Geothermal Heating and Cooling Systems: Will They Work for You?

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Our adventure (my wife and I) with the replacement of our two traditional air source heating ventilating and air conditioning systems (HVAC) with two, closed loop, ground source, geothermal heating and cooling systems began in the summer of 2008. The two traditional units we were contemplating replacing were independent of each other and were located on either side of our home. Each unit handled one half of the home’s heating and cooling needs. Each unit was rated at 3.5 tons for a total of 7 tons of HVAC.

One of our existing air source units was rated as 14 SEER (Seasonal Energy Efficiency Ratio) and the other as a 12 SEER. Newer replacement units claimed ratings of 16 SEER. The higher the SEER, the more efficient and costly the unit. Each of these systems consisted of an air handling unit located inside the home, and a supporting air source condensing unit located outside the home. Replacement with geothermal units means replacing both existing air handlers with air handlers designed to work in a geothermal environment, and their matching condensing units with a closed loop, in-ground cooling/heating system.

The geothermal units cannot be given a SEER rating since the cooling/heating medium is earth and not air. Geothermal units are rated EER (Energy Efficiency Ratio) for cooling and COP (Coefficient of Performance) for heating efficiency. Though a direct comparison between ground source systems and air source systems cannot be made, we were satisfied that the ground source geothermal system we installed would be comparable to a SEER rating of 24 to 30.

One of the original HVAC Units was listed as being in critical condition, and not long to benefit from further life support. The second unit was in better shape but was getting up in years. The replacement of the original units with similar technology was not going to get us where we wanted to be with reducing the energy consumption of our all-electric home.

Changing our existing HVAC systems over to the much more efficient geothermal heating and cooling systems seemed the right thing to do. The obvious difference between our traditional HVAC systems and the geothermal systems is that the traditional condensing units (the mechanical unit that exchanges the heat/cold from inside the home) with the air outside the home is replaced by a network of underground, high-density polyethylene tubing that carries the heat/cold water under ground for temperature absorption/dissipation. The transfer of the heat/cold from inside the home now takes place in the earth adjacent to my home.

Our new systems now consist of two air handling units designed to support the geothermal system (one located at either end of my home and replacing the current traditional HVAC air handling units), and one underground, non-mechanical, heat/cold transfer system serving the two new geothermal air handlers. One of the two new air handlers incorporates a heat recovery unit. More about the heat recovery unit later.
Geothermal heating and cooling systems can be designed to operate with closed loop, open loop, vertical, or horizontal heat/cold transfer layouts. Each has advantages and disadvantages.

The closed loop vertical system best met our needs. The layout (which I will refer to as the “well-field”) consisted of 18 vertical, 4-inch diameter borings – each 70 feet deep and spaced 10 feet apart. The layout is flexible and can be tailored to fit various sizes and shapes of yards. The number and depth of the borings were calculated to properly support the heating and cooling needs of the two, new, 3-ton air handlers. Note: The increased efficiency of the geothermal system allowed us to reduce the total capacity needed for our household from 7 tons to 6 tons.

We had the well-field sized and built to handle the replacement capacity of both of our air source units, even though we could only afford to replace them one at a time. We did not want to have the well drillers come back a second time when our second air source unit needed to be replaced.

Tell the neighbors not to worry about the appearance of your yard as a result of the drilling work. Your yard will look shabby for several weeks. However, when the work is completed, the yard will return to its previous condition.

A loop of high-density polyethylene tubing is placed in each boring and is fused (no possible leaking joints to worry about) together into a system that allows for the circulation of the cooling/heating water flowing from the air handlers to the well-field. The earth surrounding the high-density polyethylene tubing provides for the transfer of heat/cold from the home via the indoor air handlers. The ground temperature is relatively constant and works very well for both heating and cooling purposes at installations throughout North Florida. Each of the two air handlers works independently of each other, and makes use of the entire well-field as needed.

The water circulating in the well-field/air handlers is part of a sealed, self contained, re-circulating system and therefore does not require a continuing supply of fresh water.

The well-field is quite durable and can be driven over, parked on, mowed over, paved over or planted in trees or shrubs. The company drilling the borings provided us with a locator map of the borings in case we need a future location ID for trenching or planting purposes.

**Heat Recovery Component**

The first geothermal unit we installed (September 2008) came equipped with a heat recovery component built into the air handler unit. The purpose of the heat recovery unit is to use energy derived from the geothermal unit to heat water in the home’s hot water heater. The heat recovery unit was therefore connected up with the hot water heater.

This feature allowed for the dissipation of heat generated during the geothermal air handler heating/cooling operation to be used to facilitate our year-round hot water heating needs, and allowed us to turn off the heating elements in the tank that were normally used to maintain our hot water supply. This energy saving function was in addition to the energy savings provided by the more efficient geothermal unit.
Heat Strips

This new geothermal unit also came \textbf{without} heat strips. Heat strips are energy consuming components added to traditional air source HVAC systems and are designed to provide auxiliary heat for cold weather operation. The efficiency of the geothermal unit negated the need for heat strips.

Efficiency Comparisons

The new geothermal unit operating on one side of our home and the original air source HVAC unit operating on the other side of our home gave us an opportunity to compare the efficiency of the two units.

**Running Amperage:** These measurements were taken on the same day while the units were operating in their cooling cycle.

- The remaining air source 14 SEER HVAC unit registered a running amperage of 13.5.
- The running amperage of the new geothermal unit was 7.

**Energy Consumption:** A home energy auditor conducted an energy audit of our home.

- The auditor reported to us that the new geothermal unit was consuming one fourth the energy of the remaining traditional air source unit.

We were conflicted at that point, because we needed time to gather funds to replace the second unit, but at the same time were anxious to finish converting our home to a 100% geothermal heating and cooling system.

Comparing Monthly and Annual Kilowatt Consumption

Using data from past utility bills, I was able to develop a chart of our past kilowatt hour consumption – monthly and annually for the last 5 years. Monthly and yearly comparisons clearly indicate a substantial reduction in kilowatt consumption from a maximum of 19.61\% to a low of 10\%. Extra hot summers and extra cold winters make comparisons difficult, but there is no doubt the geothermal unit is living up to our expectations.

Completion of our home’s conversion to a 100\% Geothermal System took place in February of 2010 with the replacement of our remaining air source HVAC unit.

Cost/Cost Benefit

The replacement of two, 3.5 ton each, older air source HVAC units with similar technology would cost up to $7000.00 each depending on the quality of the units. Moving in that direction would
leave our energy consumption at the status quo and would ignore the obvious future impact of increasing utility bills. We decided to pay now and save later.

The cost of installing the closed loop well-field with a 6 ton capacity suitable to accommodate the replacement of both of our air source HVAC units was just short of $11,000.00

The cost of replacing one of our air source units depended on the selection from available brands and models of geothermal units and what features we wanted the units to include. That provided for a wide cost range. Our more expensive unit (the one with the Heat Recovery feature) cost almost $11,000.00. You would have a hard time exceeding that figure should you commit yourself to geothermal technology.

We were able to file for an IRS Tax credit of $2,000.00 under “qualified geothermal heat pump property costs” when filing our 2008 taxes. This credit was based on our costs for installing the well-field and purchase of our first geothermal unit in 2008. We plan to make use of that tax credit again in 2010 to offset the purchase of our second geothermal unit.

Check with your CPA as to how this Tax Credit might work for you.

Do we feel our conversion to Geothermal was the right thing to do? Absolutely!