

Geothermal Versus Boiler/Tower

Both Boiler/Tower and Geothermal systems use a closed loop, which allows energy that is not required in one area of the building (cooling load) to be moved and used in areas that do require energy (heating load). This design makes water source heat pumps one of the most efficient systems for heating and cooling buildings. For many applications, water source heat pump systems match or exceed the performance of even the most sophisticated VAV system. Geothermal systems provide the following added benefits:



Boiler/Tower

Energy Savings

Geothermal systems vary from traditional boiler/tower systems in that they do not require a boiler or cooling tower, both of which consume electricity or fossil fuel. While at first glance it would appear that the pumping power required to move fluid through the geothermal loop would be much greater, it is actually not if the system is properly designed. Using a variable flow design, which shuts off flow to heat pumps when their compressor is not operating can significantly reduce the pumping power required for the geothermal system.



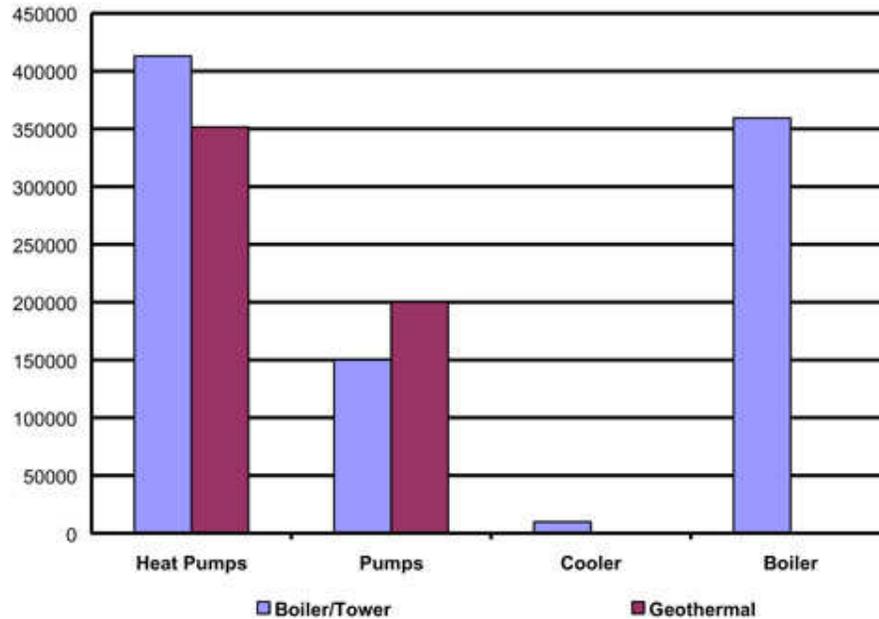
Geothermal (Vertical Loop)

Both Boiler/Tower and Geothermal systems use basically the same heat pump equipment, with a similar COP (Coefficient of Performance) when rated at the same conditions. The difference comes in the design temperature for each system. While it is not unusual for Geothermal and Boiler/Tower summer design loop temperatures to be around 90°F, Geothermal systems can have a winter design condition below freezing (25°F to 30°F) in cooler climates. Most Boiler/Tower systems are designed for 60°F to 70°F. The colder loop temperature, when the system is operating in cooling, will result in better heat pump performance (usually measured as EER or Energy Efficiency Ratio).

However, the real energy savings of a geothermal system comes from part load operating performance. Even in colder climates, heat pumps used in commercial applications operate in cooling most of the time, resulting in a significant part-load operating hours for the heat pumps. This is particularly true for units serving core areas in the building. In a Boiler/Tower system, with a loop temperature of 60 to 70°F, the heat pumps have an EER around 22. Geothermal heat pumps, with a loop temperature of 25°F to 30°F, can have an EER as high as 36.

Evaluating the performance over the entire year requires annual energy analysis. Software tools such as McQuay's Energy Analyzer™ can be used to track the energy consumed by heat pumps in Boiler/Tower and Geothermal systems. The chart below shows annual energy usage for a 160,000 ft² high school in Minneapolis. The Geothermal system uses 60% of the energy used by the Boiler/Tower system. In this case, the savings are over \$13,000/year.

Comparison of Boiler/Tower vs. Geothermal Heat Pumps



Installed Cost

On the average, installation cost for a geothermal system slightly more than a conventional boiler/ tower heat pump system. The important thing to remember is that once installed, the geothermal system requires minimal maintenance and offers superior savings for the life of the system.

Low Operating and Maintenance Costs

Geothermal systems are very easy to install, operate and maintain. Although the initial installation cost may be higher, geothermal systems cost substantially less to operate than comparable boiler/ tower systems. The only moving part in the ground loop is the pump used to circulate the fluid. There are no cooling towers or heating elements to operate, which require energy. Savings as high as 70% for heating and 50% for cooling can be realized with a geothermal system when compared to boiler/tower systems.

In addition, maintenance costs are substantially reduced. Boilers and towers require continuous maintenance to remain clean, free of algae, debris and other contaminants. There is no need for a licensed boiler operator or specialized cooling tower maintenance personnel. There is no need for sump heaters, tower water chemicals and make-up water.

Reduced Mechanical Room Space

Water source heat pump systems generally require smaller mechanical rooms than many other HVAC systems. Geothermal system mechanical rooms are even smaller. Space is only required for the circulating pumps, the main header and some chemical treatment equipment. This frees up more useable space that can be leased to tenants or occupants.