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Swedish geothermal is smarter than ours

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Last summer, I was fortunate to join the U.S. Department of Labor on an alternative energy tour of Sweden. I was joined by several university professors and U.S. government officials concerned about rebuilding the American manufacturing economy. The U.S. Ambassador to Sweden arranged for us to meet with a collection of Sweden's top alt energy entrepreneurs.

During those meetings, I was astounded at the range of clever inventions and resulting new businesses created by these entrepreneurs. I was amazed to learn how rapidly this wave of alt energy entrepreneurship is spreading throughout Europe, into the Former Soviet Republics, and now across Asia. So much of this wave entails relatively simple, elegant inventions that are streamlined and perfected to the point where they are, for the first time, affordable by many. Low-hanging fruit, so to speak. The King of Sweden's biogas plant in Flint is one of the many exciting examples in this regard. American inventors have some catching up to do.

I was especially impressed with one company, the Scandinavian Energy Efficiency Company or SEEC (www.seec.se), which has an intelligently-designed geothermal heating and cooling system for homes, large buildings, and industrial operations that use a tremendous amount of heat. Before discussing this invention, let me briefly mention the big benefit of ground source heating and cooling: it's cheap to operate. No heat is created, because the system simply moves (pumps) heat from one location to the next. As a result, energy costs only involve operating electric pumps and fans (which are cheap to operate). However, installation costs tend to be large, mainly because much soil excavation is required.

The Scandinavian Energy Efficiency Company has a clever technology that overcomes this problem. Instead of excavating large amounts of soil, it uses an array of ten or more boreholes that are drilled several meters into the soil. The genius of this method is this: it uses a computer to efficiently store and retrieve energy from the borehole array. Summer heat is efficiently stored in the soil for retrieval in winter. Winter cold is efficiently stored in the soil for retrieval in summer. Operating costs are significantly reduced.

Here's how it works. Inside each borehole is a plastic pipe filled with an alcohol-water liquid that is environmentally friendly and does not contact soil. This liquid is pumped between each borehole and into a heat pump located inside the building to be heated and air-conditioned. At first glance, the design looks very similar to ordinary US geothermal heat pump technology involving the use of soil boreholes.

What sets this method apart is its intelligent use of a computer to reduce the overall cost of operation. In essence, a computer reads the temperature of each borehole and uses that information to systematically switch on and off different boreholes at different times of the year.

The boreholes are laid out in an array of concentric circles. At the beginning of summer, boreholes in the center of the array are turned on, allowing solar heat to be stored efficiently in a small volume of soil located at the center of that array. Throughout the summer, soil at the center of the array climbs in temperature. When it reaches a critical maximum temperature, the outermost boreholes in the concentric array are turned on by the computer. In this manner, a larger and larger volume of warm soil grows in size as more and more hot summer days accumulate. By the end of summer, the system stores tremendous heat energy in small volume of soil: much smaller than that required in a traditional US ground source heat pump.

In essence, an efficient thermal battery is created in a small volume of soil that doesn't require costly excavation.

When winter arrives, the stored warmth in the soil is efficiently pumped into the house by computer control. By the end of the winter, the system pumps cold fluid into the boreholes, thereby creating a battery of cold soil around each borehole. Boreholes in the center of the array are filled up first. As the winter progresses, the outermost boreholes in the array are turned on, and a battery of cold soil grows in size. The soil remains cold until the summer, at which time the computer uses that cold soil temperature to efficiently air condition the house.

I believe this breakthrough technology will have a bright future. It's all about efficiently storing (solar) heat in a small volume of soil in the summer; and then efficiently retrieving that energy to heat your home in the winter. It's all about efficiently storing cold temperatures in small volume of soil in the winter; and then efficiently retrieving those cold temperatures to air condition your home in the summer. In the end, it's all about smart technology that reduces operating cost.

At its core, the technology involves a smart marriage between currently available ground source heat pump technology and the smart use of algebra to predict the movement of heat through soil. It's a lesson all American students of engineering and HVAC (heating, ventilating, and air conditioning) can master. I believe doing so will result in the formation of new businesses here in Michigan.