# Additional Components

*The Ground Source Heat Pump (GSHP)*

The GSHP is the mechanical device that uses a basic heat pump refrigerant cycle to transfer heat to and from the ground loop fluid to heat, cool and produce domestic hot water for a building. The amount of heat that a GSHP can output is described in terms of tons, where 1 ton of heat is 12,000 British thermal units per hour (BTU/hr) [1 BTU/hr = 0.293 Watts]. Furnaces and air conditioners of all types can be described in terms of their tonnage as well. Depending on the size of the house, a GSHP system may utilize a 3-ton, 4-ton or even a 5-ton heat pump. Multiple heat pumps designed to service different portions of a home are also common. As with all heating and cooling systems, it is critical that the size of the heat pump(s) be chosen to most precisely meet the expected heating and cooling load of the house. A heat pump(s) that is too small won't be able to provide adequate space conditioning, whereas an oversized heat pump will cycle on and off too much, use too much electricity, and result in less than optimal comfort for the occupants.

*Coefficient of Performance (COP) and Energy Efficiency Ratio (EER)*

GSHPs are rated by COP (coefficient of performance) when used for heating, and by EER (energy efficiency ratio) when used for cooling**.** The COP is a measure of the amount of heat energy the heat pump system delivers relative to the amount of electricity it consumes. Think of it as what you get divided by what you pay for. Electric resistance heat has a COP of 1, while GSHPs have COPs ranging from 2.4 to over 5. EERs of GSHPs range from 10.6 to 30. The COP and EER reported by heat pump manufacturers represent the measured thermal efficiencies of the heat pump under laboratory (ideal) conditions. The COP of the installed system takes into account the actual heat pump efficiency (under actual operating conditions) as well as additional electrical loads such as circulating pumps, distribution-side pumps/fans, and auxiliary electric heating. The COP of the entire system may be, and usually is, different than the rated heat pump COP.

*Water Flow Control*

Closed ground loops rely on a circulator pump(s) that continuously circulate water between the ground loop and the heat pump. The pump requires electricity to run and is part of the operating cost. A fixed speed external circulator pump moves water at a single speed around the ground loop. Heat pump manufacturers are also now offering variable flow circulator pumps that can be built right into the heat pump. These intelligent circulator pumps are considerably more energy efficient, but they are generally available on only the premium heat pump models. Open ground loops (groundwater pumped from a well or surface water body) rely on submersible groundwater pumps.

*Auxiliary Heat*

A GSHP is often equipped with an electric heating element called auxiliary heat. Auxiliary heat serves two purposes. It acts as a supplemental heat source if the heat pump is unable to meet the entire heating load. This may happen during periods of extreme cold. Under these conditions, the auxiliary is used in combination with the heat pump and reductions in efficiency are modest. The second purpose of the auxiliary electric heat is to provide a source of emergency back-up heat if the heat pump malfunctions and fails to produce heat for the building.

*Desuperheater: Domestic Hot Water Heating*

A desuperheater is a secondary heat exchanger that uses excess heat from the heat pump to preheat water entering the home's hot water tank. The desuperheater only operates when the heat pump is actively heating or cooling the home. In some cases, the desuperheater can provide more than half of a home's domestic hot water. Many installers strongly recommend using an intermediate storage tank (often referred to as a buffer tank) instead of plumbing directly to the domestic hot water tank(s).

*Heat Distribution Systems*

GSHP systems are compatible with forced air and hydronic systems. For a GSHP system to operate efficiently, forced air distribution systems need to be tightly sealed and properly sized. Air systems rely on an indoor fan to circulate conditioned air through the building's ductwork. Fans can be either single speed or variable speed, with variable speed fans being more energy efficient but also more expensive. Hydronic heating systems use water to move heat from the heat pump into the home. Heat is absorbed by the water at a heat source, conveyed by the water through the distribution piping, and finally released into a heated space by a heat emitter. For maximum efficiency, the piping and heat emitters must be properly sized and spaced to ensure the best thermal connection with the home.

*GSHP System Performance Monitoring*

Performance monitoring helps ensure that the GSHP system will operate at peak efficiency. Operating at peak efficiency is important not only to ensure uninterrupted comfort for homeowners, but also to make sure homeowners reap the maximum benefits from their GSHP system. Catching issues early on and making simple adjustments can save the homeowner significant time, frustration and money. Monitoring systems are relatively new to the GSHP market. Some heat pumps come with simple diagnostics that can be viewed on the thermostat or the heat pump. Web-based monitoring systems, such as the GxTracker by Ground Energy Support, allow homeowners and their GHSP installers to view the performance of their GSHP system anywhere they can get an internet connection.