ENERGY SOLUTIONS CENTER

GAS HEAT PUMP

SOLUTIONS

The versatility of Gas Heat Pumps

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Gas Heat Pump Solutions is a product of Energy Solutions Center, and is published in cooperation with PRISM Media Group. We offer our special thanks to the utilities and other businesses that sponsored this issue.

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Gas Heat Pump Solutions is published by PRISM Media Group, 8951 Cypress Waters Blvd., Ste. 160, Coppell, TX 75019. Visit prismmediagroup.com.

Incredibly efficient

Frequently asked questions about gas heat pumps

BY TONYA MCMURRAY

What is a gas heat pump (GHP)?

GHPs move heat from an external heat source to a heat sink (indoors) using natural gas as the primary energy source to drive the thermodynamic cycle. Heat pumps extract heat from air, water or the ground, and then move (pump) this heat to the inside space. Heat pumps are incredibly efficient, exceeding the 100% efficiency barrier, something conventional heating, ventilation and air conditioning equipment cannot achieve.

Are GHPs energy efficient?

GHPs offer heating and/or water heating efficiencies around 140% and save consumers money over conventional gas or electric systems in both residential and commercial buildings. GHP manufacturers continue to work to refine the efficiency of equipment to prepare for upcoming North American Greenhouse Gas reduction targets, so GHPs will continue to be an energy-efficient solution.

How can GHPs be more than 100% efficient?

Heat pumps do not create or destroy energy, they simply use energy to move or 'pump' heat from an outdoor source to an indoor space (sink). This process

uses energy much more efficiently than the consumption of energy to create heat. GHPs use natural gas as a primary source of energy and capture additional heat from the combustion process and add that to heat being moved from an outside source to improve overall efficiency and bring efficiencies of GHPs to well over 100%.

Can GHPs work in cold climates?

GHPs perform well in both warm and cold climates and offer higher performance in cold climates than electric heat pumps or conventional systems. Heat recovered from the combustion process allow GHPs to operate at temperatures below freezing without needing a back-up heating system in contrast to electric heat pumps, which typically switch to electric resistance or emergency heat mode when outside temperatures drop below 35°F (1.7°C).

What are the benefits of a GHP?

In addition to lower heating and cooling costs and reduced greenhouse gas emissions, GHPs are reliable and do not require a back-up heat source in colder climates. Some models operate without the use of harmful refrigerants, and GHPs can run on renewable natural gas or blends of hydrogen to further reduce emissions.

Can GHPs be integrated with existing equipment such as boilers, water heaters and chillers?

Yes. GHPs are easy to integrate into existing systems for both space and water heating.

How will a GHP impact my gas bill?

GHPs reach around 140% heating efficiency compared to 80% for a typical gas furnace or boiler, which leads to savings of 30-50%.

Are GHPs hard to maintain?

No. Engine-driven gas heat pumps have similar maintenance requirements as electric heat pumps with the addition of maintenance to the engine itself. Absorption GHPs require annual maintenance that often costs less than that needed for a condensing boiler.

What's the typical life span of a GHP?

GHPs usually last for 20 years or more.

Can I replace my existing electric heat pump with a GHP?

Yes. It is easy to retrofit an existing electric heat pump with a gas heat pump when natural gas is available at the property.

For more information, visit:

Energy Solutions Center
gasheatpumps.com

Impressive technology

Mixed-use properties benefit from gas heat pump versatility

BY DREW ROBB

In alignment with ongoing sustainability efforts, demand for gas heat pumps (GHPs) is growing sharply. As well as saving customers a significant amount each month on water heating and space heating/cooling, they help properties reduce greenhouse gas emissions across various climates.

URBAN REGENERATION IN PHILADELPHIA

Take the case of the Bok Building in Philadelphia, Pennsylvania. A former school with a distinctive design that made it a landmark in its district, it had sat vacant for many years and was in disrepair. Scout Ltd, a multidisciplinary design and development firm, submitted a proposal to reuse the existing infrastructure. The goal was to create affordable workspaces to a variety of tenants while offering amenity and economic opportunity to the neighborhood.

Scout took a phased, long-term construction approach that continually improves and repairs the 340,000-square-foot structure. It houses over 250 businesses, including furniture makers, restaurants, tattoo artists, product showrooms, jewelers, videographers, architects, fashion designers, product designers, artists, charitable organizations and a preschool.

A light-touch approach to renovation sought to respect the building's design as much as possible. In the rear of the building, for example, the old school library has been transformed into a coffee shop. A former culinary training kitchen provides infrastructure for a local catering company. Woodshop classrooms with high electrical capacity have been utilized by tenants in need of extra power.

Central to project success sit two Yanmar 10-ton variable refrigerant flow (VRF)

> *The Yanmar units used in the Bok Building are 50% more efficient than conventional heating equipment. Additionally, there is no vibration or noise generated from the unit. The outdoor unit is so quiet, you can hardly know it is running.*
>
> — John Murray, major accounts executive, Philadelphia Gas Works

gas heat pumps (GHP). They maintain powerful heating and cooling performance, even with low outdoor temperatures, by capturing heat off the unit's engine to increase efficiency. Being gas-driven, these systems greatly reduce electricity consumption and reduce carbon dioxide emissions as well as running costs. Each VRF system consists of a gas-driven outdoor unit connected to several indoor units that have been selected to suit the various heating and cooling demands of the building occupants. They have small footprints and operate with renewable energy air sources that make installation simple.

Philadelphia Gas Works (PGW) initially worked with the ownership group of the Bok Building to convert the boilers from oil to dual fuel (natural gas with oil backup). This was followed up with a solution that could heat and cool additional space it was making available for lease as the property's electrical service was nearing capacity. PGW introduced the owners to the GHP concept.

"They were impressed with the technology and selected two Yanmar units," said John Murray, major accounts

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PHOTO BY SAM OBERTER

Owners of The Bok Building in Philadelphia, Pennsylvania, found GHPs to be an energy efficient, environmentally friendly and affordable solution for heating and hot water.

Brrr ... Not!

Residential GHPs work well for heating and hot water in cold climates

BY DREW ROBB

People in Ontario, Canada, know a thing or two about winter weather. Unfortunately, traditional electric heat pumps perform poorly in colder climates due to their efficiency losses when ambient temperatures drop below freezing.

How about gas heat pumps (GHPs)? How well do they function in regions that experience cold winters?

A ThermoLift Inc. GHP was recently installed in a single-family home in Erie Beach, Ontario. It provides heating, cooling and hot water. Homeowner Chris Ripley said the 2,200-square-foot home was built in 1998 and sits on the north shore of Lake Erie.

"A typical Southern Ontario winter weather has temperatures dropping to well below zero Celsius with a January and February range from -5°C to -15°C," (23°F to 5°F) Ripley said. "Huge winds off Lake Erie add a further wind chill factor that impacts the home during cold months."

His GHP runs well despite these conditions and provides much needed energy security. He noted that as the electricity system in his area has reliability issues,

> *"Natural gas never has reliability issues. With our natural gas generator, we can run the gas heat pump when the power goes off and have heat and hot water."*
>
> — Chris Ripley, homeowner, Southern Ontario, Canada

PHOTO COURTESY OF ANESI GAS HEAT PUMPS

An Anesi furnace-combi gas heat pump unit is well suited for cool and cold climates.

> *Cool and cold climates should use this type of system as it performs much better than electric units. For winter heating, GHPs far less costly to operate and often have better carbon footprints than conventional heating and water heating systems.*
>
> — Scott Reed, vice president, sales and marketing, Anesi Gas Heat Pumps

his home loses power frequently.

"Natural gas never has reliability issues," said Ripley. "With our natural gas generator, we can run the gas heat pump when the power goes off and have heat and hot water."

Based on her experience, Beth Stevens, vice president of sales and marketing at ThermoLift, believes that GHPs are an ideal solution for cold winters in the northern United States and Canadian markets. Whereas a traditional gas furnace has efficiencies up to 98% annual fuel utilization efficiency (AFUE), the ThermoLift system can deliver up to 130% AFUE, which makes it an economical and reliable solution for cold climate heating.

"GHPs deliver excellent cold climate heating that is highly efficient and environmentally friendly," Stevens said. "As they experience minimal efficiency loss, <5% at temperatures as low as -40°F, they provide constant comfort in cold and very cold climates."

PHOTO COURTESY OF THERMOLIFT INC.

ThermoLift Inc. gas heat pumps are ideal for cold winters.

RESIDENTIAL COLD CLIMATE GHP STUDY

To more closely study thermal heat pumps in cold climates, FortisBC is undertaking field trials in British Columbia of the residential Anesi gas heat pump by Stone Mountain Technologies (SMTi). The pilot project is expected to be completed around the first quarter of 2024. The study is being done to evaluate energy savings, installation and customer acceptance of 10 Anesi residential units to support market adoption and education opportunities.

"Ten units have been installed across two different climate zones (4 and 5) to assess the performance and reliability for space and water heating applications throughout the winter and summer seasons," said Mila Barbour, program manager, heat pump technologies, at FortisBC.

Scott Reed, vice president of sales and marketing at Anesi Gas Heat Pumps, further explained these units can replace both the gas furnace and the water heater in the home.

Cold climate gas heat pumps are far more efficient than electrically driven vapor compression heat pumps. "Cool and cold climates should use this type of system as it performs much better than electric units. For winter heating, GHPs are far less costly to operate and often have better carbon footprints than conventional heating and water heating systems," Reed said.

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Energy Solutions Center
gasheatpumps.com

Thermolift Inc.
thermoliftsolutions.com

Stone Mountain Technologies Inc.
stonemountaintechnologies.com

Providing comfort and stability

Ultra-efficient GHP water heating provides solutions for multifamily properties

BY DREW ROBB

The cost of energy for heating, cooling and hot water has become a major concern in many parts of North America. Energy bills have soared as electricity rates have mushroomed. No wonder many are turning to natural gas to help reduce monthly utility charges.

For example, hot water heating in multifamily properties is often much cheaper and more efficient when natural gas is harnessed. These gains are multiplied with gas heat pumps (GHPs).

Take the case of an aging building on the east side of downtown Vancouver, British Columbia, containing 86 households. Run by Sch'eyk Housing Society, the facility was selected by FortisBC as part of a pilot project to test gas absorption heat pumps (GAHPs) equipment.

"Heat is included in our rent so if that portion of our expenses can be reduced or maintained then that helps our bottom line," Mayleen Ahoy, director of housing at the Sch'eyk Housing Society.

Mila Barbour, program manager, heat pump technologies at FortisBC, said that

> *"Installing a gas heat pump can be a more accessible and immediate way to lower their building's carbon emissions, and they can further lower this by using renewable natural gas for the heat pumps."*
>
> — Mila Barbour, program manager, heat pump technologies, FortisBC

her organization has already completed several demonstrations of thermally-driven heat pumps. These projects provided energy savings of up to 35%, compared to conventional natural gas boiler systems. The new project is the first time FortisBC has evaluated gas heat pumps to support ventilation heating to increase overall system efficiencies. As part of the project, two Robur Corp. GAHP-A units were installed for domestic hot water and ventilation pre-heating.

"Pre-heat for rooftop applications can help improve the delta T and heat pump performance," Barbour said. "Allowing a thermally-driven heat pump to integrate into an existing rooftop unit will increase system efficiencies to perform above 100%, meeting climate policy targets."

Initial insights indicate that this tandem natural gas heating system provides up to 19% natural gas savings or greater. It performed above 100% system efficiency during the winter of 2022. FortisBC plans to complete evaluation results in April 2023 and will utilize insights to support customer adoption and expansion.

"For some, moving to an all-electric system may require more time and budget if they have to make significant infrastructure upgrades to handle the increased electricity demand," Barbour said. "Installing a gas heat pump can be a more accessible and immediate way to lower their building's carbon emissions, and they can further lower this by using renewable natural gas for the heat pumps."

"The new, more efficient GHP equipment being retrofitted into our building will provide comfort and stability to our aging tenant population by providing better delivery of heat and hot water and improved efficiencies that should result in cost savings in our operations," Ahoy said.

PHOTO COURTESY OF VICOT

Vicot GHPs perform very well in cold climates.

PHOTO COURTESY OF ROBUR CORP.

These Robur gas heat pumps have been installed at a housing complex in Vancouver, Canada, as part of a FortisBC pilot project to demonstrate that GHPs provide more than 100% efficiency, lower emissions and reduce energy bills.

LARGE APARTMENT COMPLEXES SAVE WITH GHP

Several large apartment complexes in Toronto, Ontario, Canada, have been used as evaluation and demonstration sites for GHPs. Davisville Tower, for example, is a mid-rise rental building owned and managed by Hollyburn Properties Ltd. It was built in 1963 and has 59 units. The GHP used at the site is a Vicot Model V65.

"The gas heat pump was installed as part of an Enbridge [Gas Inc.] pilot project to test the practical application of using a GHP to preheat the domestic hot water," said Sunny Brar, national energy manager at Hollyburn Properties Ltd. "By preheating domestic hot water, we save on the natural gas used by the boiler system. A GHP is a way to achieve efficiency of more than 100% using natural gas as the energy source."

The Arleta building complex in Toronto is another example. It has 372 units across two apartment buildings that harnessed two GHP units to supply about 58% of daily peak hot water needs and 100% of daily non-peak capacity. The four-story concrete structures were constructed in 1972. Before the retrofits, two oversized gas boilers located in the basement provided space heating and domestic hot water for both buildings. The boilers heat a 3,200-gallon storage tank, which remains post-retrofit. A Robur model GAHP-A was selected for each property.

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Boosting heating efficiency

Community centers find GHP technology offers solution for retrofitting HVAC systems

BY TONYA MCMURRAY

Finding efficient heating and cooling options for retrofitted older buildings can be a challenge, especially for nonprofit community organizations with high volume use and limited budgets.

For two community centers, gas heat pumps (GHPs) were the solution to reliable, cost-effective and energy-efficient heat, cooling and hot water.

GHPs provide heating by moving heat from one place to another and offer significant energy savings over their electric counterparts. GHPs have an added energy efficiency and cold climate advantage because they feature a heat exchanger to capture and reuse exhaust heat generated by the system.

Because natural gas is typically less expensive than electricity, GHPs usually have a lower operating cost. And, because gas is not subject to the same types of power disruptions as electricity, GHPs reduce demand on the power grid, helping to improve its reliability.

A COMMUNITY HUB

When Life Remodeled, a Detroit, Michigan, nonprofit organization, renovated an empty middle school building to create the Durfee Innovation Society, a multifaceted community hub, it needed to provide heating and cooling throughout the three-story, 155,360-square-foot building.

The Durfee Innovation Society, located in the center of Detroit, provides a space for multiple community services for children, students and adults, including a dance studio, athletic facilities, tutoring services and a pizza parlor franchise that serves as an educational environment to help students learn business skills.

The challenge for the contractors was that the older building wasn't optimized for current utility needs, and it didn't have air conditioning, said Alan Deal, president of Performance Engineering Group. The contractors decided to use high-efficiency residential furnaces and

air conditioning units in individual office spaces. However, that left the center core of the building that included the gym, auditorium, cafeteria and other common spaces unconditioned.

Deal worked with the contractors to convert the building's former steam-based heating system to a gas-fueled hydronic heating and cooling for the common areas using six of Robur's GAHP AR heat pumps and six of its ACF60 ST chillers.

"We were able to cool and heat the center core of this building so they could achieve a year-round usage and be comfortable in the summer when it was going to be extremely hot," he said. "It provided a lower operating cost because running off steam was almost double the cost of the heat pumps. It's about a 40% savings."

AN ECONOMICAL RETROFIT SOLUTION

The YMCA of Northern Middlesex County in Middletown, Connecticut, needed to upgrade its heating and cooling system for its main facility, activity and fitness areas as well as for an adjoining house that had been converted into office space. The YMCA provides the community with health and wellness, fitness, childcare, family enrichment, life skills for teens, aquatics, camping, youth development and adult residential and recreation services.

The challenge was that the YMCA's electrical system would require an electrical upgrade to accommodate conventional heating, ventilation and air conditioning (HVAC) solutions, said Krishnendu Mukherjee, design engineer for Controlled Air Inc.

PHOTO COURTESY OF CONTROLLED AIR INC.

Yanmar's 14-ton gas heat pump VRF system provided a cost-effective heating and cooling solution to help the YMCA of Northern Middlesex County upgrade its HVAC system.

PHOTO COURTESY OF PERFORMANCE ENGINEERING GROUP

The Durfee Innovation Society used six Robur GAHP AR heat pumps and six Robur ACF60 ST chillers to provide heating and cooling for its 155,360-square-foot community center providing services for children, students and adults.

Controlled Air recommended the Yanmar 14-ton gas heat pump VRF with heat recovery, which provides a more cost-efficient solution than conventional heating systems with boilers or gas furnaces. The Yanmar system operates on a single phase with a natural gas compressor, allowing it to consume minimal electric energy, Mukherjee said.

"This makes it ideal for retrofit applications where the existing building does not have a large enough electrical service to power conventional HVAC systems," he said. "The YMCA's electrical system could not handle any additional load without an upgrade to the electrical service."

The Yanmar system features indoor fan coil units that provide a flexible and modular solution, which is ideal for older buildings with varying zone loads, Mukherjee said. This allows the system to simultaneously heat and cool different zones to meet the individual needs of occupants and provide better provide energy savings.

For more information, visit:

Energy Solutions Center
gasheatpumps.com

Robur Corp.
robur.com

Yanmar America Corp.
yanmarenergysystems.com

Climate control

GHP VRF system offers efficient heating and cooling

BY TONYA MCMURRAY

Maintaining effective climate control in a building with multiple zones and differing needs can be a challenge for a business looking to maximize cost and energy savings.

The challenge is one that Burnham Family Farm Market struggled to address. Located in Cobourg, Ontario, the market offers fresh local produce and baked goods produced on-site. The building includes a retail store, a bakery, a staff breakroom and storage areas.

"The grocery area needs heating in the winter and cooling in the summertime," said Farzin M. Rad, senior advisor for commercial and industrial technology development with Enbridge Gas Inc. "The bakery is an open area with ovens that produce a lot of heat. They need cooling even in winter."

Rad and his colleague, Aqeel Zaidi, thought the bakery offered an ideal opportunity to test the efficiency of a three-pipe, engine-driven gas heat pump (GHP), variable refrigerant flow (VRF) system.

Engine-driven GHPs are typically more efficient than conventional heating and cooling systems, offering both cost savings and reductions in emissions. An engine-driven GHP operates on a vapor-compression cycle that uses an internal-combustion engine to power the compressor. The heat pump pulls air from outside or, as in the case with the market, from another heat source such as the bakery, to provide heating and cooling. The VRF technology uses a variable speed reciprocating engine that allows the system to work at part-loads, leading to lower energy consumption.

COST-EFFECTIVE SOLUTION

Kenny Nguyen, regional sales and ser-

vice manager at Yanmar Energy Systems Canada Inc., said the three-pipe VRF system is ideal for operations such as Burnham Family Farm Market.

"With the three-pipe system, you can do heating and cooling at the same time," he said. "With our gas heat pump, they didn't have to upgrade their electrical service. If they went with conventional rooftop units, they would have had to upgrade their electrical service and that would cost a lot of money."

Enbridge Gas approached the market with a proposition: It would supply an engine-driven, three-pipe GHP VRF system and track its performance.

"The owner was cooperative and even enthusiastic," Rad said.

The GHP VRF system installed at the 7,642-square-foot Burnham Family Farm Market consisted of a 14-ton outdoor unit, five indoor units for the bakery and six indoor units for the retail area.

> *"With the three-pipe system, you can do heating and cooling at the same time. With our gas heat pump, they didn't have to upgrade their electrical service. If they went with conventional rooftop units, they would have had to upgrade their electrical service and that would cost a lot of money."*
>
> — Kenny Nguyen, regional sales and service manager, Yanmar Energy Systems Canada Inc.

PHENOMENAL EFFICIENCY

Rad and Zaidi highlighted the results of the study in a paper — "Performance Evaluation of 3-Pipe Engine Driven Gas Heat Pump VRF System in Cold Climate" — published by the American Society of Heating, Refrigerating and Air Conditioning Engineers.

The study showed that the GHP offered significantly better performance than could be expected with conventional heating and cooling units.

Rad and Zaidi measured the efficiency of the GHP using the coefficient of performance (COP), which provides a ratio of how much useful heating or colling a heat pump produces given a certain energy input. The COP values ranged from 1.1 to 1.62.

According to the team's study, the initial analysis of the market's system showed that using a conventional rooftop package for two months of heating and seven months of cooling, heating costs would total $962 and cooling costs would total $3,258 over a seven-month period – from March to September. During that same time frame, the GHP provided heating costs of $614 and cooling costs of $1,321 – about half the anticipated cost of a conventional rooftop system.

"The efficiency is phenomenal," Rad said. "Rooftop units typically have an efficiency of about 85%. During our study, the VRF system never had an efficiency below 110%. So, we were able to show that a three-pipe system is very efficient when you need both heating and cooling. It offers significant savings."

PHOTO COURTESY OF YANMAR ENERGY SYSTEMS CANADA INC.

Yanmar's Gas Heat Pump Variable Refrigerant Flow system provides both heating and cooling for Burnham Family Farm Market, which includes a bakery and a retail store.

For more information, visit:

Energy Solutions Center
gasheatpumps.com

Yanmar America Corp.
yanmarenergysystems.com

Flexible options

GHPs offer comfortable, efficient and cost-effective heating solutions

BY TONYA MCMURRAY

Gas heat pumps (GHPs) offer a flexible, cost-effective and energy-efficient solution for both commercial and residential buildings. A recent ICF International Inc. study conducted for the Energy Solutions Center Inc. showed that GHPs have lower emissions and operating costs over their life cycle when compared with electric heat pumps (EHPs) and traditional gas heating systems.

Heat pumps operate somewhat like an air conditioner in reverse. While air conditioners take warm air from indoors and move it outside, a heat pump takes heat from the outside air, water or a ground source and moves it inside to heat indoor spaces. Heat pumps can heat both indoor spaces and water, and some offer both heating and cooling in a single unit.

While heat pumps can be fueled either by electricity or natural gas, GHPs provide an extra advantage because they can capture additional heat off the gas combustion process to improve overall efficiency, especially in colder climates. By capturing the additional heat from gas combustion, GHPs are not only more efficient in colder climates, but also typically will not need a back-up heat source, said David Jones, manager, CHP distributed grid strategy for ICF.

In addition, GHPs heat more efficiently. A study by the University of Chicago's Eckhardt Research Center found that EHPs typically deliver hot air at between 90°F and 95°F to a space while GHPs usually provide hot air at between 100°F and 120°F. Because of this, EHPs need to circulate more air to warm a space and can leave a space feeling cold and drafty compared to natural gas options.

FLEXIBLE OPTIONS

Natural gas heat pumps offer consumers installation flexibility because they can supply multiple zones, use a variety of terminal points and can be mounted on either the roof or ground.

GHPs use either a gas engine or an absorption cycle to operate the heat

pump. Engine-driven GHPs use a reciprocating natural gas engine to produce the shaft horsepower to turn a vapor compressor, replacing the electric motor in an EHP with a natural gas engine. Absorption heat pumps use gas to heat a solution of water and ammonia or lithium bromide in a sealed absorption circuit to provide both heating and cooling.

The ICF study compared both absorption and engine-driven GHPs, EHPs and standard natural gas rooftop heating systems in four different U.S. cities.

"We chose four locations that have different climates, different energy prices and different grid mixes to see how those factors played into the results," Jones said.

ICF modeled operational costs and carbon emissions over a 20-year future period for all four heating systems in each of the four cities. The ICF analysis showed that absorption GHPs provide the lowest heating costs while engine-driven GHPs offer the lowest overall operating costs.

> *In all the analysis cases, GHPs and EHPs provided cost reductions and emissions savings compared to incumbent systems. Engine-driven GHPs offered the most favorable operating economics in all four locations. This can be attributed to the relatively low cost of natural gas compared to electricity, and reduced efficiencies of EHPs in heating mode, particularly in low ambient temperature conditions.*
>
> — ICF International Inc. study

"In all the analysis cases, GHPs and EHPs provided cost reductions and emissions savings compared to incumbent systems. Engine-driven GHPs offered the most favorable operating economics in all four locations," according to the ICF study. "This can be attributed to the relatively low cost of natural gas compared to electricity, and reduced efficiencies of EHPs in heating mode, particularly in low ambient temperature conditions."

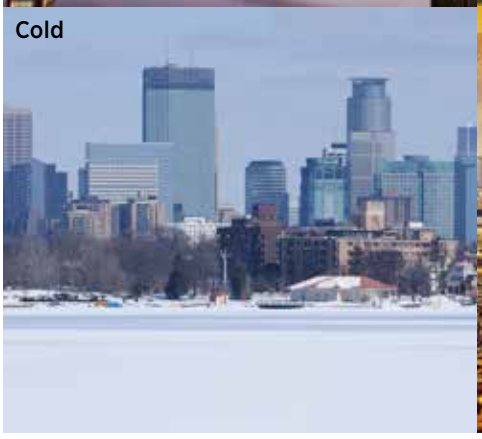
The study notes that GHPs may be even more cost-effective than its research indicates since the study used average electric rates. However, utilities have higher rates or demand charges during the summer cooling season and many gas utilities may offer lower rates for cooling applications during the summer since gas is typically in less demand.

The ICF study also found engine-driven GHPs have lower emissions than either standard heating, ventilation, air conditioning and heating systems or electric heat pumps when considering emissions and efficiency losses from electricity production and distribution.

"Gas heat pumps are very efficient and comparable to electric heat pumps in emission reductions," Jones said. "Especially in areas where the grid is not very green, a gas heat pump may be more beneficial."


Mixed humid


Hot humid


Cold


Hot dry

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Impressive technology

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executive at PGW. "The units have been running for almost a year, and the customer is satisfied. They helped to reduce the electric demand, especially in the summer, where a high electric demand may have a large impact on the total cost of electricity for the building."

He added that natural gas heat pump heating systems provide efficiencies more than 100%, while using low-cost natural gas as the primary fuel source. This helps achieve near-term carbon reduction goals and lower energy costs. And over the long-term, gas heat pumps can be fueled with renewable natural gas as a pathway to decarbonizing space and water heating.

"The Yanmar units used in the Bok Building are 50% more efficient than conventional heating equipment," Murray said. "Additionally, there is no vibration or noise generated from the unit. The outdoor unit is so quiet, you can hardly know it is running."

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Energy Solutions Center
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yanmarenergysystems.com

PHOTO COURTESY OF PHILADELPHIA GAS WORKS

The Yanmar units used in the Bok Building are 50% more efficient than conventional heating equipment.

GHP LESSONS LEARNED

Pike Road School in Montgomery, Alabama, serves 275 students in seventh through 10th grades. The facility includes 28 classrooms, a science lab, assembly hall, administration area and gymnasium. The school system selected Yanmar's variable refrigerant flow (VRF) natural gas heat pump system due to the manufacturer's ability to design the system without the need for building modifications (which were not allowed due to its status as a historic building). Yanmar engineers used ductless units in areas with low ceiling heights with no room for ductwork. The system also reduced electrical usage sharply compared to installing an electric-driven heating, ventilation and air conditioning system, which would have required large, costly electrical upgrades to the facility.

"The Yanmar system and the Yanmar team have met all of the requests during the project, and the system has worked flawlessly since being commissioned," said Laura Penn, program manager at Volkert Inc., construction managers for the project. "Yanmar has been engaged in the project from start to finish, providing a high level of customer support."

PHOTO COURTESY OF ROBUR CORP.

Robur gas heat pumps outside the Arleta complex in Toronto, Canada, are designed to boost efficiency and lower fuel costs.

Providing comfort and stability

(continued from page 9)

Modelled efficiency of the new system is 110%, compared to 54% before. The project team installed two Robur units just outside the boiler room to minimize the length of exterior piping and avoid any noise issues for occupants.

According to a study by the City of Toronto's TAF (The Atmospheric Fund), GHPs offer significant performance improvements when compared to conventional, gas-fired heating equipment. Based on a pilot installation, they were also found to generate substantial carbon and operating cost reductions.

"GAHPs are best suited to water heating applications, due to the relatively low supply/return temperatures and the ability to take advantage of much higher efficiencies during warm weather," said TAF's "Gas Absorption Heat Pump Technology Assessment and Field Testing Findings" report.

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