Geothermal in North Carolina

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North Carolina Energy Policy Council
November 18, 2019
What is NCSEA?

Our Mission

Drive policy and market development to create clean energy jobs, economic opportunities and affordable energy to benefit all of North Carolina.

The NC Sustainable Energy Association is a 501(c)(3) nonprofit membership organization of consumers, businesses, government, utilities and nonprofits interested in North Carolina's sustainable energy future.
What is Geothermal?

• Includes both Geothermal Energy and Ground Source Heat Pump (GSHP) technologies:
  
  • Geothermal energy technologies utilize the thermal energy stored in the Earth to generate electricity
  
  • GSHPs are central heating and cooling systems that increase efficiency by transferring heat to or from the ground
Geothermal Energy Potential

Geothermal Resource Potential for the United States
(Depth 3-10km)

Favorability of Geothermal System

- Most Favorable
- Favorable
- Moderate Favorable
- Least Favorable
- No Data

Source: National Renewable Energy Laboratory
Earth Sub-Surface Temperature
What is a GSHP?
What is a GSHP?

• 2 main types:
  • Open loop
  • Closed loop

• 2 main subcategories:
  • Vertical
  • Horizontal
What is a GSHP?

Closed Horizontal Loop
What is a GSHP?

Open Loop Well Water
What is a GSHP?

Closed Vertical Loop
What is a GSHP?

Lake or Pond System
How Efficient is a GSHP?

- According to the International Ground Source Heat Pump Association, GSHPs are:
  - 50-70% more efficient than comparable heating systems
  - 20-40% more efficient than comparable cooling systems
How is a GSHP Installed?
How is a GSHP Installed?
How is a GSHP Installed?
What are the Costs Associated with Installing a GSHP?

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost Ratio (%)</th>
<th>Unit Cost for Installation ($/RT)</th>
<th>Repair Period (Year)</th>
<th>Replacement Period (Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat pump</td>
<td>10.74</td>
<td>404.63</td>
<td>7</td>
<td>20</td>
</tr>
<tr>
<td>Drilling &amp; Trench</td>
<td>45.42</td>
<td>1711.19</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Terminal unit</td>
<td>6.41</td>
<td>241.50</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>Pump</td>
<td>2.15</td>
<td>81.00</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Pipe</td>
<td>15.37</td>
<td>579.06</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Controller</td>
<td>0.89</td>
<td>33.53</td>
<td>5</td>
<td>20</td>
</tr>
<tr>
<td>Duct</td>
<td>19.02</td>
<td>716.58</td>
<td>8</td>
<td>15</td>
</tr>
</tbody>
</table>

- Development of a Multi-Objective Sizing Method for Borehole Heat Exchangers during the Early Design Phase, 2017
How Much is an Average GSHP?

• Residential:
  
  • $2,500/ton for the system itself
  
  • 5-10 year payback

How Does a GSHP Compare to Traditional HVAC Systems?

Table 7.4. Summary of inputs and outputs from BLCC for the four HVAC systems

<table>
<thead>
<tr>
<th>Costs</th>
<th>Baseline: GHP</th>
<th>Option 1: ACC/VAV</th>
<th>Option 2: WCC/CV</th>
<th>Option 3: WCC/VAV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial cost</td>
<td>$1,021,257</td>
<td>$1,129,286</td>
<td>$835,916</td>
<td>$1,164,268</td>
</tr>
<tr>
<td>First year maintenance cost</td>
<td>$7,383</td>
<td>$7,824</td>
<td>$13,651</td>
<td>$7,928</td>
</tr>
<tr>
<td>First year electric cost</td>
<td>$22,138</td>
<td>$23,037</td>
<td>$34,152</td>
<td>$19,448</td>
</tr>
<tr>
<td>1st year gas cost</td>
<td>$3,533</td>
<td>$10,963</td>
<td>$23,944</td>
<td>$11,034</td>
</tr>
<tr>
<td>Water cost</td>
<td>—</td>
<td>—</td>
<td>$385</td>
<td>$385</td>
</tr>
<tr>
<td>Total annual O&amp;M costs</td>
<td>$33,054</td>
<td>$41,824</td>
<td>$73,826</td>
<td>$38,795</td>
</tr>
<tr>
<td>Life cycle cost</td>
<td>$1,498,835</td>
<td>$1,734,327</td>
<td>$1,912,297</td>
<td>$1,728,736</td>
</tr>
</tbody>
</table>

*Geothermal Heat Pumps in K-12 Schools: A Case Study of the Lincoln, Nebraska, Schools* (Shonder, Martin, and Hughes; 2000)
GSHPs in NC

• From 2007-2018, over $30 million has been invested in Geothermal systems in the state
  • 0.2% of direct spending in clean energy development by technology

• Over 7,600 geothermal systems were installed in NC from 2007-2018
  • 49.8% of renewable energy systems installed over that period
GSHPs in NC

Ground Source Heat Pumps Installed in NC

Cumulative Installations

- 2013: 1,000
- 2014: 2,000
- 2015: 3,000
- 2016: 4,000
- 2017: 8,000

Year
GSHPs in NC
Geothermal Industry in NC

• According to NCSEA’s 2018 Clean Energy Industry Census:
  
  • 225 companies active in the sector (7% of the clean energy industry)
  
  • 1,075 jobs (4%)
  
  • $252 million in revenue (2%)
Geothermal Industry in NC

Business Activities

<table>
<thead>
<tr>
<th>Business Activities</th>
<th>Percent of Question Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installer and developer of ground source heat pump systems</td>
<td>33%</td>
</tr>
<tr>
<td>Sub-contractor and/or loop installer</td>
<td>21%</td>
</tr>
<tr>
<td>Designer of ground source heat pump systems</td>
<td>17%</td>
</tr>
<tr>
<td>Manufacturer and distributor of ground source heat pump systems</td>
<td>10%</td>
</tr>
<tr>
<td>Well-driller</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>10%</td>
</tr>
</tbody>
</table>
Geothermal Industry in NC

Customer Base

<table>
<thead>
<tr>
<th>Category</th>
<th>Percent of Question Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential single family</td>
<td>30%</td>
</tr>
<tr>
<td>Residential multi-family</td>
<td>14%</td>
</tr>
<tr>
<td>Commercial &lt; 4,000 ft²</td>
<td>18%</td>
</tr>
<tr>
<td>Commercial &gt; 4,000 ft²</td>
<td>17%</td>
</tr>
<tr>
<td>Industrial and/or Commercial</td>
<td>10%</td>
</tr>
<tr>
<td>Military</td>
<td>6%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
</tr>
</tbody>
</table>
Geothermal Industry in NC

Geothermal System Type

- Open loop heat pump systems: 23.36%
- Vertical closed loop heat pump systems: 28.47%
- Horizontal closed loop heat pump systems: 21.17%
- Lake loops and/or pond loops: 16.06%
- Commercial water source heat pump: 7.30%
- Other: 3.65%
What Contributed to Growth of GSHPs in NC?

- NC’s 35% renewable energy tax credit that expired at the end of 2015 and the federal residential renewable energy 30% tax credit that expired at the end of 2016
  
  - The federal tax credit was brought back at 30% in 2018, with step downs eventually to 22% in 2022, but has no maximum value limit
Thank You

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