

# GEOTHERMAL HEAT PUMPS

## AT CONCORD ACADEMY

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### 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.

Water warmed in ground helps warm air for facility conditioning.

Water cooled in ground helps cool air for facility conditioning.

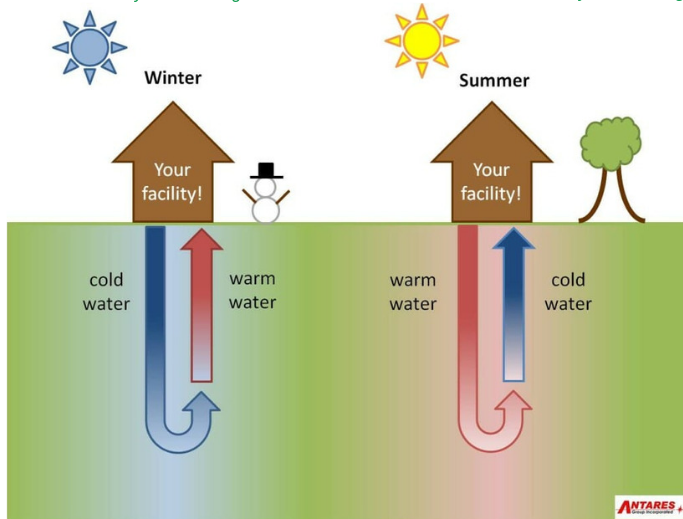


Image Source: <https://modernize.com/hvac/heating-repair-installation/heat-pump/geothermal>

### 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:

| Electric Heat | Fuel Oil | Natural Gas | Propane | Units              |
|---------------|----------|-------------|---------|--------------------|
| 9,330         | 8,285    | 2,705       | 4,797   | kg CO <sub>2</sub> |
| 22,047        | 19,576   | 6,392       | 11,335  | miles not driven   |

### 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.



Installation of horizontal ground loop GHP.  
Source: [www.carolinacounty.com](http://www.carolinacounty.com)

### Works Cited:

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