



Ground Source Heat Pumps

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Last week found me at the top table at a conference, having just given one of my “we’re doomed” talks on energy supply to the assembled group. As the conversation flowed around the table, the topic turned to reducing the size of electricity bills that have become a visible marker to the growing problem. Of the eight folk at the table, two had installed ground-source heat pumps, and a third is planning on doing it this summer. Earlier this year, while in Maine, I had a chat with the Bishop* who was considering putting in a system as a means of saving energy (and money) at the church complex.

A couple of years ago I had worked a little on a project that would speed, and reduce the cost, for using vertical wells as the location for the heat transfer pipes, and had given serious thought to putting a system in at home. However in all the cases I have just mentioned the pipes have been laid out relatively horizontally, in three cases in the ground, and in one at the bottom of a pond. With this growing popularity I thought it would be interesting to explain to those of you who don’t know, some of the basics of the concept, while at the same time perhaps drawing better words of wisdom from those of you that have already got systems in place.

Heating and Air Conditioning is, at its most basic, a way of moving heat around. In my search for entertaining bits of video to demonstrate ideas to my classes, last week I watched the “Eat, Drink and Be Merry” episode of Connections 1 by [James Burke](#) in which he demonstrates one of the earliest air conditioning systems, as invented by [John Gorrie](#) in Appalachicola. It gained him the first U.S. patent for mechanical refrigeration, in 1851, and is the basis for most refrigeration systems used to this day. The initial system (which was not a financial success) used the compression and expansion of air as a means of transferring the heat/cold. As a gas expands (caused in this case, by a retracting piston within a cylinder) it draws heat from the surroundings. Thus by setting the expansion cylinder within a vat of brine, the temperature of the brine can be lowered to 26 degF, which was sufficient to freeze water into ice, or chill the air for the medical wards in which it was placed. Although this original system did not catch the public attention it provided the basis for a subsequent development by Ferdinand Carre, who changed the circulating gas/liquid to ammonia, which did catch on. After the gas has extracted heat in one part of the process it will circulate through the system to a point where it can be recompressed, or liquefied, and in this compression, it generates heat.

In its simplest form, therefore, this circuit consists of a part that radiates heat, and a part that radiates cold, with a circulating fluid/gas that moves (pumps) the heat from one to the other. The efficiency of the process is driven, however, to some degree, by the difference in temperature between the event occurring in the circuit, and its surroundings. So that, for example, if I were

using this as a heating system, with the heat generating part inside the house, and the air outside providing the cooling part of the cycle, as the temperature outside drops, so the system becomes less efficient. (Which is why the air source heat pump we currently use is less efficient in winter).

And it is here that the development of the [ground source heat pump](#) comes into its own. By locating the pipes for one of the two heat transfer sections in the ground, or deep enough in a pond that the temperature is relatively constant, then a relatively stable temperature source can be formed. With the pipes long enough the circulating fluid will stabilize at the temperature of the surroundings, before being returned to the unit in the house. There, depending on the time of the year, it can be used as a source for air conditioning, or as a source for heating in the winter.

The piping system that goes into the ground can be mounted either horizontally (though it needs to be deep enough to be beyond surface temperature variations), or vertically, or it can be mounted underwater. Systems can also either circulate fluid in a closed pipe system, or can be open in which case they can draw water from a pond/lake/river and transfer heat either to it or from it, before piping it back into the source. The system is claimed to be much more efficient than other heating and cooling systems, the [international ground source heat pump association](#) stating:

The GSHP is one of the most efficient residential heating and cooling systems available today, with heating efficiencies 50 to 70% higher than other heating systems and cooling efficiencies 20 to 40% higher than available air conditioners.

. One of the folk at the table talked of having his electric bill cut by more than half.

Now here is the rub, because on my way back from the meeting I gave a fair amount of thought to possibly changing our system. But, over the years we have spent a considerable effort in insulating the house, and, as I mentioned the other day, use a wood-fired [tile stove](#), or [masonry heater](#) in the winter, which keeps us warm with relatively little wood, and leaves us, even in the coldest months, with an electricity bill that is less than \$300. We live on land that is better for raising rocks than vegetables (there is not a lot of soil cover) so that it seems more practical to look at the vertical pipe version rather than a horizontal layout (and our yard isn't that large). The cost of vertical systems, so I was told, runs up to over \$10,000 – which does not seem out of line with the numbers that [DOE provide](#), albeit for a much larger system than I would need.

Putting these thoughts together it would seem to suggest that my return on such an investment, would be at most \$700 to \$800 a year in reduced power bills, and while I recognize that power costs will go up, I am not sure that it will be a wise move at this time. But I will continue to look into the idea, and garner more detailed costs – and certainly would appreciate any advice/experience that folks out there might offer.

There is one slight additional thought you might want to consider, the Actress* woke me the other day with an appropriate track from the Beatles [Sgt. Pepper's Lonely Hearts Club Band](#) album, suggesting that our remaining tenure at this place may be a little time challenged.

* For those that wonder at the possible ecclesiastical name dropping, I should mention that I have given family members the same sorts of pseudonyms that I have graced myself with, and so my connections are not, at least yet, that eminent.



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