Residential HVAC Gas Absorption Heat Pump

Considerations for Installation

North American Gas Heat Pump Collaborative
TECHNOLOGY FOR A CLEANER FUTURE

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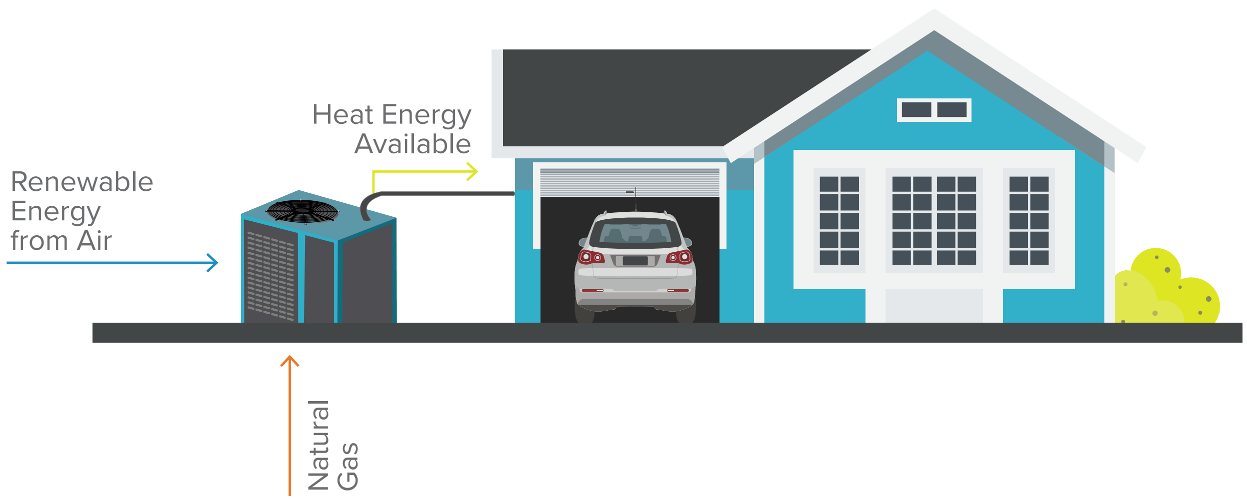
Introduction

Residential gas heat pumps (GHP) are a highly energy efficient technology used for space heating, cooling, water heating, and a "combi" option that combines heating, cooling, and water heating. These products operate similarly to other electric heat pump technologies where heat is moved from one place, such as air, water, or the ground, and is transferred indoors. Hydronic systems are systems that heat/cool water in order to heat/cool the air.

Gas heat pumps have superior heating performance compared with their electric counterparts. They operate more effectively and efficiently, particularly in colder climates. Gas pumps efficiently utilize the heat coming from the combustion of natural gas, and they do not require a backup heating source like electric heat pumps require. GHPs also offer a more climate-friendly option than their electric counterparts due to the type of refrigerant used. Ammonia refrigerant used in GHPs results in low or no global warming potential.

There are three types of GHP technologies manufacturers are developing: engine-driven vapor compression, sorption (absorption/adsorption), and thermal compression. Each type uses different refrigerants and pressurization methods. This document focuses on absorption equipment. Figure 1 demonstrates how GHPs generally work.

Figure 1 Residential Gas Heat Pump



Product Benefits & Features

There are numerous benefits to GHPs including energy and cost savings, utilization in cold climates, and greenhouse gas reductions.

- **Energy and Cost Savings.** Residential HVAC GHPs are over 120% efficient (AFUE). This high performance continues in freezing temperatures, significantly reducing the amount of gas needed for heating, saving up to 40% in operational costs over condensing boilers.[1]
- **Cold Climates.** Because cold ambient temperatures only minimally impact the performance of gas-fired heat pumps, a residential HVAC GHP is a highly efficient solution in cold climates.
- **Greenhouse Gas (GHG) Reductions.** GHGs are gases that trap heat in the atmosphere, and typically include carbon dioxide (CO_2), methane, and nitrous oxide. Residential HVAC GHPs cut down on an estimated 1.4 tons[2] of CO_2 emissions per year with every installation.

Residential HVAC Gas Heat Pump Customer Benefits

Natural gas is the most predominant and economical form of heating in North America. GHPs have the potential to significantly reduce energy use and greenhouse gas emissions. Customer electricity can cost up to three times more than the cost of natural gas[3] and customers can save up to 40% in operational costs when compared to condensing boilers[4]. Gas heat pumps can operate efficiently even at low temperatures, without a requirement for a back-up heating source. Gas heat pumps also don't require ozone-depleting refrigerants to operate.

1 GAHP A gas heat pump (robur.com)
2 Assumes a typical household gas annual consumption of 2400 m3, GHG natural gas emission factor of 1.9 kg, and a 30% GHP gas consumption reduction.
3 ESC Efficient & Affordable Natural Gas Heat Pumps The Guide to Efficient & Affordable Natural Gas Heat Pumps (myescenter.com)
4 GAHP AR reversible gas heat pump (robur.com)

Considerations for Installation: Absorption GHP

Installation Best Practices

Quality service and installation of household appliances can generate word-of-mouth referrals, increase sales, and improve customer satisfaction. Conversely, a bad installation or poor customer experience can hurt contractors' business momentum. To ensure customers get the most from their residential HVAC GHP system, this guide includes considerations for contractor installation. However, due to the variety of end-use technical solutions, installation best practices will vary by technology type. This document **does not** replace manufacturer specifications or installation guidelines. In addition to the product manual instructions, consider the following installation guidance.[5]

Sizing Considerations

- Establish the design heating load from Manual J calculations, which is a formula that identifies the HVAC capacity of a building.
- For replacement of a furnace or boiler, contractor should not rely on the capacity of the existing appliance, as there is a high likelihood that the existing appliance is over-sized. Envelope changes to the home since the original heating system was installed should also be considered, such as up-graded windows or doors, additional insulation, or the addition of climate-controlled space.
- Size the GHP appropriately. Using Manual J calculations can help ensure proper sizing of the GHP.
- For design heating loads greater than about 40,000 btu/hr., there should be no need to add additional heat pump capacity to account for the water heating load (if a combi system is installed), as the water heating load is not significant compared to the space heating load. For loads less than 40,000 btu/hr., an additional 5-10% heat pump capacity should be selected for combi installations.
- For forced-air systems, the air-handler unit (AHU) should be sized such that it can provide the design heating load (not the heat pump capacity at 47°F) at a hydronic supply temperature no higher than 140°F. Hydronic air-handlers are normally sized for 160 or 180°F hydronic supply temperatures, which will result in an under-sized AHU. Ensure the duct work in the home is properly sized for the maximum air flow rate designated by the manufacturer's instructions. Note Stone Mountain Technologies, Inc. (SMTI) AHU has been carefully designed to provide the required capacity at a hydronic supply temperature less than 140°F.
- For hydronic heating systems, ensure the indoor heat emitter capacity can provide the design heating load at a hydronic supply temperature of no higher than 140°F. If not, additional indoor heat emitter capacity should be added (such as a baseboard, wall hung, or ceiling mounted fan-coil) or the existing boiler should be retained to provide higher hydronic temperatures during very cold periods.
- For hydronic heating systems, the number of zones should be noted. For 2-3 zone systems, a buffer tank is probably not required to prevent excessive cycling. For highly zoned systems (greater than 3), a buffer tank is recommended to prevent heat pump cycling. The thermostat on the buffer tank should have a delta T of at least 20°F.
- If an indirect storage tank (IST) is to be installed, select a tank with a volume of at least 60 gallons (75-80 preferred) and the aqua stat located at the approximate mid-height of the tank in order to prevent short heat pump recovery cycles. Aqua stats set low in the tank will create short cycling and may impact efficiency. The internal heat exchanger must be large enough to allow adequate tank heating with low hydronic supply temperatures (use ISTs designed for connection to condensing boilers or thermal solar systems). Note ISTs supplied or recommended by SMTI have been vetted for proper operations with GHP.
- If not provided by the manufacturer within the heat pump or AHU, size and select a suitable hydronic pump that will provide the required flow rate per the manufacturer's instructions.
- Gas piping for HVAC GHPs must meet all codes and standards and include a manual shut-off valve to isolate the appliance when required. The minimum line size is a ½" diameter gas pipe. Consult manufacturer installation instructions for specific unit requirements.

5 Installation considerations is provided, in part, from Stone Mountain Technologies, Inc. for contractors installing GHPs and air handling units (AHU) for residential absorption GHP types.

Location Considerations

Residential absorption GHPs must be installed outdoors. In addition, there are a variety of other factors to consider when selecting the appropriate location.

- Ensure ample space for the GHP and all required clearances per the manufacturer's instructions. Adequate space will allow easy access to all controls, filters, and drains.
- The location of existing windows and doors should be considered due to the heat pumps operating sounds and any local code requirements.
- Distance from the GHP to the AHU and/or IST should be minimized to reduce pumping power, hydronic loop volume, and heat losses from the hydronic lines.
- Distance and routing of the gas line and electric power to the GHP should be considered, as well as the routing and penetration location of the hydronic lines from the GHP to the indoor load(s).
- Ensure the site where the GHP will be located is reasonably level.
- Consider how and where the flue gas condensate line will be routed, whether simply into a limestone filled pit, or into the interior space to a suitable drain.
- Consider location of heat pump as it relates to the existing air-conditioning system condenser unit (if applicable). Ensure there is enough space to re-install the indoor evaporator coil on top of the new hydronic AHU.
- If the GHP is configured with Wi-Fi connectivity, consider availability of signal strength or how it can be increased if necessary.
- GHPs typically weigh more than standard electric air-conditioners or heat pumps. Consideration for moving the GHP from the truck or trailer to the installation site includes the terrain and surfaces, fences or gates, steps, and the use of a small, wheeled cart.

Install Steps

- Ensure the heat pump is installed level, and on a pad or other support system per the manufacturer's instructions.
- Route gas line and electric power suitable per manufacturer's instructions to the heat pump.
- Route hydronic lines and control wiring from the heat pump to the indoor loads(s). Ensure the size, length, and number of bends/fittings of the lines are adequate for the flow rate required.
- Flush and leak test the hydronic lines prior to final connection to the heat pump and indoor load components.
- Route the flue gas condensate line in a manner per the manufacturer's instructions and in accordance with all local codes. Condensate lines must be insulated and heat-traced and include a condensate neutralizer if required by local code.
- Fill the hydronic lines with a food-grade heat transfer fluid per the manufacturer's instructions (typically inhibited propylene glycol at a concentration suitable for the local minimum temperature) and bleed the air out of the lines.
- Install all controls and wiring between the heat pump, thermostats(s) and indoor load components. Test to ensure working properly.
- Bleed the air out of the gas lines prior to initially starting the heat pump. Check to make sure combustion settings are correct using a suitable flue gas analyzer and per the manufacturer's instructions.

Other Considerations

- Install indoor thermostats appropriately for maximum efficiency. Location should be approximately 54 inches above the floor and away from air supply grilles, drafts, direct sunlight from the outdoors, and electrical appliances known to give off heat, such as lamps or televisions.
- Perform preliminary checks of the equipment before start and first use. This should include checking the water, electrical, and gas systems for both their required capacities and required safety and control devices; checking for leaks in the water and gas systems; checking the type of gas being supplied and associated gas pressure; and checking for any issues with the flue exhaust duct and power supply.
- Test for gas line leaks using a soapy water solution. All GHPs and their gas connects must be tested for leaks before they begin operation.

- Regularly service the GHP after installation to maintain the system's performance and keep running costs low. Follow the manufacturer's recommended service requirements.
- Review any available utility rebates and tax credits. **Consult the [NAGHP Collaborative website](#) for up-to-date information or consult your local utility's program offerings by visiting their website directly.**

Figure 2 Single Family Residential Heating