

## Geothermal Heat Exchange Provides Lower Utility Bills & Reduced Emissions

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The most unusual place to harvest energy from the sun is perhaps also the most effective and efficient – underground. Earth absorbs nearly 50 percent of the sun's radiation that reaches the surface and stores it as heat that can be used to warm up or cool down homes and other buildings – without polluting the environment. All you have to do is exchange it between subterranean sources and the surface with a mechanical device called a geothermal heat exchange (GHX) system.

According to the Department of Energy, GHX systems use 25 to 50 percent less electricity to operate than conventional natural gas and electric HVAC systems and move three to five times more energy than the electricity they consume because they are extracting it from the ground. The aggressive deployment of GHX in the U.S. could save \$30-40 billion in energy costs annually while greatly reducing greenhouse gas emissions, according to Richard Butler of EnLink Geoenergy Services in Rancho Dominguez, Calif.

Butler outlined the design, installation and workings of GHX systems during a public workshop held at the California Center for Sustainable Energy in San Diego, Calif. He said that although GHXs are more costly to install than traditional HVAC systems, the additional up-front costs are returned in energy savings in five to 10 years. GHXs have lower operating costs because they take advantage of “the only renewable energy resource that is available everywhere, on-demand, and that cannot be depleted.”

### Moving the Heat

Using geothermal sources for heating and cooling is not the same thing as geothermal power or even geothermal heating, both of which have to do with geologically hot rocks that produce heat used to generate electricity or to heat a building. Instead, a GHX system takes advantage of the fact that a few yards below the earth's surface the ground remains at a relatively constant temperature, generally from 45°F to 75°F depending on the location's latitude.

A GHX extracts ground heat in the winter (for heating) and transfers heat back into the ground in the summer (for cooling). There are two major components – an earth heat exchanger that is buried underground and a geothermal heat pump located inside a building.

The heat exchanger is basically a loop or a series of loops of polyethylene plastic tubing buried underground through which either water or an antifreeze solution is pumped. Tubing can be installed

horizontally in trenches or vertically as a series of U-shaped wells. Some systems employ copper tubing and a refrigerant to capture the heat.

Depending on the location, soil conditions and other factors, the heat exchanger may be a few yards to a couple of hundred feet deep. Because digging and drilling is costly, the heat exchanger accounts for a third to a half of GHX costs.

The geothermal heat pump is the central handling unit for the GHX system and acts much like a standard HVAC system. The heat exchanger fluid circulates through the heat pump where an electrically driven compressor and a heat exchanger concentrate the earth's heat energy and release it inside the home at a higher temperature.

In summer, the process is reversed with the underground loop drawing excess heat from the house and allowing it to be absorbed by the earth. The system cools in the same way that a refrigerator keeps food cool – by extracting heat from the interior, not by blowing in cold air, Butler explained.

### **Benefits of GHX**

Direct-exchange geothermal heating and cooling systems have been around for more than 60 years and became popular in Sweden in the 1970s. Their use has spread worldwide since then, with about 80,000 systems installed annually in the U.S. In addition to lowering energy costs and nearly eliminating onsite greenhouse gas emissions, GHX systems offer energy efficiencies between 300 to 600 percent, according to Butler.

“For every kilowatt of electricity consumed by a GHX system, it can deliver three to six kilowatts of energy to heat or cool your facility,” Butler said. “This translates to using 40 to 70 percent less energy than conventional HVAC systems. GHX systems are a sound investment with a guaranteed payback.”

Financing a GHX system is made easier because they are considered renewable energy and energy efficient technologies, making them eligible for incentives from multiple sources. Federal, state and local governments, as well as many utility companies, offer rebates for GHX projects.