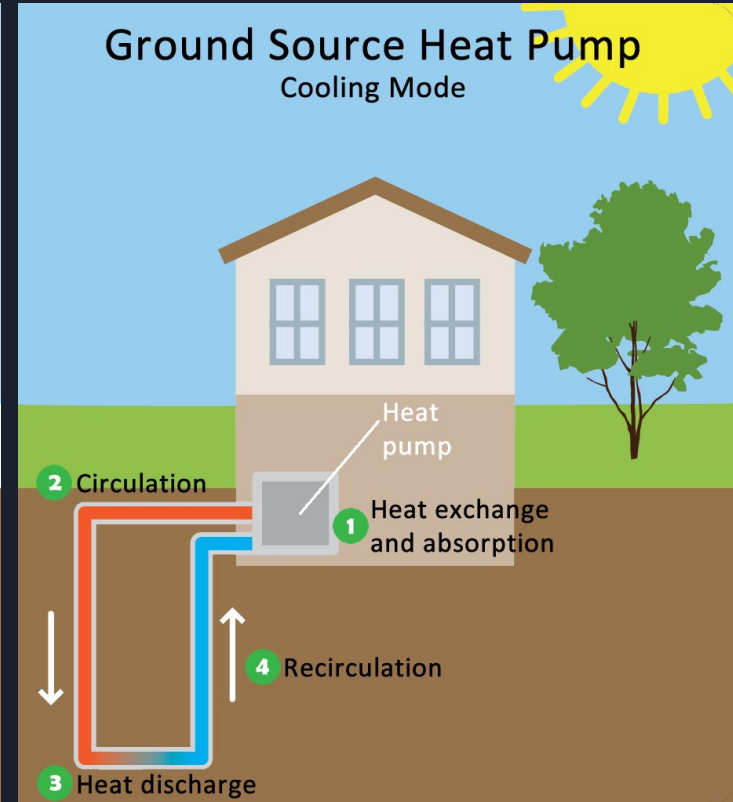
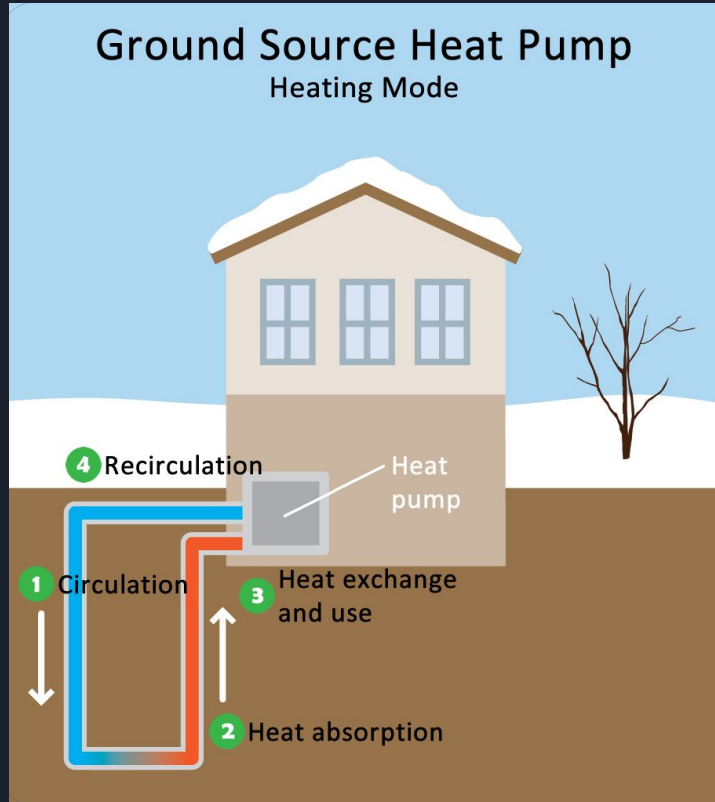




Geothermal Wells at Carleton College

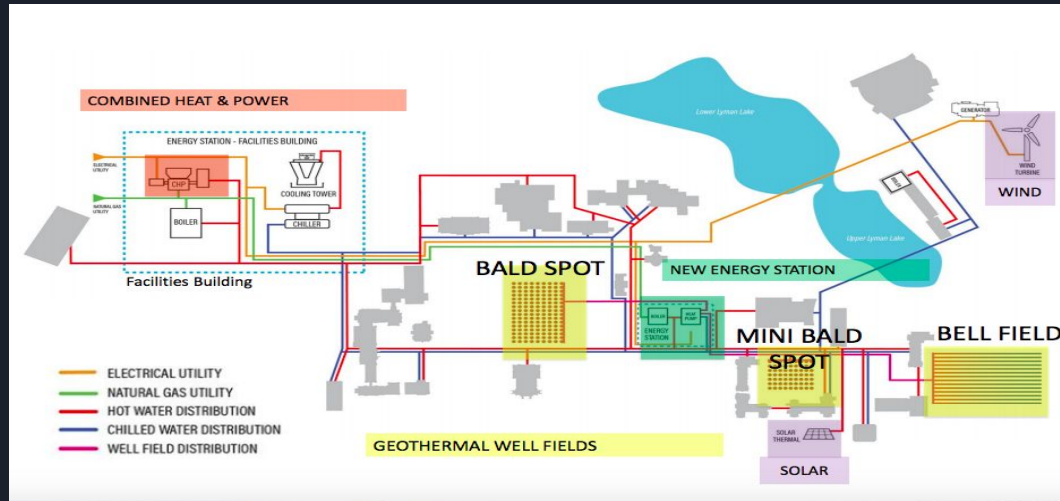
Final Project for Geol 120 - Carlos Morales, Rajkumar Raiyani and Chit Khin

What is Geothermal heat pump system?



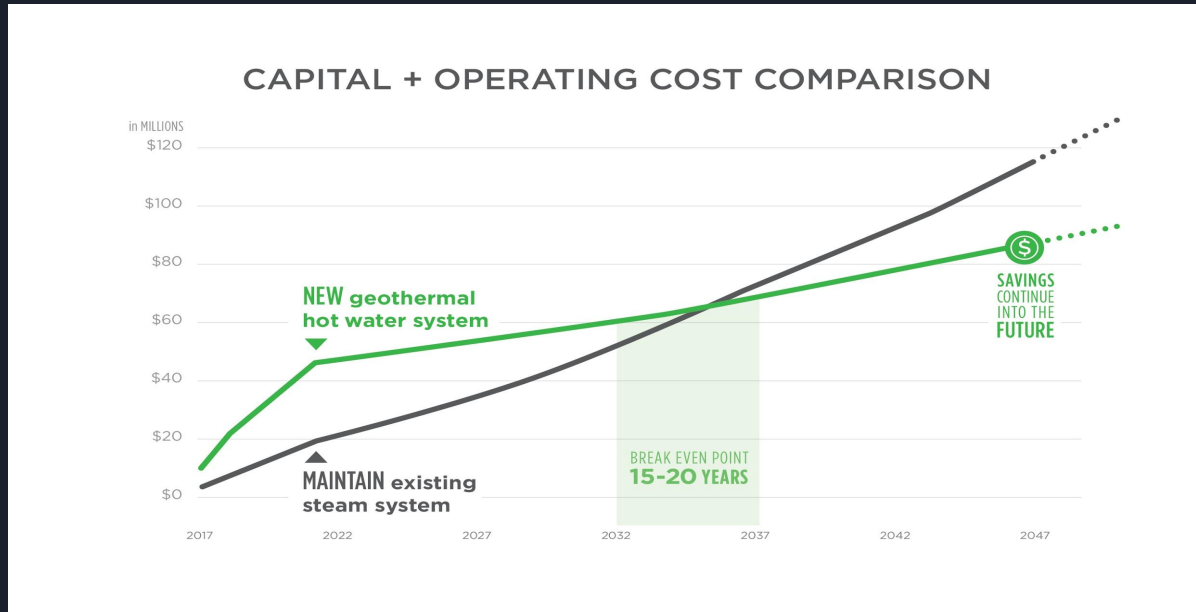
Carleton and Geothermal

- Carleton is the first campus in MN to install a direct-energy geothermal heating system
- Carleton's heating and cooling needs are currently met through gas-powered steam boilers.
- Geothermal wells utilize the static temperature of the earth to supplement the boilers and chillers in heating and cooling water, which saves energy.
- The utility master plan aim : Reduce Carleton's annual central plant carbon emissions by 35-40%.



Operational Costs

- Existing steam system would require \$20 million in upgrades over the next 15-20 years
- Annual Operating cost of existing system - \$3 million
- New Geothermal heating system costs - \$38 million
- Annual operating cost of new system - \$2 million
- Overall, \$40 million in operational savings



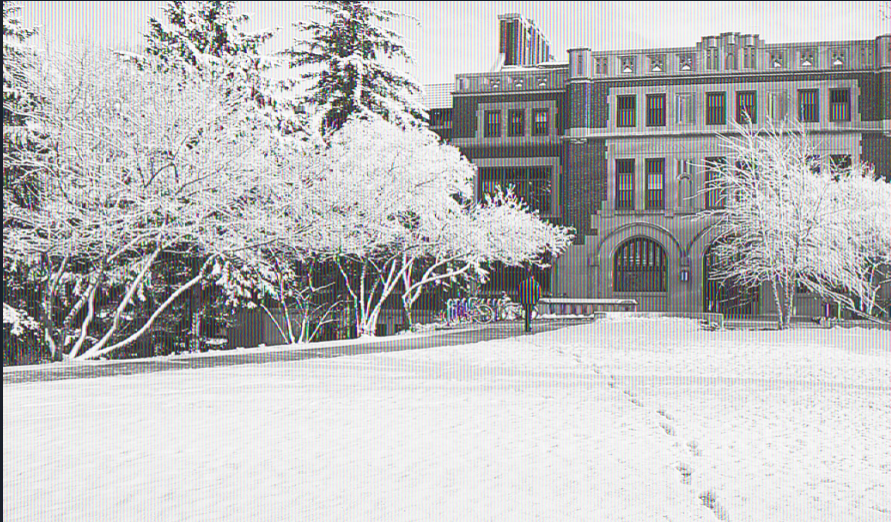


Did you know?

- 60 miles of geothermal piping will be installed on campus
- Each vertical bore is 520 feet deep
- 95 horizontally-orientated wells in Bell Field
- 77 vertical wells under the Mini Bald Spot

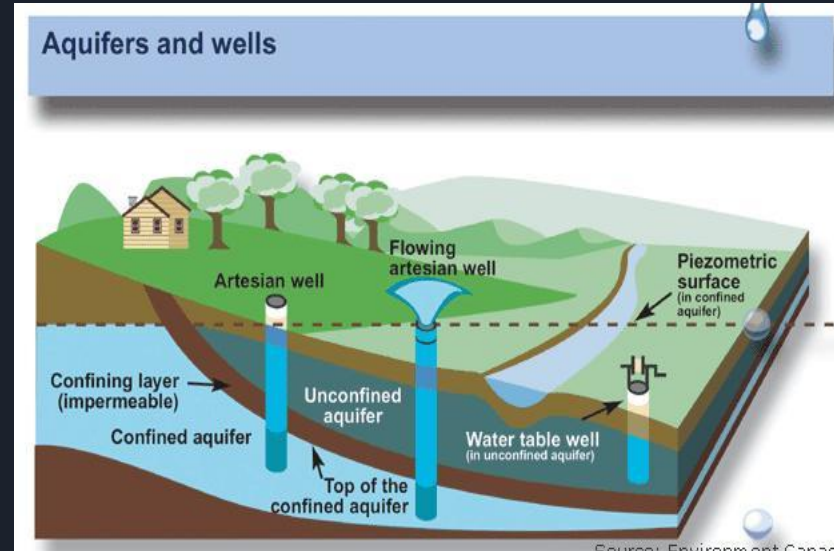
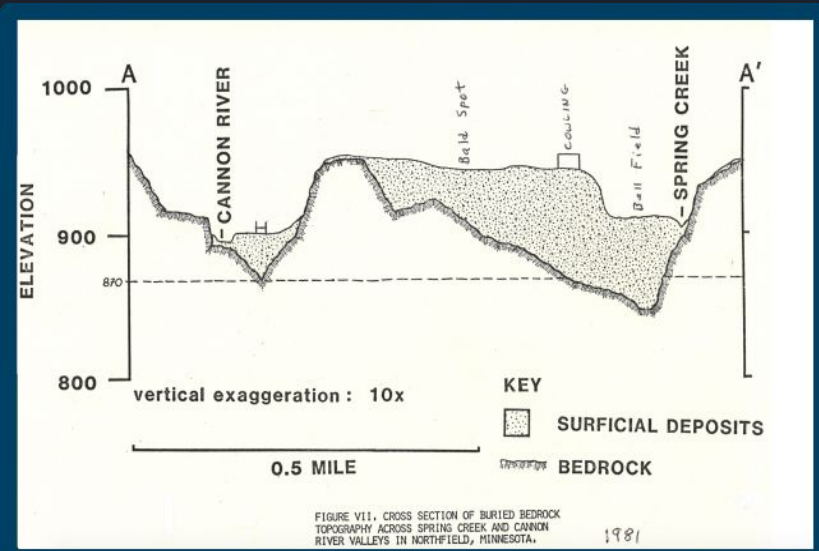
Climate Factors

- Geothermal heating and cooling works best in places with extremes in temperature; the greater the difference between the surface temperature and geothermal, the better.
- Carleton is well suited to geothermal, with an average winter temperature of below 20 degrees, and summer averages in the 70's, compared to the static 40-50 degree geothermal temperature at 50 feet.



Geologic Factors

- Carleton is constructing a horizontally-oriented geothermal well network in Bell Field, and a vertically-oriented field in the Mini Bald Spot.
- Vertical wells are ideal for situations where the wells are in contact with bedrock, whereas horizontal wells are best for unconsolidated material.
- Test drilling in Bell Field revealed groundwater under artesian pressure, which made the use of vertical wells impossible.



More info on vertical loop field

- Holes are drilled (As deep as 520 feet)
- Filled with grout.
- Ideal because it takes up less space
- Reach the soil with higher thermal conductivity



More info on horizontal loop field

- Dig trenches on the surface of the ground with the backhoe
- Lay the ground with piping beneath it.
- Reaches between 15 to 30 feet
- Require more space than the vertical loop field.

