Affordable Geothermal Heating and Cooling

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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.

### Results/Outcomes

- **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.

- **Cost Estimates**

<table>
<thead>
<tr>
<th>Cost</th>
<th>Our System</th>
<th>Current Geo System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Pump</td>
<td>$7,000</td>
<td>$7,000</td>
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<tr>
<td>Tubing</td>
<td>$2,000</td>
<td>$3,000</td>
</tr>
<tr>
<td>Excavation</td>
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<td>$9,000</td>
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<tr>
<td>Installation</td>
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<td>$2,500</td>
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<tr>
<td>Insulation</td>
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<td>$0</td>
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<tr>
<td>Total Cost</td>
<td>$11,200</td>
<td>$21,500</td>
</tr>
<tr>
<td>Payback Period</td>
<td>5.17 years</td>
<td>≈12 years</td>
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</tbody>
</table>

- **Payback period**
  - 5.17 years
  - ≈12 years

- **Cost**
  - 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.

### 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 through 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.

### References