DIGGING DEEP: Harnessing the earth's solar energy

Discussion about renewable power sources such as wind and solar energy remains robust. However, one sustainable resource – geothermal energy is often either downplayed or overlooked. This paper looks at the prospects and challenges that geothermal energy brings for businesses and residents in the Commonwealth of Massachusetts.

What is geothermal energy?

There are two distinct types of geothermal energy. The first relies on the earth's natural heat, where below the earth's crust the decay of radioactive elements heats the earth to over 1,600 degrees Fahrenheit. This heat can be tapped to produce steam to generate electricity or to produce hot water for direct heating of buildings. In the United States, most of the areas with the ability to harness this power are located in the West, notably Idaho, Montana, California, and Colorado. Additionally, Hawaii, with an abundance of volcanic activity, is also able to harness this energy to generate electricity. Given our local geology, this type of geothermal energy cannot be tapped or harnessed in Massachusetts.[1]

The second type of geothermal energy, and that which is available in Massachusetts, comes from utilizing the stored solar energy located within a few hundred feet of the earth's surface. By employing geothermal heat pumps (GHPs), this energy can be used to heat and cool buildings as well as to supply domestic hot water – thus relieving the building from needing to rely on other fuel sources such as natural gas, heating oil or propane.

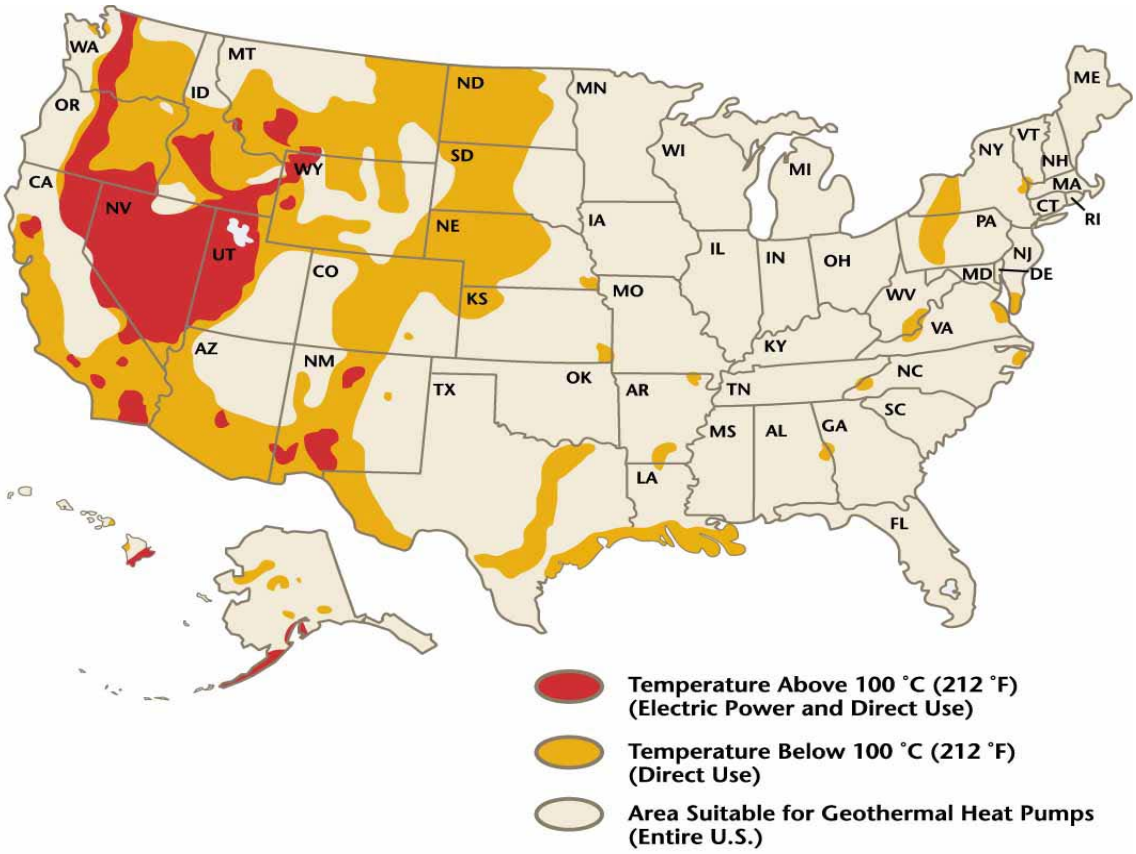
Geothermal systems collect the earth's constant 50-degree temperature through a series of pipes in the ground, usually 150 – 600 feet deep, and then use a compressor and heat exchanger to concentrate it for heating or cooling. Ducts and fans are used to circulate the hot or cool air through the building. A GHP unit is much quieter and compact, than a conventional system and, due to the moderate temperatures here in the northeast, GHPs require minimal electricity to run.

[1] U.S. Department of Energy. U.S. Geothermal Resource Map: http://www1.eere.energy.gov/geothermal/geomap.html

The geothermal potential.

Although geothermal power currently supplies less than one percent of the nation's total electricity supply, [2] there is great potential to harness geothermal heat pumps for heating and cooling.

GHPs are used in all 50 states today, with great potential for near-term market growth and savings. In fact, the entire United States is suitable for GHP use.



The Nation's geothermal resources represent a huge and viable energy resource, providing the U.S. with various ways to use them and enhance national security, and economic and environmental health. [3]

The Massachusetts Department of Environmental Protection has set guidelines for ground source heat pump wells. The document can be found in both Word and PDF at http://www.mass.gov/dep/water/laws/uic.htm.

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[2] "The Future of Geothermal Energy – Impact of Enhanced Geothermal Systems (EGS) on the United States in the 21st Century," Report prepared by MIT
http://www1.eere.energy.gov/geothermal/geomap.html

[3] "Geothermal: The Energy Under Our Feet," November 2006, Bruce Green and R. Gerald Nix, National Renewable Energy Laboratory

Geothermal in Massachusetts

Geothermal energy is being put to use locally by North Andover, Mass-based Nexamp, a Mass AREA member, and an energy and carbon reduction systems integrator that designs, builds, and maintains clean energy systems.

As part of its energy systems, Nexamp provides residential clients with geothermal heat pumps that are designed and installed to maximize energy savings, ensure thermal comfort, and reliability. Nexamp systems are expected to pay for themselves in less than eight years.

For example Nexamp estimates that for a 2,000 sq ft house with an existing forced hot air oil furnace and ductwork, a GHP system has an estimated project cost of $28,400 and a life expectancy of 25 years. Assuming one accesses the 30 percent Federal Tax Credit for GHP systems (see details below), the lifetime savings would be $159,905, a payback period of just over 8 ½ years and an annualized return on investment of 14.9 percent [4]

Geothermal well drilling in process. Photo courtesy of Nexamp.

Commercial use of geothermal systems is also 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.

The MassInnovation Center, Fitchburg, MA, a 400,000 square foot complex on the site of the former Anwelt Shoe Co boasts one of the largest solar roofs in New England and a geothermal exchange system for heating and cooling, thereby lowering utility costs for tenants, reducing their carbon footprint, and improving local air quality.

In March 2008, Boston-based nonprofit Hebrew SeniorLife 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. [5]

[4] Assumptions: existing oil furnace is 80% efficient, $3.00 a gallon of oil and fuel prices rise 10% a year

[5] http://hebrewseniorlife.reachlocal.com/coupon/?scid=1137146&cid=343872&tc=09060809512285859&kw=4930957&dynamic_proxy=1&primary_serv=hebrewseniorlife6.reachlocal.net&pub_cr_id=2806612732

Last November, Shawmut Design and Construction completed the renovation of historic Byerly Hall at Harvard University's Radcliffe Institute for Advanced Study. The complete renovation included the drilling and development of five geothermal wells. Four wells reach 1,500 feet below grade; a fifth reached 600 before groundwater forced crews to cease drilling. As a result of this challenge, Shawmut's team devised an innovative hybrid system of operation for the vents, which utilize both "closed" and "open" styles of geothermal well operation.

Incentives – Federal and State

Recent changes in Federal law contain long-term tax incentives to encourage the use of geothermal heat pumps in homes and businesses. In October 2008, geothermal heat pumps were added to section 25D of the Internal Revenue Code.

Federal residential geothermal tax incentives include 30 percent of total GHP system cost, with credit limited to $2,000 for 2008. There is no limit to credit amount from 2009 to 2016. The credit can be used to offset AMT tax, be combined with solar and wind tax credits and be used in more than one year. In order to be eligible, the home must be located in the U.S. and includes houses, apartments, condos, and mobile homes. It does not have to be the primary residence. The GHP system must meet Energy Star requirements and be installed between January 1, 2008 and December 31, 2016.

Commercial Geothermal Tax Incentives include 10 percent of total GHP 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.[6]

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. More information can be found here: M.G.L. c. 64H, sec. 6(dd)[7]

Businesses that invest in solar or geothermal energy systems but elect not to claim the Corporate Production Tax Credit (PTC) are eligible for a tax credit of up to 10 percent of their investment. The maximum annual credit is $25,000, plus 25 percent of the total tax remaining after the credit is taken. Remaining credit may be carried back to the three preceding years and

[6] http://www.climatemaster.com/index/tax-information

[7] http://www.masstech.org/cleanenergy/cando/financing.htm

then carried forward for 15 years. Installations financed in whole or in part by the Massachusetts Technology Collaborative or other tax-advantaged sources are eligible for credit on a pro-rated basis.[8]

Conclusion

With the incentives in place, geothermal systems are more obtainable from a price perspective than they were in the past. More importantly, this clean energy option for heating, cooling and domestic hot water could contribute significantly to reducing the growing energy needs of Massachusetts residents and businesses thus reducing our dependence on imported fossil fuels and leading to a cleaner environment.

[8] http://www.masstech.org/cleanenergy/cando/financing.htm