**BACKGROUND**

1. Traditional heating and cooling systems require non-renewable energy and contribute to greenhouse gas emissions.
2. The IPCC reports serious reductions to human carbon emissions must happen by 2030 to avoid the most catastrophic effects of climate change.
3. Geothermal Heat Pumps (GHPs) utilize Earth’s constant subsurface temperature to heat or cool buildings and help decrease non-renewable energy use; GHP’s are efficient, environmentally clean, and cost effective.

**OBJECTIVES**

1. Equip all new CA buildings with Geothermal Heat Pump systems.
2. Include in GHP systems an educational component and use GHP systems as a learning tool.
3. Decrease greenhouse gas emissions from CA, thus working to limit climate change.
4. In long term, reduce CA’s cost for heating and cooling energy.

**HOW IT WORKS**

- **Solar energy stored in Earth**’s shallow subsurface keeps Earth at a constant temperature (45 - 75 degrees F) year round.
- **Geothermal Heat Pumps** use fluids in thermal connection with ground to move energy inside ground to outside.
- Warmed or cooled fluids **decrease energy needed** to heat or cool outside air, overall decreasing energy need in HVAC systems; 70% of energy for GHP is renewable ground energy.

**PROJECT EXAMPLE: TWENHOFEL MIDDLE SCHOOL (KY)**

*Image Source: HPB Magazine*

“We REALLY LIKE GEOTHERMAL SYSTEMS, AND ALL OF OUR NEW SCHOOLS ARE BEING CONSTRUCTED WITH THIS SYSTEM. WE AVOID THE ANNUAL BOILER INSPECTIONS AND TEAR-DOWNS.”

(Chris Baker, Kenton County Energy System Coordinator)

- Installation Date: 2004
- Cost Savings: GHP system annual costs half of traditional HVAC system.
- Educational Model: TMS includes a “truth window” for students to observe and learn from GHP system.

**Local Projects: Carlisle MA**

Geothermal Heat Pump system installed for single family home (3,500 square feet, built 1996). System uses closed loop through three 400 foot deep boreholes.

**Total Savings** (in electric heat, fuel oil, natural gas, propane): $7,233

**Total Operating Cost:** $2,509

**Carbon offsets in one year:**

<table>
<thead>
<tr>
<th>Electric Heat</th>
<th>Fuel Oil</th>
<th>Natural Gas</th>
<th>Propane</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>9,330</td>
<td>8,285</td>
<td>2,705</td>
<td>4,797</td>
<td>kg CO₂</td>
</tr>
<tr>
<td>22,047</td>
<td>19,776</td>
<td>6,392</td>
<td>11,335</td>
<td>miles not driven</td>
</tr>
</tbody>
</table>

**NEXT STEPS**

1. Conduct a site assessment: consult bedrock geologists, field experts, and geothermal company consultants to estimate cost and plan
2. Determine which type of GHP system (closed loop, open loop, horizontal, vertical)
3. Design plan for integrated educational curriculum

**SUMMARY**

- Concord Academy should equip new buildings with Geothermal Heat Pumps.
- GHPs utilize ground energy and reduce carbon emissions.
- Concord Academy should evaluate its site for installation.

**Works Cited:**


