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Geothermal Heat Pump: A New Energy Efficiency Technology as Old as the Hills

by Mark Mizrahi, President and CEO of EnLink Geoenergy Services

One of California's greenest energy resources actually tends to be more brown than green, but it is available in virtually every part of California and can help cut electricity costs as well as operations and maintenance costs.

It's called geothermal heat pump technology, and it uses the power of the earth to heat and cool buildings, and it can supply hot water, as well. You could call it a new energy efficiency technology that's as old as the hills.

Many people have heard of geothermal energy, but they usually think of deep holes in the earth where water is poured over hot rocks and turned into steam, which then rises up to the surface to spin turbines that make electricity.

That is NOT the kind of geothermal energy we are talking about here.

Geothermal heat pump technology works because just a few hundred feet below the earth's surface, temperatures are relatively constant. Heat pumps — a form of refrigeration technology that can cool things off or heat them up — use the differential between the temperature below the surface and the ambient temperature outside. This technology has been around a long time, is very well understood, and is in use all over the United States today.

Heat pumps are a conventional technology considered to be a more efficient way of heating or cooling a building. When you couple a heat pump to the earth through a geothermal heat exchanger it becomes super-efficient.

With the current push for more energy efficiency in the west, particularly in California, we are beginning to understand the amazing potential this simple GHP technology holds.

Here are two GHP projects recently completed in California:

City College of San Francisco

While planning for the construction of five new buildings, totaling 318,700 ft² for the district's Ocean campus, the district decided to use GHP to heat and cool all five buildings. One of the criteria for the project was to achieve LEED Platinum Certification and the best way to reduce the buildings' energy use was by integrating the GHP.

The first of those buildings to open was the 110,000 ft² joint-use building, which includes classrooms meeting space, and administrative offices. In addition to the joint-use building, the project will include a performing arts center, advanced technology center, bookstore, and additional classrooms. The entire site has been pre-drilled and the piping is in place to serve all five buildings as they come on-line.

The district expects an approximate energy-cost savings of \$101,000 annually, and \$3.5 million over the life of the project.

Some specifics for the system are:

HVAC System Capacity

Joint use building - 200 tons

Entire project - 650 tons

Ground Heat Exchanger

Vertical loops - 400

Borehole depth - 400 feet

Estimated Annual Costs, all five buildings - GHP

Energy - \$85,000

Maintenance - \$37,000

Water* - \$0

TOTAL - \$122,000

Estimated Annual Costs, all five buildings - Traditional HVAC

Energy - \$145,000

Maintenance - \$74,000

Water - \$4,000

TOTAL - \$223,000

Total Project Savings with GHP**

Annual - \$101,000

Lifetime - \$3.5 million

*GHP eliminates the use of water used for evaporative system cooling.

**Savings could be significantly higher with the addition of a Cap and Trade system or some other means of pricing carbon.

American Canyon High School

American Canyon High School is a newly-built 260,000 ft² high school in Napa Valley, California. Architects and engineers designed the campus to be one of the first Collaborative for High Performance School (CHPS) certified schools in the country. CHPS is a building rating system similar to LEED, but is intended for educational institutions.

CHPS certification is awarded to energy and resource efficient schools that possess a healthy environment and beneficial amenities for a quality education. One of the key contributing factors to the high school's CHPS certification is the Geothermal Heat Pump System (GHPs).

An operational cost analysis on the GHPs shows an annual savings of \$130,000 when compared to the operation costs of a conventional heating and cooling system.

Some specifics of the project include:

Building Size

All buildings - 260,000 ft²

Ground Heat Exchanger

Vertical loops - 285

Borehole depth - 350 ft

Electric Service Demand

Heating/Cooling - 200 tons

Annual Energy Use

GHPs - 1.6 million kWh

Traditional HVAC - 2.7 million kWh

Savings with GHP - 1.1 million kWh

Annual Energy Costs

GHPs - \$289,000

Traditional HVAC - \$377,000

Annual O&M Costs

GHP O&M - \$21,000 annually

Traditional HVAC O&M - \$63,000 annually

Total system savings with GHP

Annual Energy Savings - \$88,000

Yearly O&M Savings with GHP - \$42,000

Annual cost savings - \$130,000

Lifecycle savings - \$4.5 million

Clearly, GHP technology should be on the short list of HVAC systems being considered for just about any commercial or institutional construction project. It will help meet our goals for reducing energy use, adds LEED certification points and will make your building more valuable over a longer period of time because of its simple operation and long life expectancy.*GHP eliminates the use of water used for evaporative system cooling.