

# High-Profile Blog

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## The Real Cost of Going Green with Geothermal Energy By Bruce Fairless, PE, Associate Principal, GZA GeoEnvironmental, Inc

While every business would happily bear the designation of an environmentally friendly company, the bottom line has to be cost. Quite simply if the numbers don't add up it may not be in the company's best interest to "go green." The basic investment in a geothermal HVAC system is much more expensive than traditional HVAC system; however there are a great many variables that can change the final numbers.

Basically, geothermal systems make use of heat energy captured from the earth using ground-source heat pumps (GSHPs) in building applications. Using water source heat pumps, in conjunction with the ground as a heat exchanger results in a highly efficient system that can both heat and cool spaces, depending on the season. The geothermal heat pump system can be either a closed or open loop piping system. Closed loop geothermal systems consist of pipes that carry the heat exchange fluid—an environmentally safe water-antifreeze mix—into the ground to be heated or cooled, and then run directly back to the heat pump for conversion. Open loop geothermal systems are different in that they use groundwater as the refrigerant drawn to the geothermal heat pump.

Large commercial buildings and schools often use vertical closed loop systems because the land area required for horizontal loops would be prohibitive. Vertical loops are also used where bedrock is too shallow for easy trenching, and they minimize the disturbance to existing landscaping. For a vertical system, boreholes (approximately six inches in diameter) are drilled about 20 feet apart and 300 to 500 feet deep. Into these holes go two pipes that are connected at the bottom with a U-bend to form a loop. The vertical loops are connected with horizontal pipe (i.e., manifold), placed in trenches, and connected to the heat pump in the building.

While the upfront cost can appear prohibitive, many factors can come in to play that make it worth a look. A case in point, I recently completed a geothermal feasibility study for a proposed big-box retail store in Somerville MA. The building was already designed using conventional heating/cooling technologies. However, we were asked to evaluate the feasibility of installing GSHP, with particular attention to payback. We performed a conceptual cost estimate of the installation and potential savings. Installation costs would be about \$3M. Annual energy savings are estimated to be about \$100,000. A simple payback calculation gives a payback of 30 years, which is too long for a commercial enterprise. However, it does not take into account the likely energy cost escalation and potential financing, which can reduce the payback period. If the energy savings is greater than the cost of financing, then the payback is immediate. To finance \$3M at an annual financing cost of \$100,000 (so that financing cost equals energy savings) would require a loan rate of about 3.3%. I believe if a loan was available at around 3 or 4 percent then my client would find such a GSHP installation attractive.

Another payback factor is energy escalation. If the energy cost inflates each year then the payback period on the fixed investment decreases because the energy savings increases. For example, if energy costs increase on average 5 percent over the next ten years, energy cost savings would be \$163K per year after 10 years. This savings would service debt for a 30 year loan at about 4.3 percent. Hence, one could argue that payback occurs when the debt service costs are exceeded by the energy savings.

A business should also take into consideration the Green Building Rating System administered by the United States Green Building Council. Building to Leadership in Energy and Environmental Design (LEED) standards can lower a company's operating costs, earn tax credits and incentives. One entire section of the LEED rating system focuses on energy efficiency. Utilizing a geothermal system has the potential to gain multiple points in this category.

Federal Commercial Geothermal Tax Incentives include 10 percent of total GSHP system cost with no limit to total credit amount. It can be used to offset AMT tax, be combined with solar and wind tax credits, and be used in more than one year. A 10 percent grant is available in lieu of tax credit. The building must be located in U.S. and be installed between October 3, 2008 and December 31, 2016. The Modified Accelerated Cost Recovery System (MACRS) provisions of the federal tax code give businesses the opportunity to recover investments in solar, wind, and geothermal systems by taking depreciation deductions over an accelerated 5-year period.

In Massachusetts, purchases of equipment directly relating to photovoltaic, wind, solar thermal or geothermal systems are exempted from the state sales tax if they are to be used as a primary or auxiliary source of energy for heating or otherwise supplying the needs of a person's principal residence in the state. A good place to start understanding incentives for using geothermal is the website [www.dsireusa.org](http://www.dsireusa.org).

Commercial use of geothermal systems in Massachusetts is indeed growing. The Noble and Greenough School in Dedham installed a geothermal system in 2007. Projected savings for the middle school are \$17,000 a year. Although the system cost \$723,000 (about \$100,000 more than a conventional HVAC system) the additional first costs will be recouped in six years.

In March 2008, Boston-based nonprofit Hebrew Senior Life announced it was investing \$4 million to dig 408 geothermal wells that will be 500 feet deep each and will heat and cool its new facility, NewBridge on the Charles, a 1 million-square-foot housing and mixed-use campus on 162 acres in Dedham. At the time they expected to save 20 percent annually over operating a fossil fuel system. In five years, savings were projected at \$400,000 annually, and in 10 years, a \$700,000 annual savings.

As federal and state incentives stay in place, "going green" remains a viable option for businesses reducing their costs and carbon footprint, and enhancing their reputation. Geothermal energy systems are recognized as one of the most efficient heating and cooling systems on the market and promise real savings to businesses, organizations and private homes while delivering real benefits to the environment.

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