a market transformation strategy for Gas Absorption Heat Pump (GAHP) water-heating systems. The objective of this initiative is to accelerate the adoption of high-efficiency, low-emissions water-heating technologies in commercial and multifamily applications by addressing key market barriers, validating real-world performance, and providing designers and installers with the tools necessary for reliable deployment.

Across the emerging technologies portfolio, four overarching needs identified as critical to enabling widespread GAHP adoption are: (1) improved system-sizing methodologies, (2) valid laboratory and field performance data, (3) robust simulation and design tools, and (4) comprehensive workforce training and program design guidance. Collectively, these overarching needs establish the technical foundation for a long-term market transformation strategy focused on advancing efficient, low-carbon thermal technologies.

The initial market assessment identified several technical barriers to GAHP deployment. A key issue was widespread oversizing of domestic hot water systems due to reliance on prescriptive heuristics rather than measured load data. To address this, SoCalGas authorized a DHW sizing study for multifamily and hotel buildings (ET23SWG0012)[13], which compared common design practices to real-world profiles and developed updated screening criteria, improved sizing methods, and GAHP-appropriate design guidance.

The assessment also highlighted the need for validated performance and emissions data. In response, SoCalGas completed a series of laboratory and field evaluations (ET23SWG0015, ET24SWG0003, ET24SWG0004, ET24SWG0010) measuring capacity, efficiency, part-load behavior, and emissions under natural gas and hydrogen-enriched blends up to 30%. These datasets were used to generate EnergyPlus-compatible performance curves and maps, enabling accurate simulation of GAHP technologies in code, incentive, and decarbonization modeling. Field verification further revealed limited installer familiarity with GAHP systems, including issues with sizing, hydronic design, and commissioning. These findings informed us of targeted workforce training strategies to support consistent, high-quality installations.

To translate the research and analytics into practical resources, SoCalGas developed several tools to support engineers, modelers, and planners. The GAHP Design Tool Phase 1 (ET26SWG0001) assists practitioners with system sizing, design comparisons, and consistent evaluation of GAHP, electric heat pump, and conventional gas options. EnergyPlus performance

[12] This analysis has not yet been published.
[13] All reports can be accessed on https://ca-etp.com/

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mapping studies (ET23SWG0015, ET24SWG0003, ET24SWG0004, ET24SWG0010) supply the empirical inputs needed to model GAHP operation across diverse climates and load conditions. These data enable evaluations of annual energy use, emissions, hydrogen blend impacts, and operational performance.

Recognizing the significant energy use associated with pool-water heating, SoCalGas completed an analytical study (ET24SWG0001) that assessed five heating technologies and produced an Excel-based hourly simulation tool for evaluating energy, cost, and greenhouse gas outcomes. Additional project studies—including dual-fuel system modeling (ET23SWG0005) and statewide building simulations using ResStock (ET22SWG0009)—expanded understanding of GAHP impacts across building types and fuel scenarios.

GAHP systems require more advanced installation and maintenance practices than conventional gas water heaters. Field observations showed that incorrect recirculation integration, insufficient thermal storage, and improper controls setup reduced system performance and reliability.

In response, SoCalGas will be incorporating workforce education and training into its market strategy. Workforce training material needs, as identified in ET22SWG0008 and field-verification project installations, include:

- Load calculation and system sizing
- Integration with centralized DHW recirculation
- Controls configuration, testing, and commissioning
- Maintenance and diagnostic procedures
- Key differences between absorption and vapor compression heat pumps

These findings provide guidance for subsequent studies that aim to improve installation quality, reduce operational issues, and strengthen contractor and customer confidence in GAHP technologies.

As energy efficiency programs increasingly emphasize emissions metrics, administrators require validated data for planning. Hydrogen-blend performance evaluations (ET24SWG0010, ET24SWG0004) provide emissions-ready datasets to assess GAHP performance under future low-carbon gas scenarios.

Field pilot studies (ET25SWG0007, ET25SWG0002, ET24SWG0012) compare GAHP systems with electric heat pump water heaters across operating conditions, costs, grid impacts, and emissions outcomes, helping identify segments where GAHPs offer the highest value. The pool-heating analytical tool (ET24SWG0001) also provides a standardized, technology-neutral method for evaluating pool heating options using hourly simulations. Together, these resources support incentive design, cost-effectiveness evaluations, emissions quantification, and long-term decarbonization planning.

Next Steps for Gas Heat Pump Market Transformation

The above examples show several opportunities that DSM program administrators see for gas heat pumps based on their successful implementation in a variety of end uses. Pilots and early-stage programs are demonstrating operational success of gas heat pumps in a variety of end uses, providing heat and hot water in varying configurations and conditions while also providing gas savings over conventional equipment. While upfront costs are a current barrier, utility program incentives can help buy down the incremental costs of this more efficient equipment, serving the role DSM programs are intended to serve. These case studies also showcase remaining market transformation needs and the tools and resources being developed for customers, contractors, program evaluators, and others who are unfamiliar with the technology. Fulfilling their regulatory obligations, program administrators are seeking solutions and pulling the market toward higher efficiency gas equipment to increase available energy savings and help customers identify and install that equipment at reasonable first cost to achieve ongoing bill savings. In addition, gas heat pumps are demonstrated to reduce equipment emissions, helping to achieve decarbonization goals.

The examples covered in the paper acknowledge ongoing market challenges around equipment cost and contractor awareness relative to conventional equipment. Further, there remain very limited commercially available products. The CEE Qualified Products List contains only two, which represent the equipment currently available for sale in the US or Canada. Following the approach of past market transformation efforts, as more gas heat pump applications are successfully demonstrated, DSM program administrators can leverage the data to deploy energy conservation measures and demonstrate a market in which equipment manufacturers can compete on performance. Broad DSM program support may encourage more equipment manufacturers to develop and certify products for sale in North America. Demonstrating demand to trigger an increase in supply, on a short timeline, is critical as energy efficiency program incentives for gas equipment are already restricted in states like Massachusetts may be restricted in more locations soon. Rapid market transformation to drive down upfront costs of GHP equipment will help this category of space and water heating solutions to be cost competitive with other, more established options.

Shifts in emphasis and goals for energy efficiency programs are limiting the ability of DSM program administrators to support advances in gas equipment efficiency. The opportunity to demonstrate market demand for gas heat pumps, via coordinated US and Canadian DSM program support, is tempered by a lack of policy support. By continuing to test and demonstrate the value of gas equipment performance advances, utilities and their partners are playing a vital market transformation role: showing what's possible when resources are combined to push equipment manufacturers to develop and commercialize better and better products.

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