Geothermal Heat Pump Systems: Get to Know the Type of System That Might Be Right for You

Geothermal heat pump systems are among the most efficient and comfortable heating and cooling technologies available, using the Earth itself to provide both space heating and cooling capabilities, and in some instances, hot water heating for residential and commercial buildings. When operating as a heating source, geothermal (also known as ground source) heat pump (GSHP) systems transfer thermal energy from the ground (or body of water) to a building. When operating as a cooling source, GSHP systems transfer thermal energy from the building to the ground (or body of water).

While some may be aware of GSHP systems at a high level, it is worth diving a little deeper into the details around GSHPs. This is especially beneficial when it comes to considering whether the technology might be the right choice for your building or facility as a way to improve energy efficiency, cost savings, and occupant comfort levels.

Types of Geothermal Heat Pump Systems

GSHP systems are generally categorized by whether they are closed vs. open loop and the configuration of the ground loop (vertical vs. horizontal). Closed-loop systems use a ground loop (typically made of polyethylene or PVC piping) that circulates water or antifreeze to exchange heat with the ground or a groundwater source.

Closed loop horizontal "slinky"-like systems are generally considered the most cost-effective for residential or smaller commercial installations, specifically for new construction where sufficient land is available as it requires trenches at least four feet deep.

Vertical GSHPs, which can have column wells of up to 400 feet deep, are often used for large commercial systems where land is limited, or where the soil is considered too shallow to bury the horizontal loops in the trenches. While these systems can be more costly, they require less land space and create a more minimal disturbance to the existing landscape.

If a commercial institution is located near an adequately sized body of water and is considering installing a GSHP, the pond/lake closed loop system may be a cost-effective option. For these systems, a supply line pipe would run underground from the building to the water and coils into circles at least eight feet under the surface, which helps to prevent freezing. The coils should only be placed in a water source that meets minimum volume, depth, and quality criteria.

Geothermal heat pump systems can also be designed as direct exchange systems, a closed loop-type system that circulates a refrigerant through a copper pipe instead of a typical ground loop. Direct exchange systems are highly efficient at heat extraction and rejection.

Open loop systems differ from closed loop geothermal systems in that they circulate water for heat extraction and rejection directly from local groundwater sources, such as a well or nearby surface body of water. This can reduce the installed cost due to less piping and enhance system efficiency due to improved heat transfer. Once it has circulated through the system, the water returns to the ground through the well, a recharge well, or surface discharge. While this can reduce the cost of installation due to less piping and enhance overall system efficiency due to improved heat transfers, this option is practical only with an adequate supply of relatively clean water, and if all local codes and regulations regarding groundwater discharge have been met.

Conclusion

Although there are several variations in the types of geothermal systems available, GSHPs have several universal benefits, including ease of use, simplicity of design, improved durability and reliability, as well as increased energy efficiency and low carbon footprint.

NYSERDA is working with several partners and stakeholders throughout the state to help grow the awareness and implementation of geothermal systems in large commercial and institutional entities statewide as a way to improve comfort, reduce energy use, and help New York State meet its ambitious clean energy goals. To learn more, download the full summary report on Stages 1 and 2 of the Geothermal Clean Energy Challenge, and consider signing up for a free screening to determine if geothermal might be a good fit for both your building and your clean heating and cooling needs.

Get Started