Affordable Geothermal Heating and Cooling

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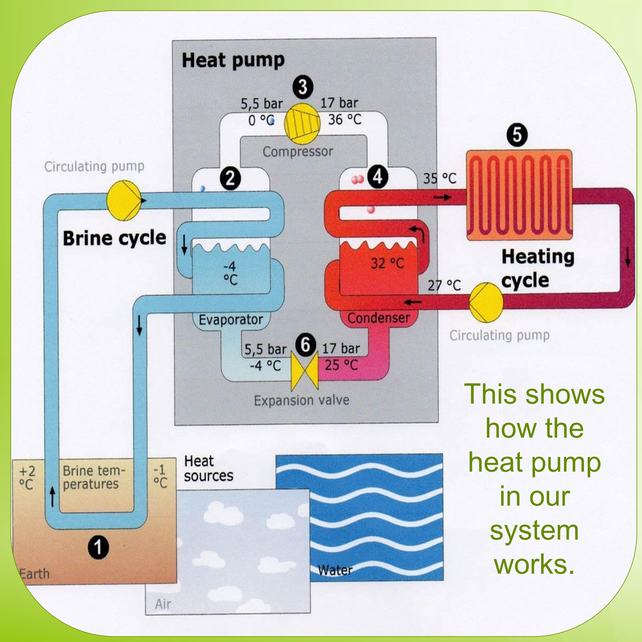
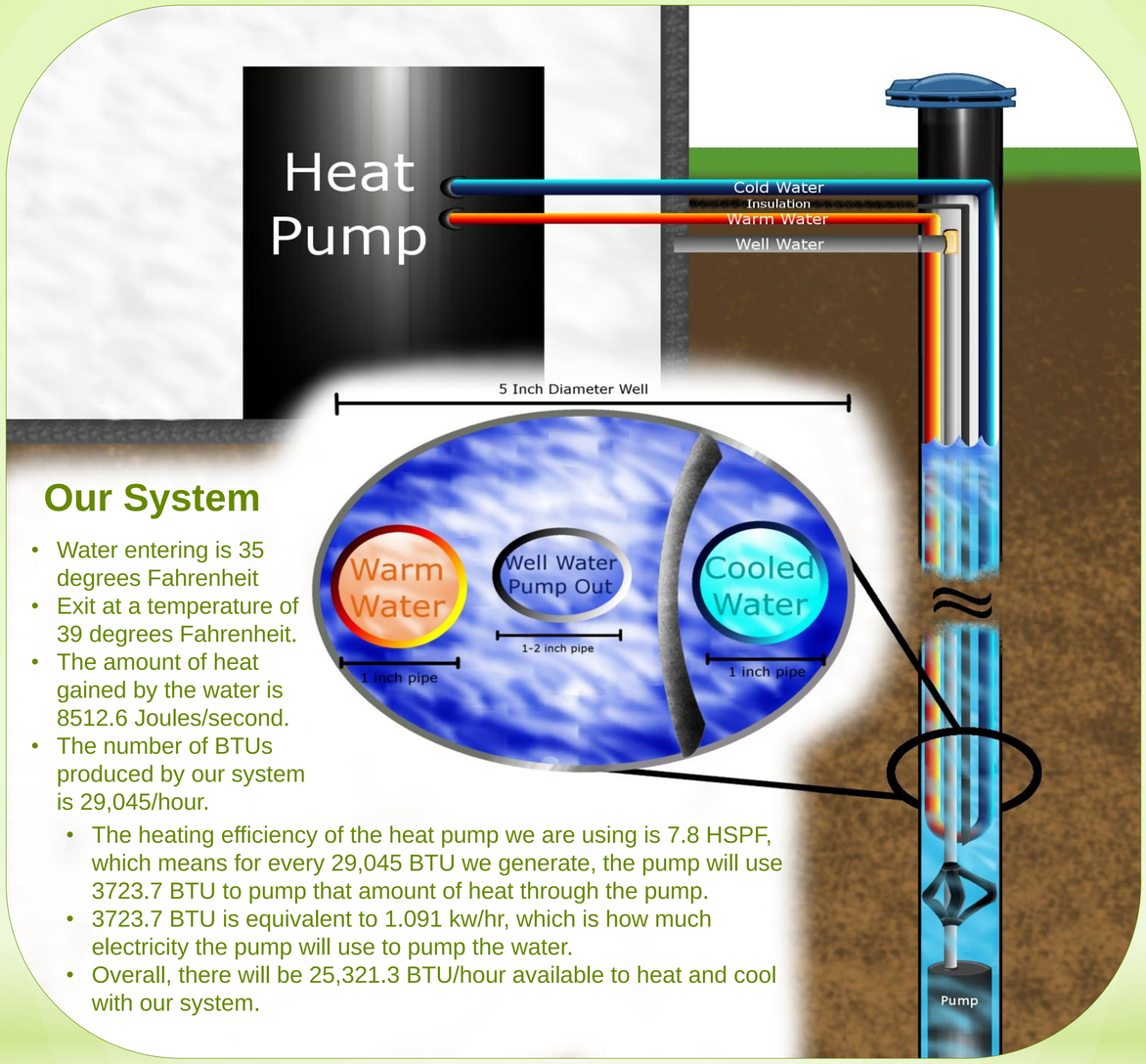
Abstract

Our goal is to lower the peak electricity demand of the northeast grid through the use of a geothermal home heating and cooling system. We will do so by targeting homes in the northeast furnished with preexisting wells through which the geothermal systems will be retrofitted. In turn, the large excavation cost of a home geothermal system will be greatly reduced, if not eliminated, and correspondingly, the peak electricity demand will drop.



This shows how the heat pump in our system works.



Our System

- Water entering is 35 degrees Fahrenheit
- Exit at a temperature of 39 degrees Fahrenheit.
- The amount of heat gained by the water is 8512.6 Joules/second.
- The number of BTUs produced by our system is 29,045/hour.
  - The heating efficiency of the heat pump we are using is 7.8 HSPF, which means for every 29,045 BTU we generate, the pump will use 3723.7 BTU to pump that amount of heat through the pump.
  - 3723.7 BTU is equivalent to 1.091 kw/hr, which is how much electricity the pump will use to pump the water.
  - Overall, there will be 25,321.3 BTU/hour available to heat and cool with our system.

About Geothermal

- The earth's core has a constant temperature of about 12.7 degrees Celsius (55F). This constant temperature can be used for heating and cooling.
- Geothermal energy is extracted from this constant temperature though the use of thermal loops.
- These thermal loops are made up of pipes filled with some form of fluid from which energy is drawn from, for either heating or cooling.
- For a cooling system warm air is passed over these cooled pipes in a heat exchange. In a heating system a conventional heat pump is often used.
- Geothermal heat pumps can extract heat energy from any fluid however the warmer the liquid the more efficiency the heat pump is.

Results/Outcomes

- Our System **requires 1.091 kw/hr** of electricity from the grid to run and **produces 7.42 kw/hr** for heating and cooling.
- Equates to a maximum of 65,043 kw/year from our system.
- System only needs to run 21% of the time and **requires 1873.31 kw/year** to run
- Total **cost of $337.20** a year for heating and cooling in the year compared to $2502 for an electric heating and cooling system.
- **Save $2164.80 a year!**

- **12,026.69 kw/hrs** saved per year per house.
- If every house used this system for heating and cooling about **2.3 MW of energy is saved** on the New England energy grid reducing carbon emissions by approximately **5322 kilotons of CO2 each year.**

Cost Estimates

Cost	Our System	Current Geo System
Heat Pump	$7,000	$7,000
Tubing	$2,000	$3,000
Excavation	$500	$9,000
Installation	$1,500	$2,500
Insulation	$200	$0
Total Cost	$11,200	$21,500
Payback Period	5.17 years	≈12 years

References

- Moreno, J. (n.d.). Tapping the Underground [Graphic Picture]. Retrieved from Delta-Montrose Electric Association database.
- Deutschland, G. D. (n.d.). Heat Pump [Schematics]. Retrieved from http://www.solarheatpump.co.uk/#/schematics/4521430299