# Earth Source Heat Update for Environmental Management Council

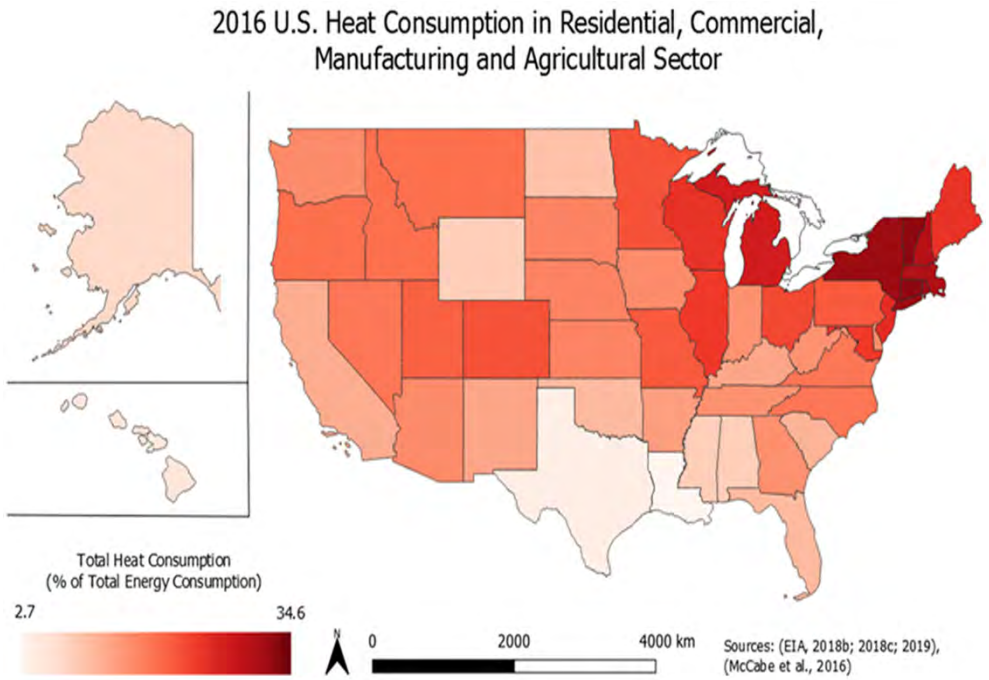
March 12, 2020

# Cornell ESH community forum panelists

- Steve Beyers, Environmental Engineer, Facilities and Campus Services
- Rick Burgess, Vice President for Facilities and Campus Services
- Lance Collins, Joseph Silbert Dean of Engineering
- Tony Ingraffea, The Dwight C. Baum Professor of Engineering Emeritus of Civil and Environmental Engineering
- Teresa Jordan, The J. Preston Levis Professor of Engineering
- Matthew Pritchard, Professor Earth and Atmospheric Science, College of Engineering
- Jefferson Tester, Croll Professor of Sustainable Energy Systems, College of Engineering

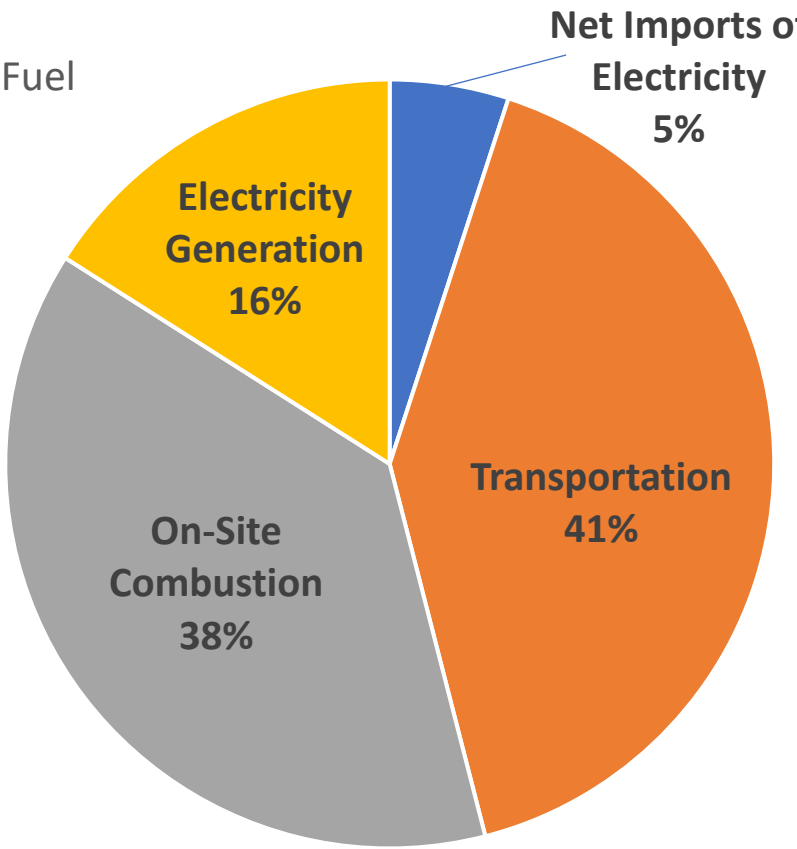
# Heating needs contribute significantly to CO2 emissions

- Heating demand is large in New York state and is provided by burning fossil fuels
- Opportunity for geothermal direct use in NY state for district heating to significantly reduce carbon emissions



# NY Heating needs contribute significantly to CO2 emissions

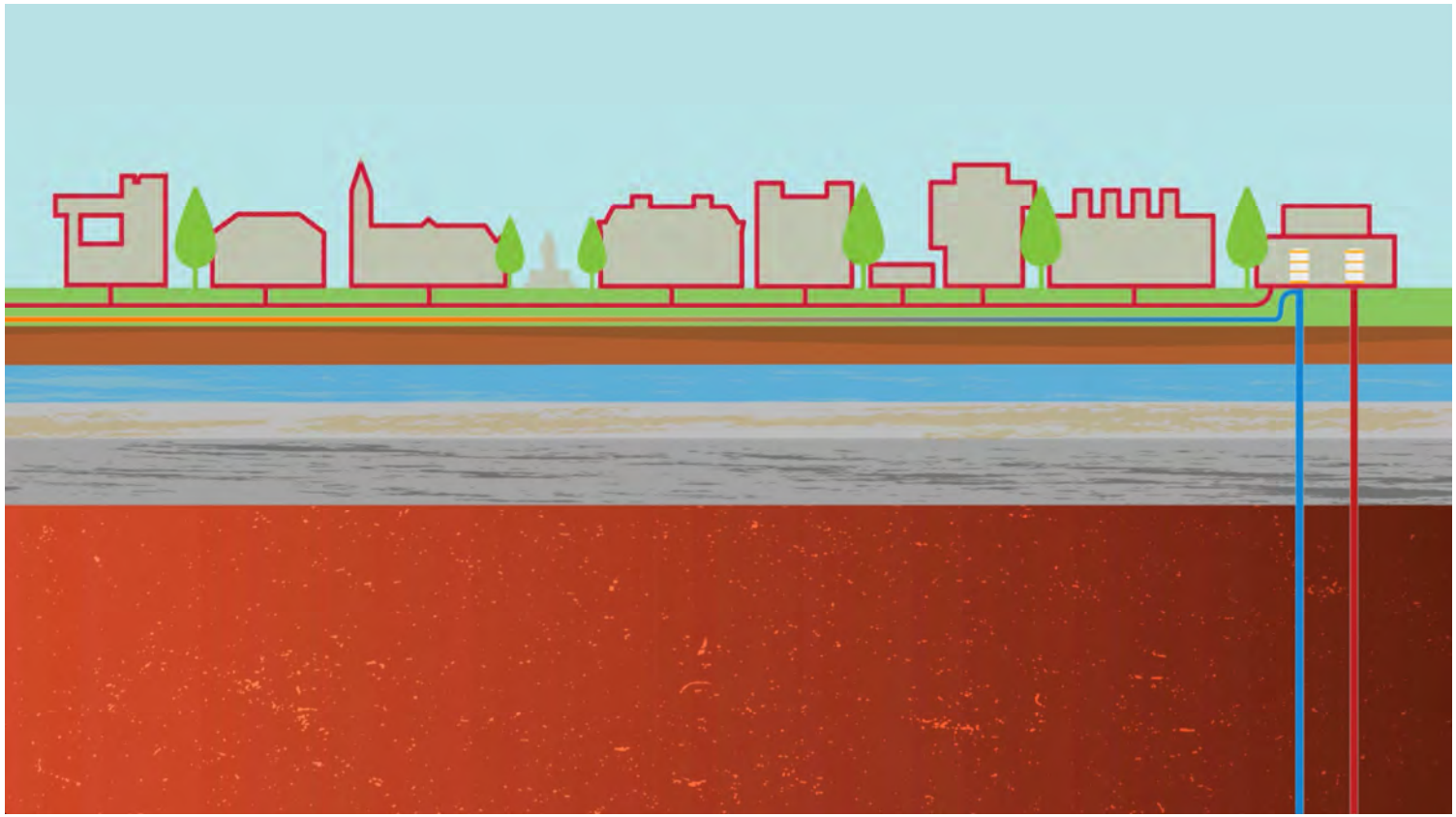
Percent of CO2e Emissions from Fuel Combustion




Source: New York State Greenhouse Gas Inventory: 1990–2015 Final Report, Revised September 2018 (NYSERDA)

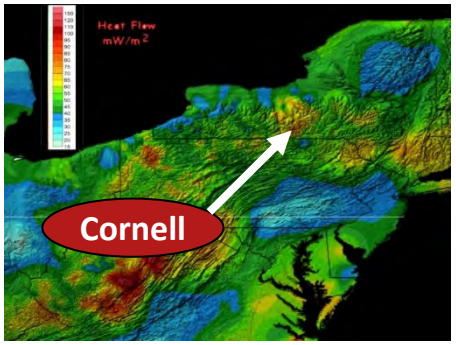
Opportunities to offer programs that promote the use of electric heat pumps [for heating] may arise …. **Electrification of these end-uses will likely have a significant impact on peak demand and could increase winter electric usage to the point where the system peak shifts from the summer to the winter.**

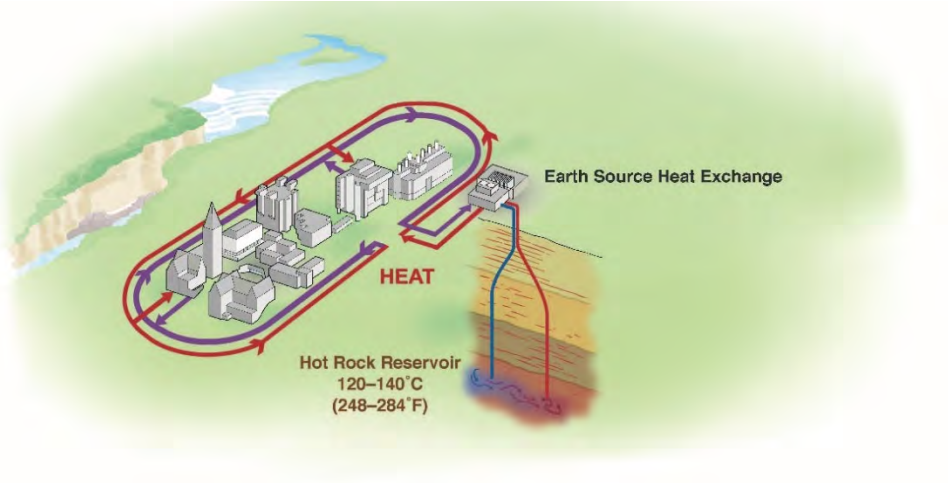
Source: **ConEd** Electric Long-Range Plan 2019-2038 *(emphasis ours)*



# Common requirements for enhanced geothermal systems

- Accessible, sufficiently high temperature rock mass underground (>80°C)
- Ability for water to circulate through the rock mass to extract energy
- Ability to develop and operate an economically and environmentally sustainable system



# Project designed in stages to mitigate risks

## DISCOVERY & DESIGN

- Data collection, including subsurface imaging, background seismic and water testing
- Single test borehole and subsurface analysis (DOE)
- System design

• 2016 – present
• Test borehole subject to DOE funding (summer 2020)

## DEMONSTRATE

- Create functioning well-pair
- Continued risk analysis
- Connect to district heating system

• Subject to funding, 2-3 years
• Rigorous risk analysis to determine system efficacy

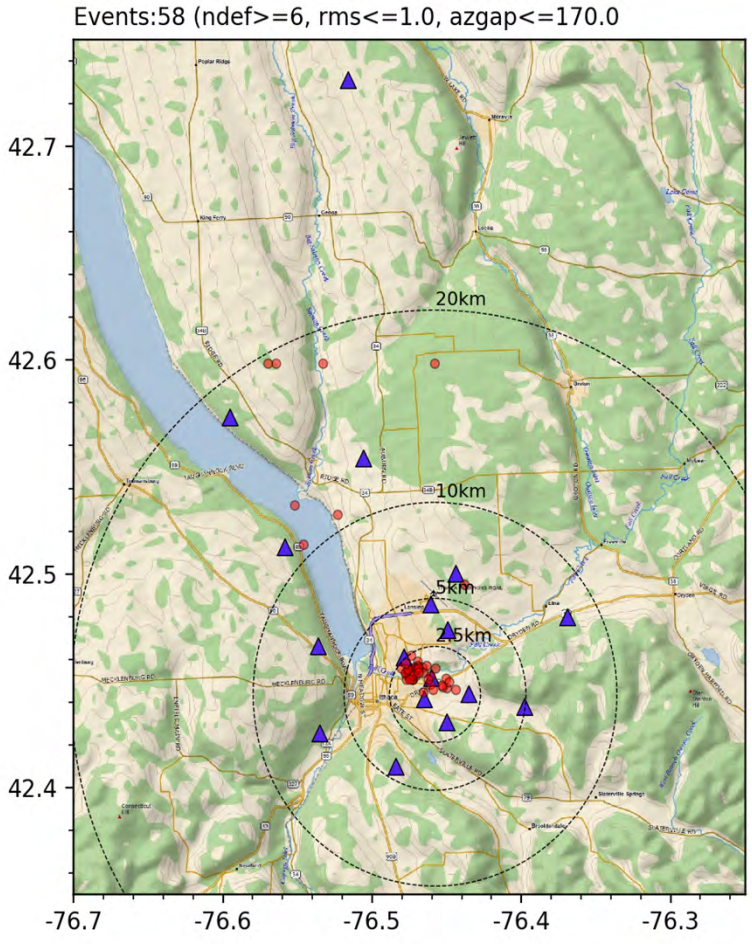
## DEPLOY

- Technology derisked, new industries created
- Private-sector deploy across the state at sites with existing district heating systems and appropriate geological subsurface

• Subject to funding, 3-5 years, after successful demonstration full deployment to campus and beyond

# Recent ESH activities

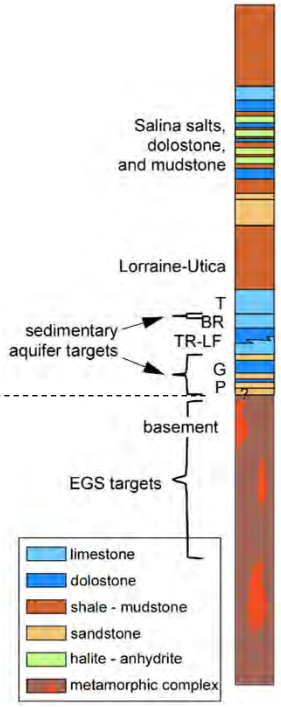
- Active seismic imaging and assessment
- Passive seismic array installed and monitoring
- Extensive historical research – drilling logs and core samples
- Hosted international experts (Intercontinental Science Drilling Program) to obtain best practices in environmentally-safe drilling, monitoring, and scientific testing protocols

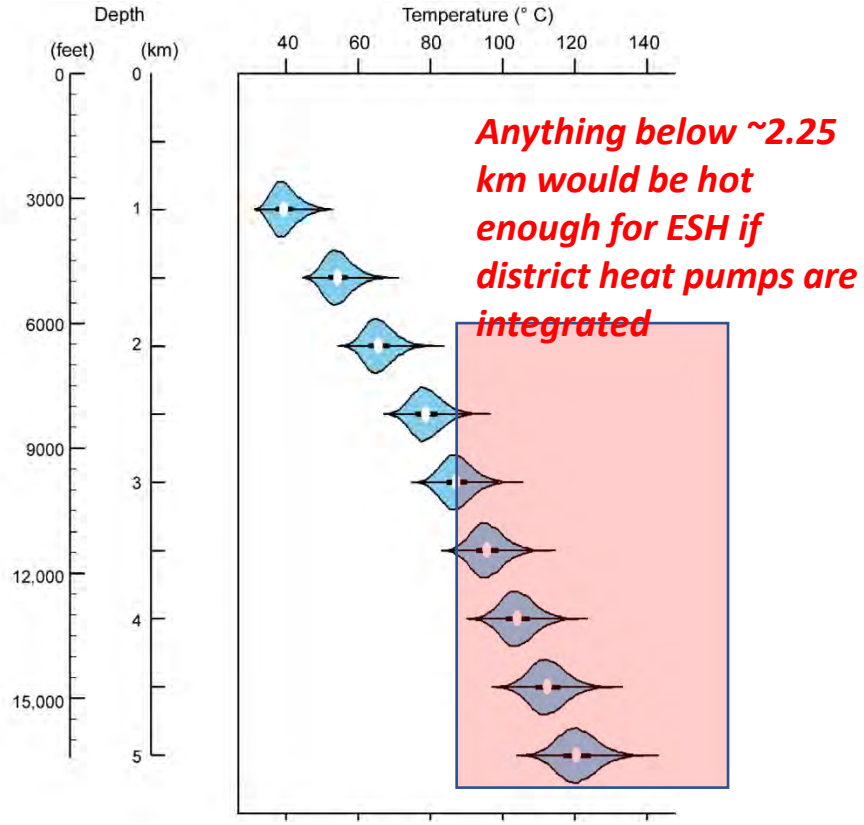


# Estimated subsurface rock types, depths, and temperatures

Sedimentary rock

Metamorphic rock



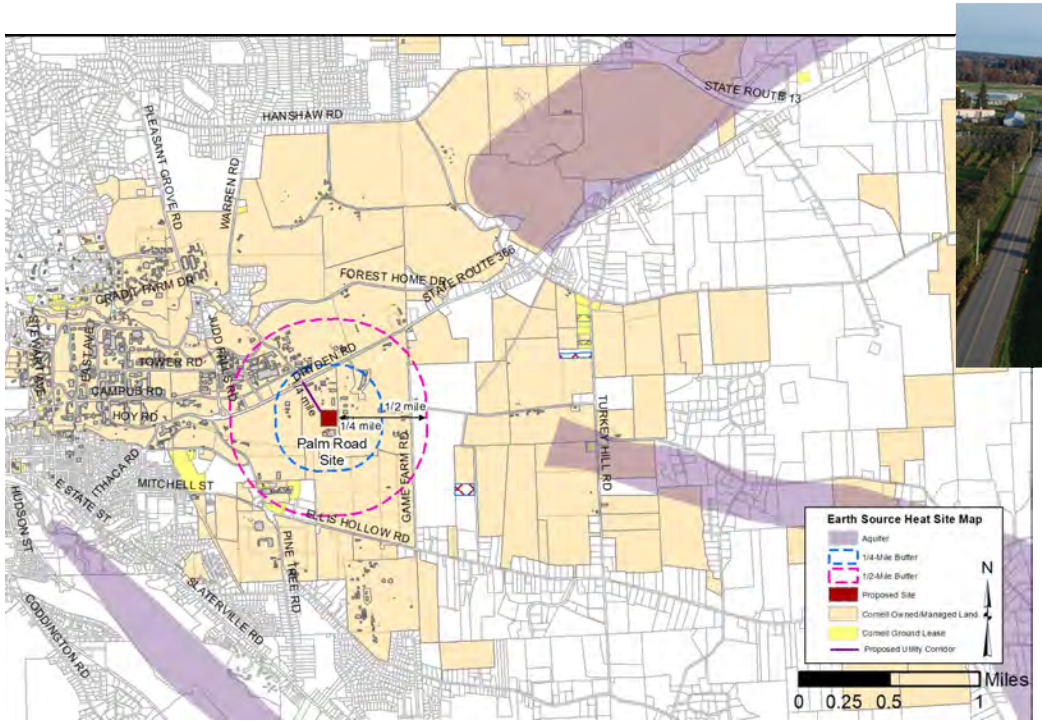



# Lessons learned from U.S. DOE feasibility study*

- Several viable targets exist in the subsurface under campus
- Incorporating district heat pumps would allow ESH to target multiple potential formations and improves operability and range of ESH
- A combination of heat pumps, tank storage, biomass and other renewable integration could be well optimized – reducing capital costs and overbuild for any one system and having the lowest overall carbon footprint
- Details of design district heat systems are critical to renewable heat integration regardless of source
- “Levelized Cost of Heat” of an ESH system is competitive with conventional boiler systems

* Delivered to DOE Nov. 2019

# Proposed ESH test borehole site

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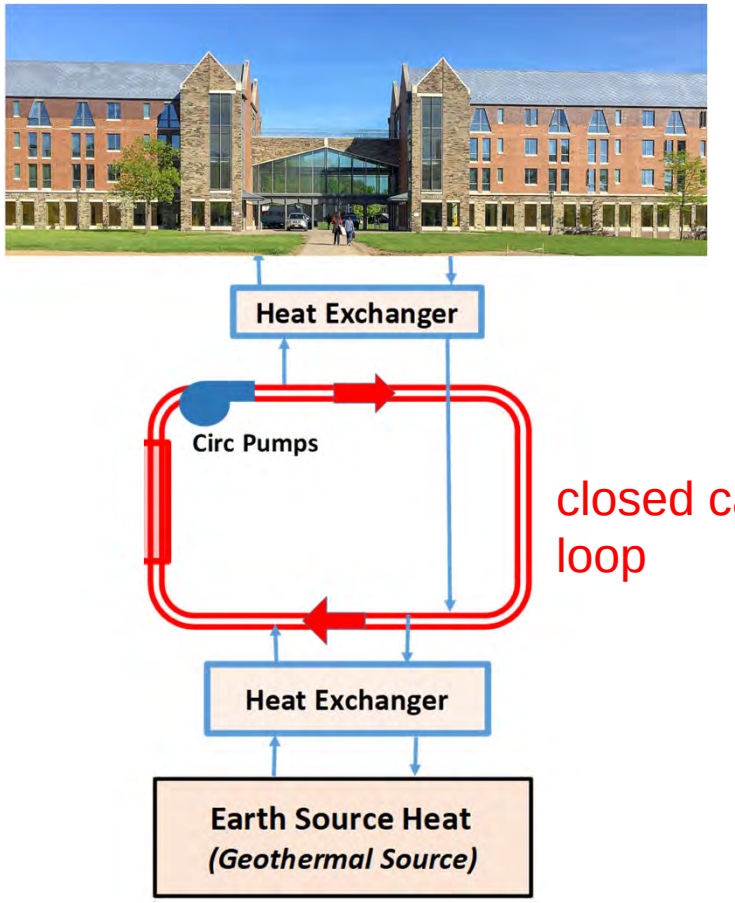
# Discussion

# Thank you

For more information, please visit:

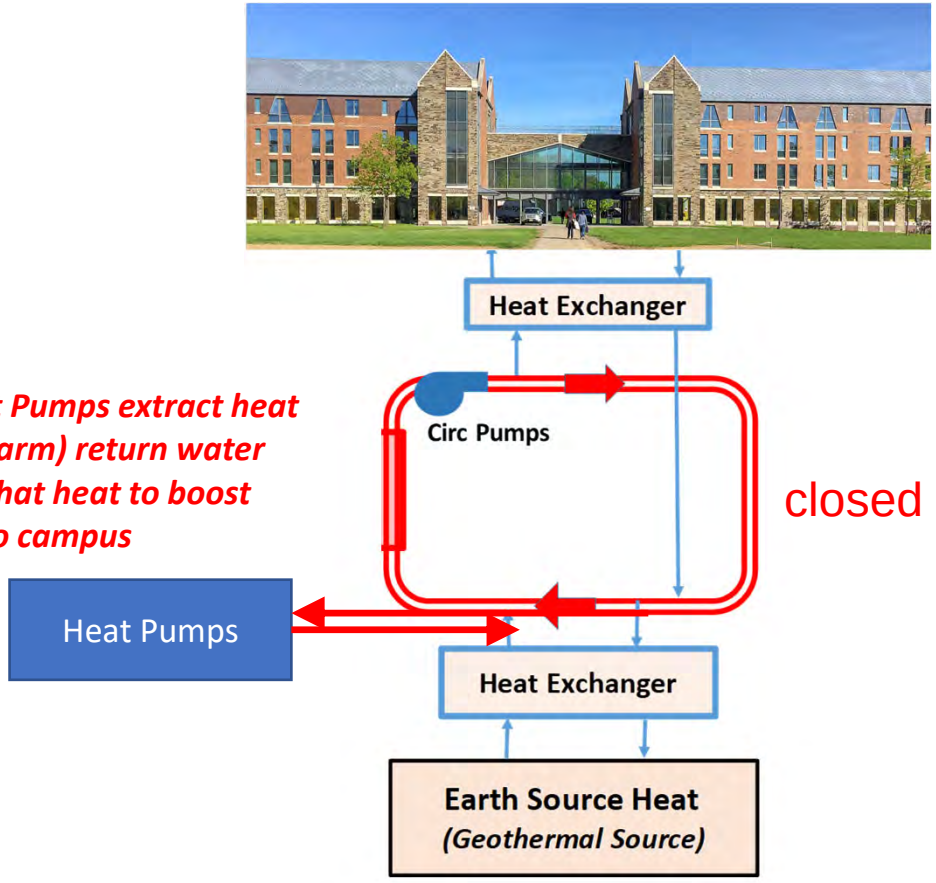
earthsourceheat.cornell.edu

# “Classical” direct use




closed campus heating loop

# Direct use with district heat pumps




***District Heat Pumps extract heat from (still warm) return water and return that heat to boost the supply to campus***

closed campus heating loop