GEOTHERMAL HEAT PUMPS – ADVANTAGES AND DISADVANTAGES

ADVANTAGES AND DISADVANTAGES OF SYSTEMS[19]

Geothermal Loop Type	Advantages	Disadvantages
Open-Loop	Simpler design; lower drilling costs than for vertical closed-loop systems; more efficient performance by avoiding thermal degradation associated with heat transfer across pipe wall from ground or water body to antifreeze solution in closed-loop; lower installation cost if a supply well already exists for domestic water or grounds irrigation, with sufficient surplus production capacity to supply heat pump system.	Subject to local, state, and Federal groundwater and surface water withdrawal and discharge permitting; large water flow requirements may exceed local water availability; supply-side of heat exchangers subject to corrosive and abrasive agents, chemical scaling, and microbial fouling; main circulating pumps typically require more power in open loops than in closed loops; water discharge regulations may preclude single-well systems or constrain the design of standing-column systems; higher installation cost if a separate injection well is required for loop water discharge.
Horizontal Closed-Loop	Trenching costs for horizontal loops usually are much lower than well-drilling costs for vertical closed-loops, and there are more contractors with the appropriate equipment; flexible installation options depending on type of digging equipment (bulldozer, backhoe, or trencher) and number of pipe loops per trench.	Largest land area requirement; performance more affected by season, rainfall, and burial depth; drought potential (low groundwater levels) must be considered in estimating required pipe length, especially in sandy soils and elevated areas; ground-loop piping can be damaged during trench backfill; longer pipe lengths per ton than for vertical closed loops; antifreeze solution more likely to be needed to handle winter soil temperatures.
Slinky Closed-Loop	Slinky loops require less land area and less trenching than other horizontal-loop systems, and installation costs may be significantly less.	Greater pumping energy needed than for straight horizontal-loops; backfilling the trench while ensuring that there are no voids around the pipe coils is difficult with certain types of soil, and even more so with upright coils in narrow trenches than with coils laid flat in wide trenches.
Vertical Closed-Loop	Requires less total pipe length than most other closed-loop systems; requires the least amount of land area; seasonal soil	Cost of drilling is usually higher than cost of horizontal trenching, and vertical-loop designs tend to be the most costly GHP systems; potential for long-term soil

	temperature swings are not a concern.	temperature changes if boreholes not spaced far enough apart.
Submerged Closed-Loop	Can require the least total pipe length and can be the least expensive of all closed-loop systems if a suitable water body is available.	Submerged loops are likely to require more regulatory permitting than buried closed-loop systems; unless properly marked, can be damaged by boat anchoring.
Direct-Exchange Loop	Higher thermal efficiency; no liquid/liquid heat exchangers required; less land area needed for horizontal configuration.	Soil in contact with ground loop subject to freezing; copper tubing should not be buried near large trees where growing root system could damage the coil; ground-loop leaks can lead to catastrophic loss of refrigerant; smaller supporting infrastructure in GHP industry, with greater care and higher skill needed to install and consequently higher installation costs.
Closed-Loop In Series	Single pipe diameter entails simpler pipe fusion joints, enabling quicker installation; single flow path enables easier purging to remove air from the loop when filling with water or antifreeze solution.	Longer flow path requires larger-diameter pipe to minimize pressure drop and maintain pump power at reasonable levels; larger diameter also entails greater antifreeze volumes; system capacity limited by total pressure drop from end to end, so not suitable for large building applications.
Closed-Loop In Parallel	Shorter flow paths enable smaller pipe diameter to be used, which lowers unit piping cost and requires less antifreeze; reduced pressure drop along shorter flow paths results in smaller pump power requirements.	Header lines must be larger diameter than individual loops and so require more complex pipe joining operations than series installation; special care needed to ensure complete air removal from all flow paths when purging system at start-up.

THE BOTTOM LINE – COST EFFECTIVENESS/ENERGY REDUCTIONS/BENEFITS

*Advantages:

- The biggest benefit of geothermal heat pumps is that they use 25%–50% less electricity than conventional heating or cooling systems.
- According to the EPA, geothermal heat pumps can reduce energy consumption—and corresponding emissions—up to 44% compared to air-source heat pumps and up to 72% compared to electric resistance heating with standard air-conditioning equipment.
- Geothermal heat pumps also improve humidity control by maintaining about 50% relative indoor humidity, making geothermal heat pumps very effective in humid areas.

- Various Geothermal heat pump loop systems allow for design flexibility and can be installed in both new and retrofit situations. Because the hardware requires less space than that needed by conventional HVAC systems, the equipment rooms can be greatly scaled down in size, freeing space for productive use.

- Geothermal heat pump systems also provide excellent "zone" space conditioning, allowing different parts of your home to be heated or cooled to different temperatures.

- Because geothermal heat pump systems have relatively few moving parts, and because those parts are sheltered inside a building, they are durable and highly reliable. The underground piping often carries warranties of 25–50 years, and the heat pumps often last 20 years or more.

- Since they usually have no outdoor compressors, geothermal heat pumps are not susceptible to vandalism on the other hand, the components in the living space are easily accessible, which increases the convenience factor and helps ensure that the upkeep is done on a timely basis.

- Because they have no outside condensing units like air conditioners, there's no concern about noise outside the home. A two-speed geothermal heat pump system is so quiet inside a house that users do not know it is operating: there are no tell-tale blasts of cold or hot air.

- Utility bills will be lowered on average 25% to 70% as compared with conventional systems.[20]

- Geothermal system burns no fossil fuel on-site to produce heat, it generates far fewer greenhouse gas emissions than a conventional furnace.

- Can also completely eliminates a potential source of poisonous carbon monoxide within the home or building.

- Factoring in its share of the emissions from the power plant that produces electricity to operate Geothermal systems, total emissions are far lower than that of conventional systems.

- According to data supplied by the U.S. Department of Energy (DOE) Office of Geothermal Technologies, nearly 40% of all U.S. emissions of carbon dioxide (CO_2) are the result of using energy to heat, cool and provide hot water for buildings. This is about the same amount of CO_2 contributed by the transportation sector.

- A typical 3-ton residential GeoExchange system produces an average of about one pound less Carbon Dioxide (CO_2) per hour of use than a conventional system. To put that in perspective, over an average 20-year lifespan, 100,000 units of nominally sized residential GeoExchange systems will reduce greenhouse gas emissions by almost 1.1 million metric tons of carbon equivalents. That would be the equivalent of converting about 58,700 cars to zero-emission vehicles, or planting more than 120,000 acres of trees.

- The waste heat removed from the home's interior during the cooling season can be used to provide virtually free hot water-resulting in a total savings in hot water costs of about 30% annually, and lowering emissions even further.

*Disadvantages

- The initial cost of purchase and installation can be upwards of $20,000 before any governmental tax credits are applied. Although the lower monthly utility costs will offset this there are "payback periods" associated with the price and savings of a system which can take years.

- Some geothermal heat pump systems that utilize refrigerants can be associated with CFC's and HCFC's causing environmental concerns.

- Since the earth is used as a heat transfer medium which is typically buried, repairs in the piping loop network and be costly and time consuming.

Source : http://me1065.wikidot.com/geothermal-home-heating-and-cooling