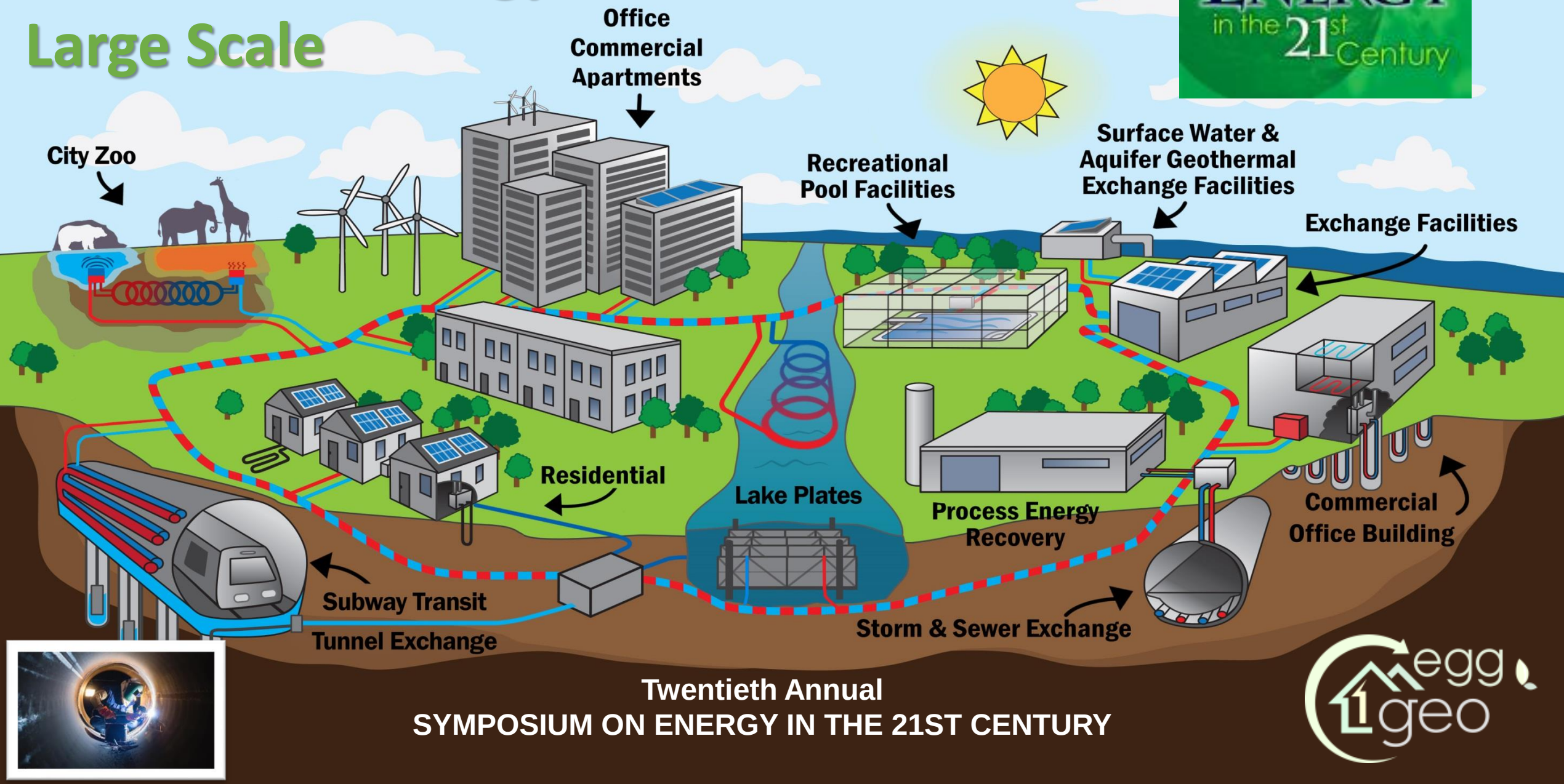
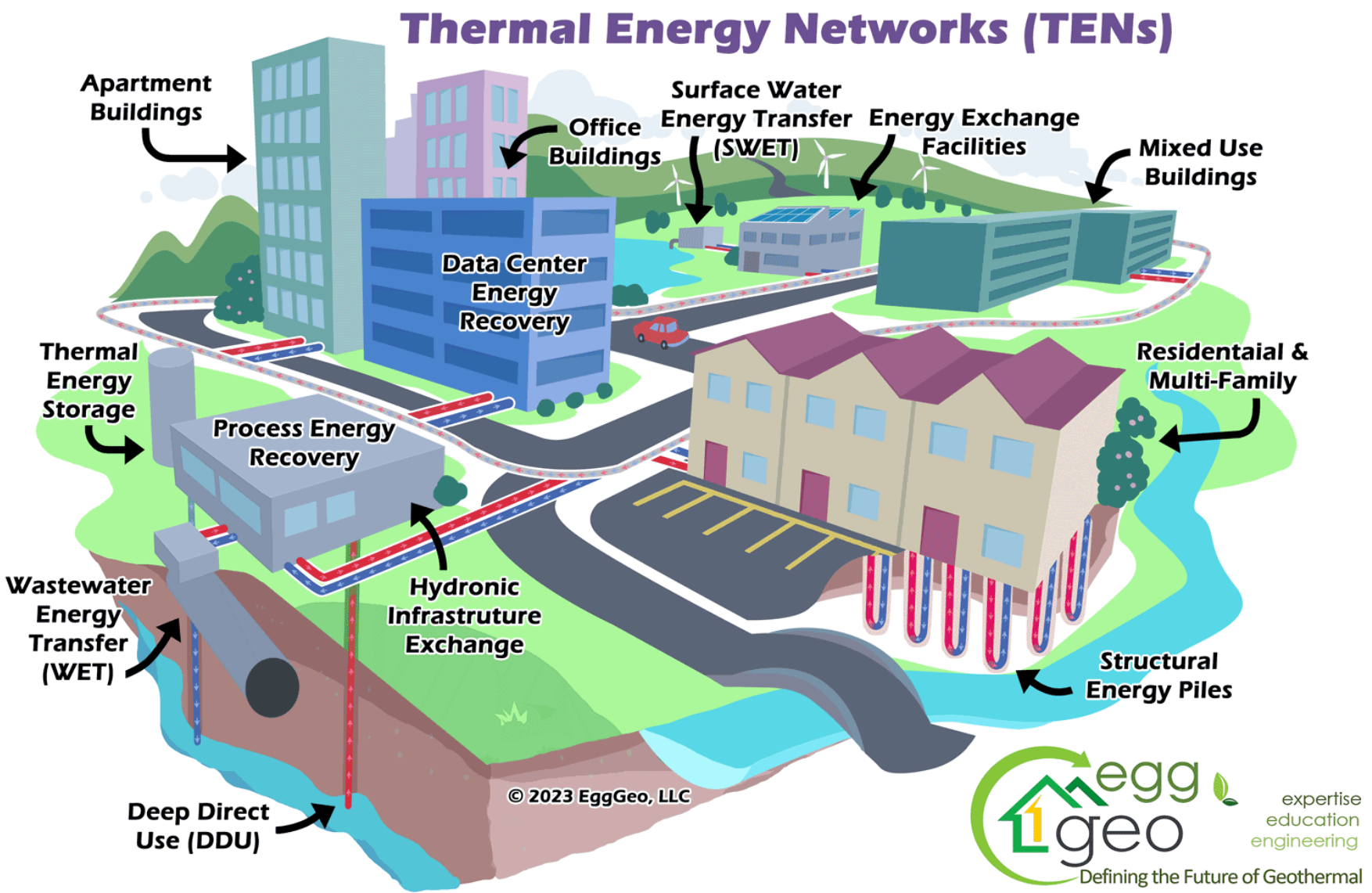
Geothermal Energy Networks on a Large Scale



Twentieth Annual
SYMPOSIUM ON ENERGY IN THE 21ST CENTURY

Geothermal Energy Networks on a Large Scale



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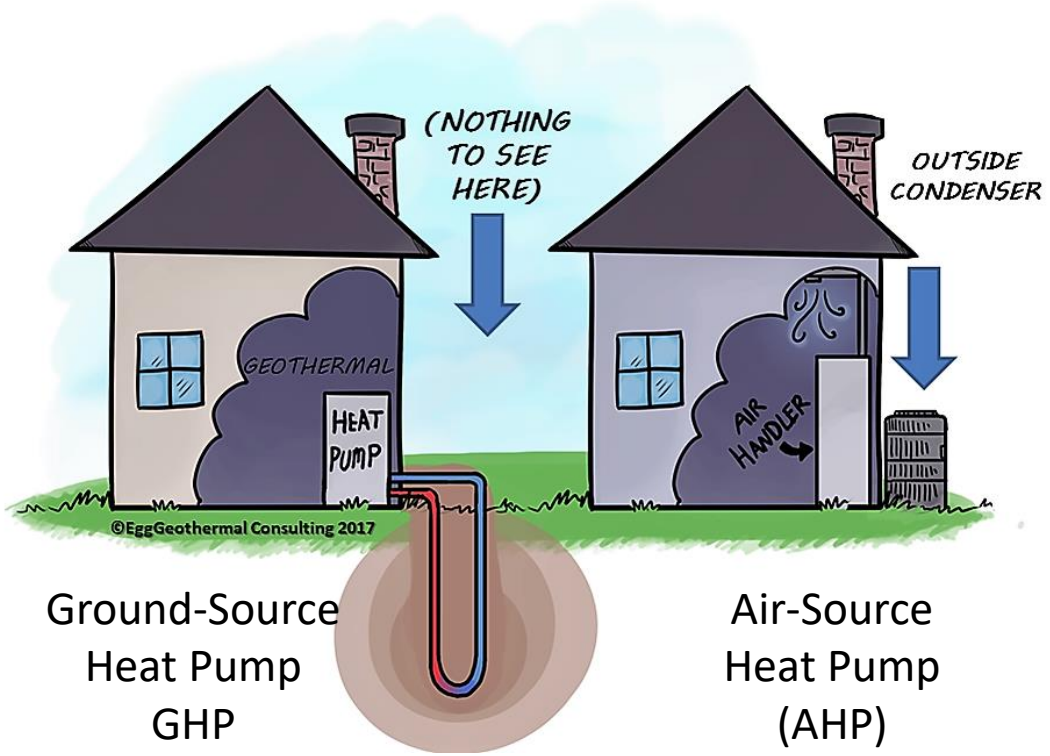
Defining the Future of Geothermal

Both Air Source & Ground Source Heat Pump are All Electric

They use renewable energy (from the air & the earth) to help heat and cool buildings

Nothing outside

Both use “Renewable Energy”

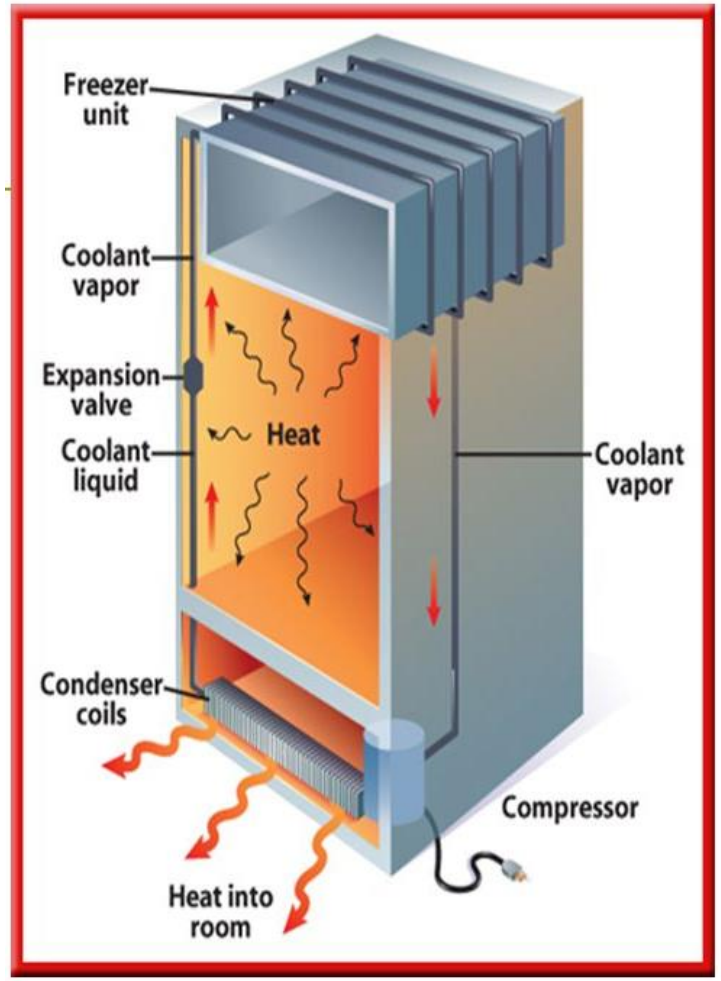


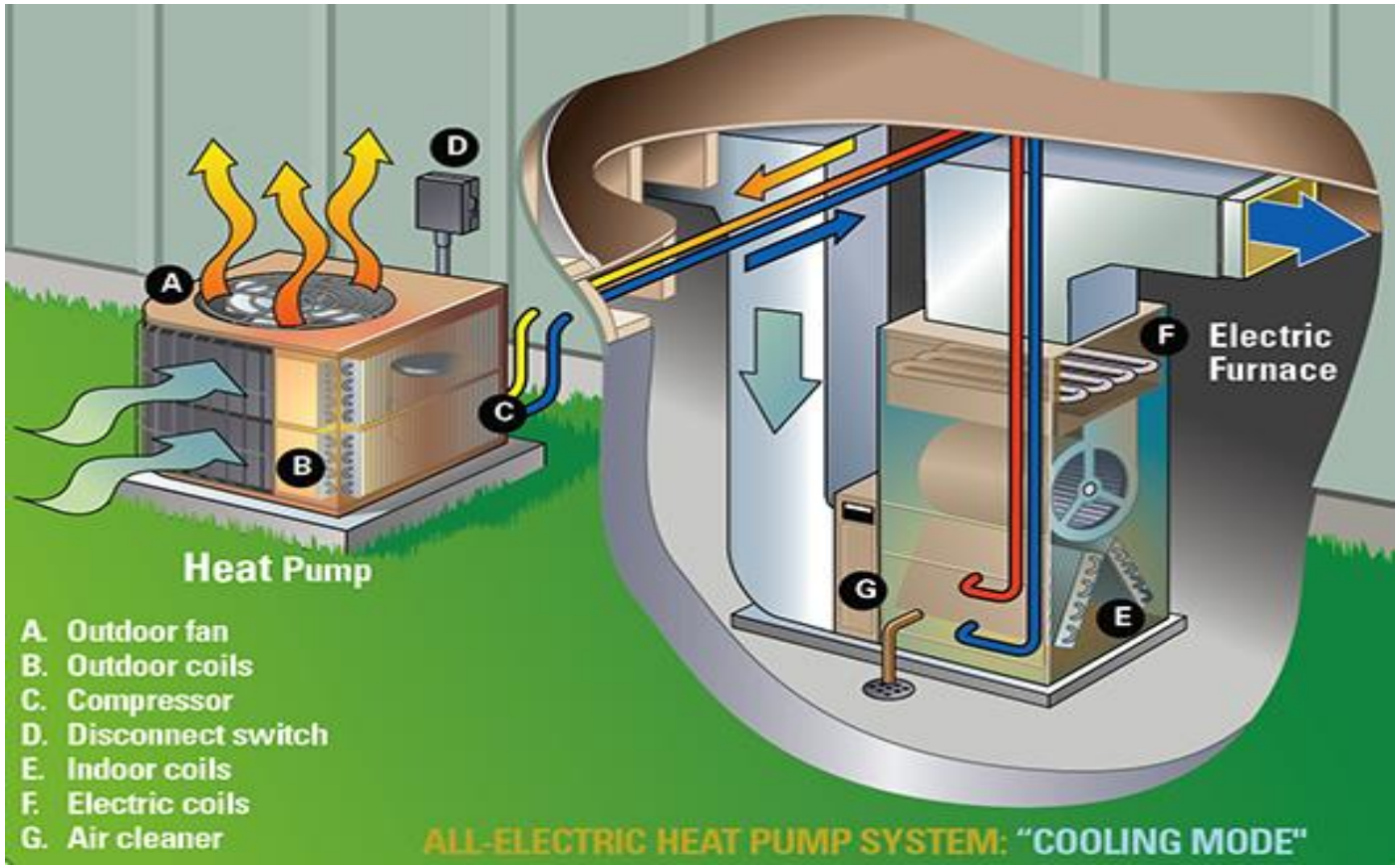
Ground-Source Heat Pump GHP

Air-Source Heat Pump (AHP)

Remote Outside Condenser

How to cool & heat spaces by "pumping heat"- exactly like a refrigerator





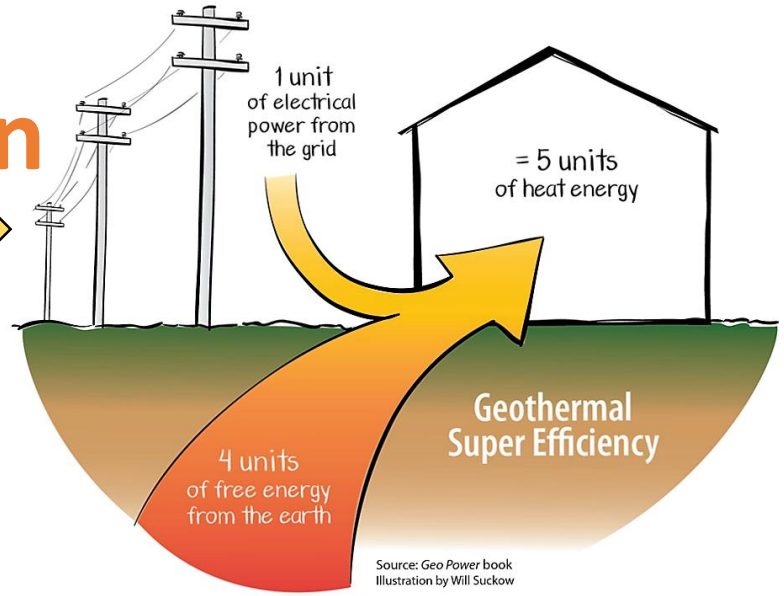
Heat Pump = about 3.0 to 5.0 + COP

1 kW of Electricity = 3412 BTUs/Hr

1 kW in

= 3,412 BTUs/Hr of heat (Electric Space Heater)

1 kW in



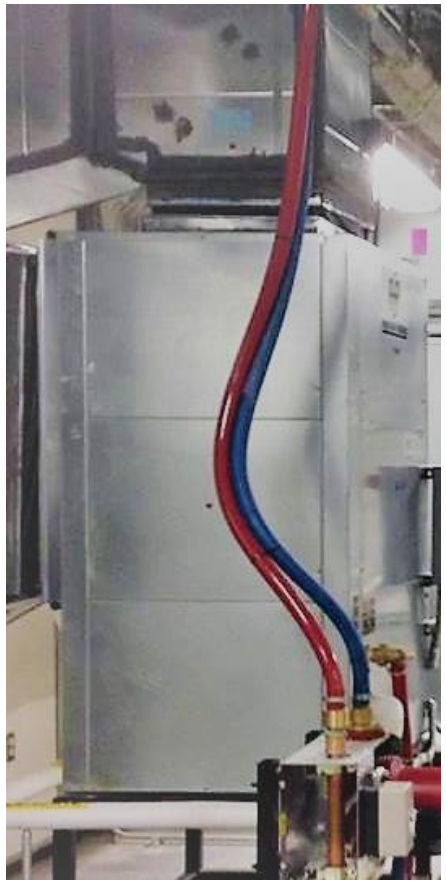
= 17,060 BTUs/Hr of heat* (Geothermal Heat Pump)

- ***It takes 20% of the kW to do the same heating with a geothermal heat pump***

*@ 5.0 COP

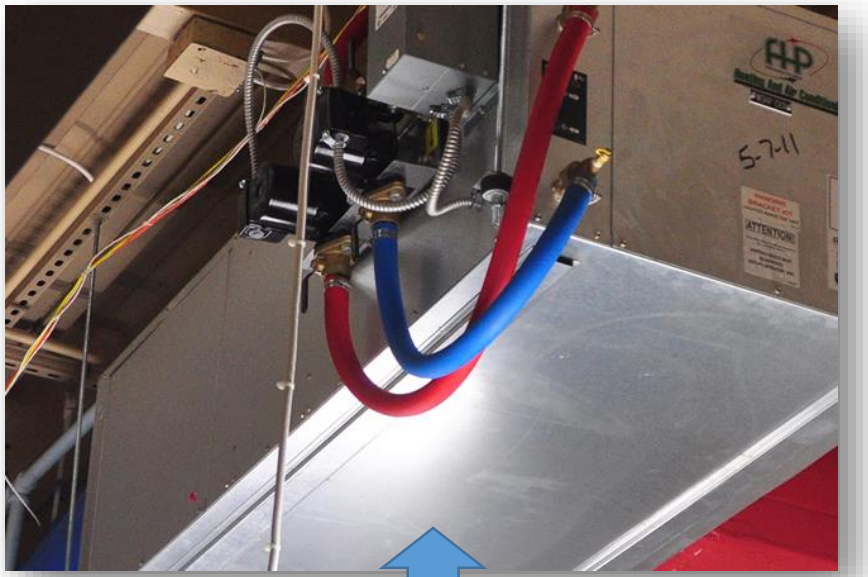
egg geo Sharing Knowledge Engineering and Education

Like ASHPs GSHPs are also designed to fit every type of structure

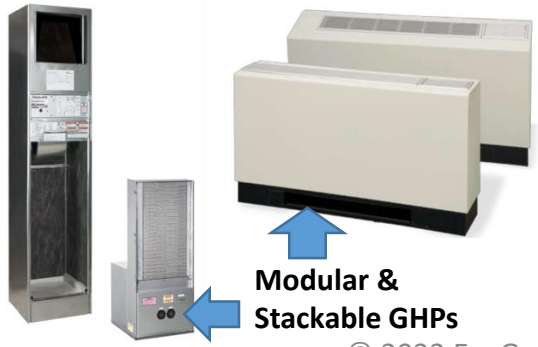


Various Types of Geothermal Heat Pumps (GHPs)

Vertical GHP (**water-to-air** GHP)



Horizontal; GHP (**water-to-air** GHP)



Modular & Stackable GHPs

Pool or Dedicated Hot Water GHP; (**water-to-water** GHP)

GHPs to fit every type of building, even roof tops

Replacement Roof Top GHPs

All Inside 100% Fresh Air (DOAS)

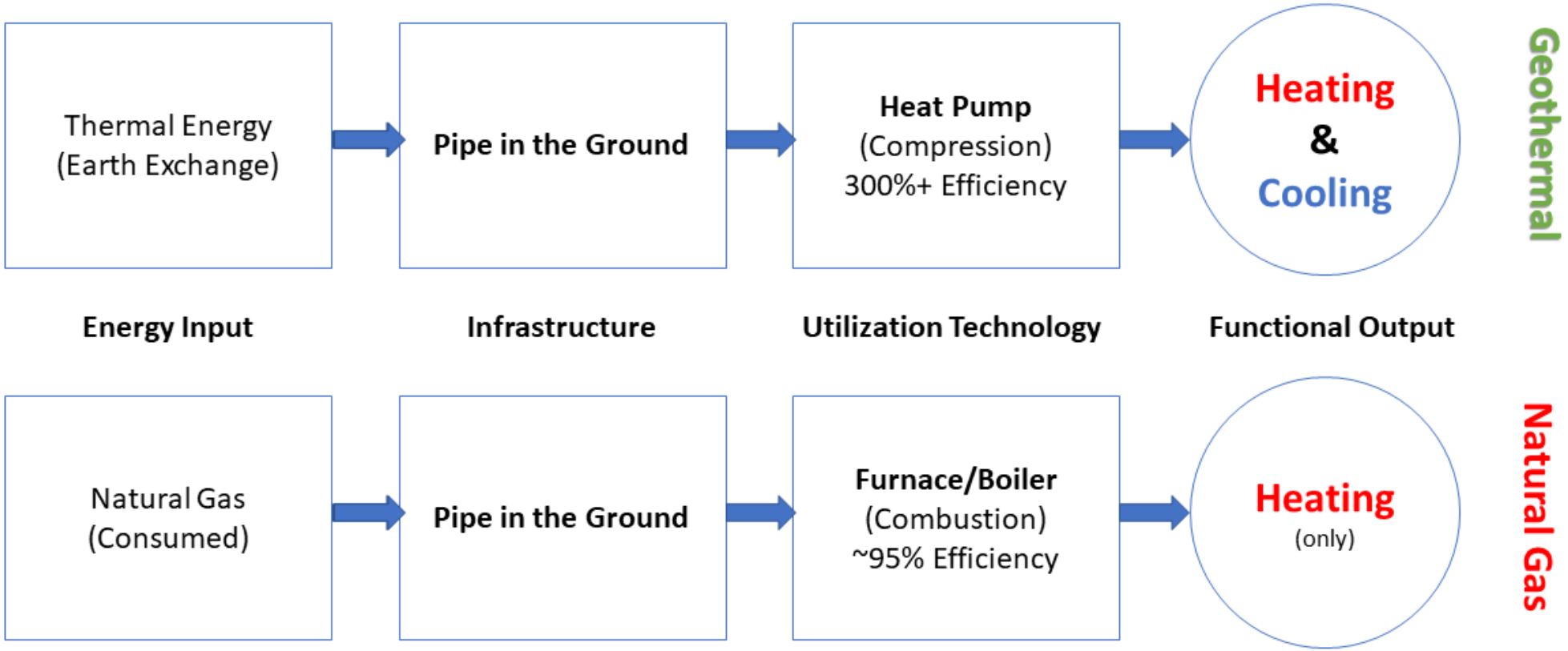
District Thermal Energy Networks

…making thermal network heat pumps a reality for all

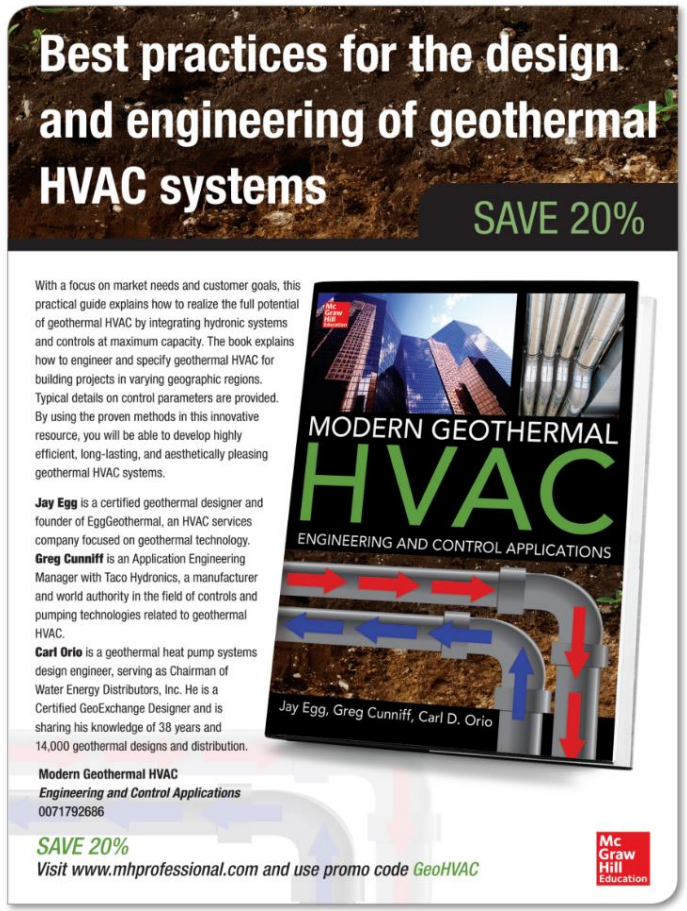
- No more outdoor equipment to replace
- More hurricane and storm resilient (no HVAC equipment outside)
- HVAC system longevity (a benefit of having equipment inside)
- No combustion boilers, cooling towers or furnaces (Decarbonization)
- Noticeably superior comfort in heating and cooling modes
- Remarkable system efficiency at standard equipment pricing
- Thermal Energy Network Wells /Piping are permanent infrastructure

Utility Thermal Energy Network
A Just Transition to Renewable Heating and Cooling

Convert Natural Gas to Geothermal Energy Networks



Commissioned for new Curriculum; this time for the UA



Op Ed and Article in *Standard & Poors*

https://bit.ly/SandP_ThermalEnergyNetworks

Op-Ed

Op-Ed | We must work together to move towards an equitable transition away from fossil fuels

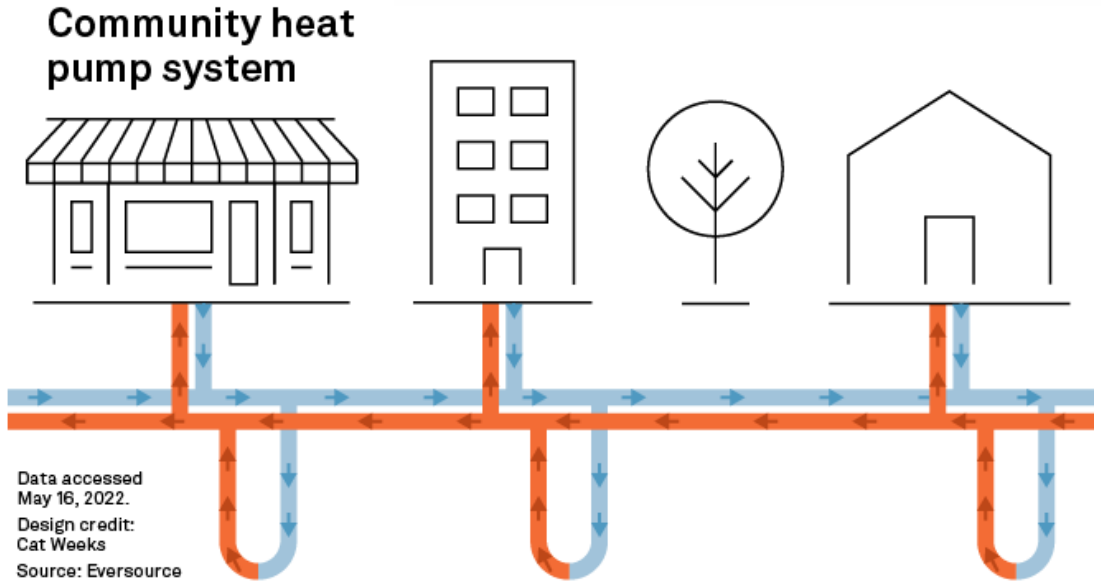
By John Murphy and Lisa Dix 8 comments Posted on May 25, 2022

S&P Global
Market Intelligence

Efforts to develop centralized community geothermal heat pumps expand

The District of Columbia is soliciting design proposals for a community heat pump system, the latest pilot project to attempt to scale a decades-old geothermal heating and cooling technology to the neighborhood level.

The district's Public Service Commission asked developers May 17 to apply to construct a large community heat pump system, capable of serving multiple buildings.



“Beneficial Electrification” was a real thing in 1958 - Some history, and the logic behind it…

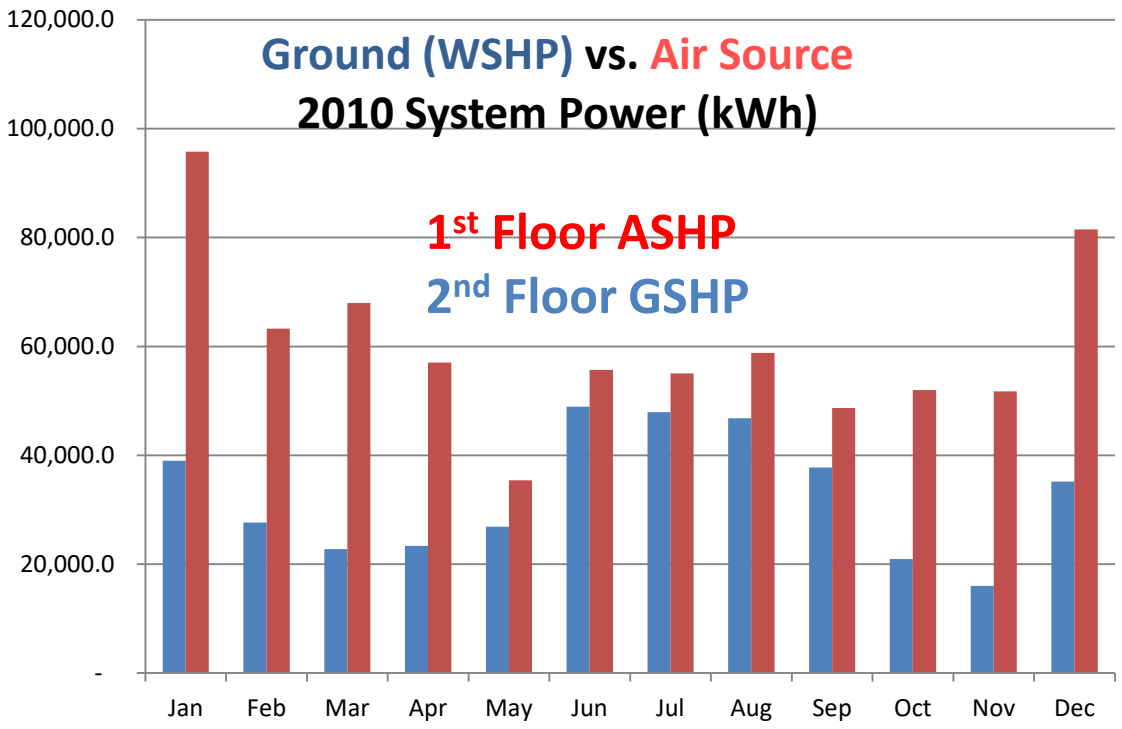
These homes received "*Total Electric*" medallions indicating the home was inspected & safe.

Decarbonization = Electrification

In 1958 the National Electric Manufacturers Association (NEMA) provided medallions for homes that were all electric. This effort could be renewed, and for many of the same advantages cited as advantages for homes built between 1957 and the mid-1970s.

Understanding efficiency; the ASHRAE Building in Atlanta

Thermal Energy Heat Pumps consume less energy than air-source heat pumps

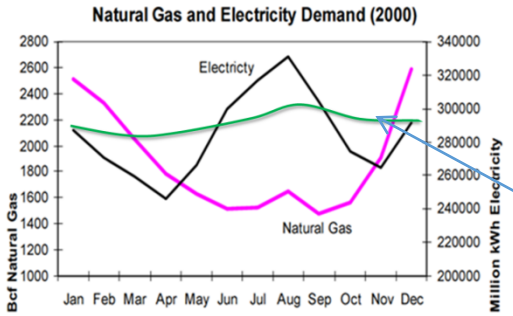


Power Consumption at ASHRAE Bldg, Atlanta

Electrical Load is “**leveled out**” using WSHPs

- Utility Benefits
  - Highly efficient heating and cooli systems.
  - Potentially a cost-effective optior to defer capital commitment for utility gas and electric infrastructure.
  - Reduces electric peak demand, improves load factor and improves the efficiency of the electric delivery system.
  - Gas peak load reductions.

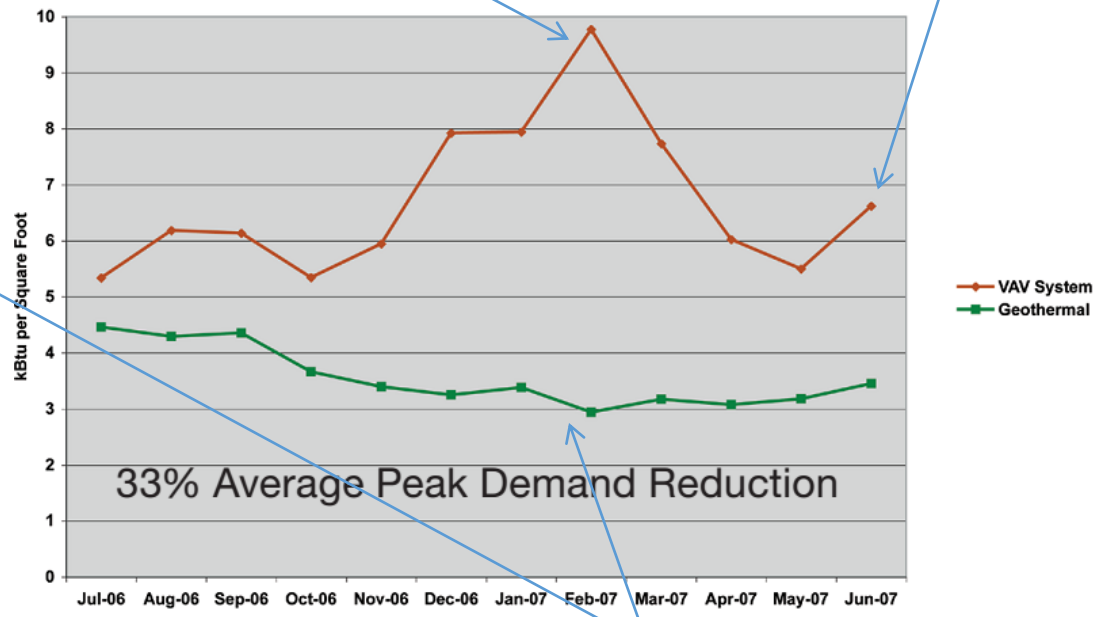
nationalgrid
HERE WITH YOU. HERE FOR YOU.



13

Combination Gas-Heat & Electric-Cooling Peaks in the Summer

Air Source Heat-Pumps tend to “peak” in the winter, as well as the summer

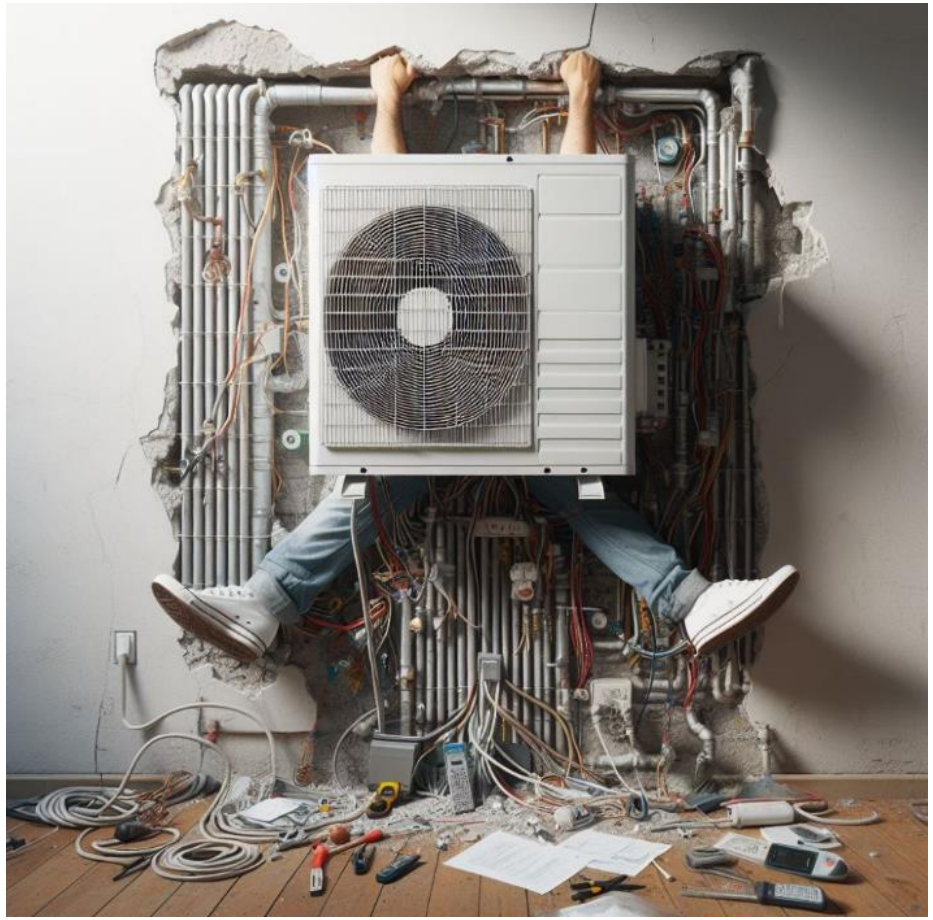


Ground Source Heat-Pumps Shave Both Summer and Winter Peaks

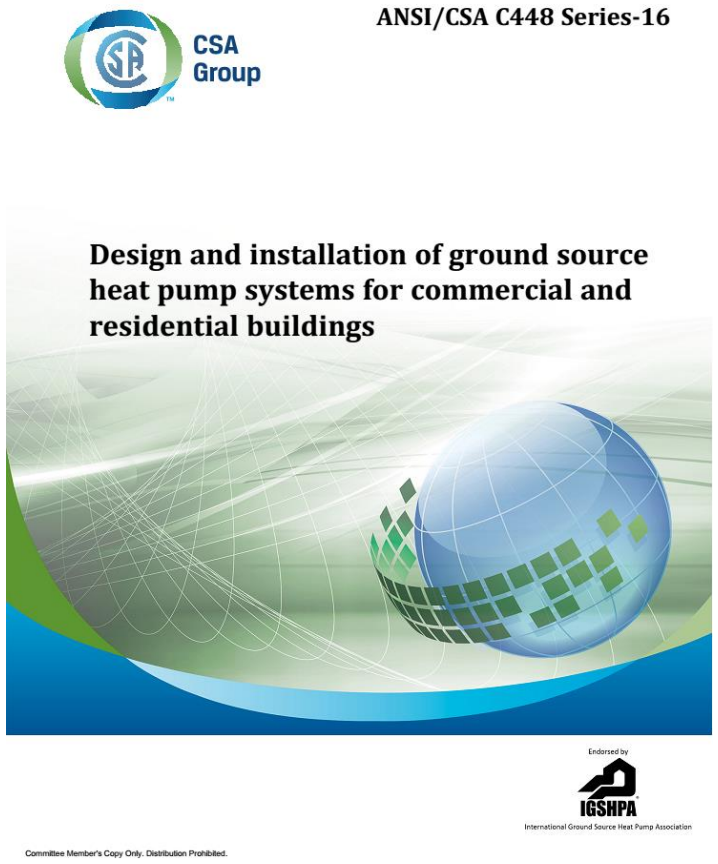
Geothermal Energy Networks

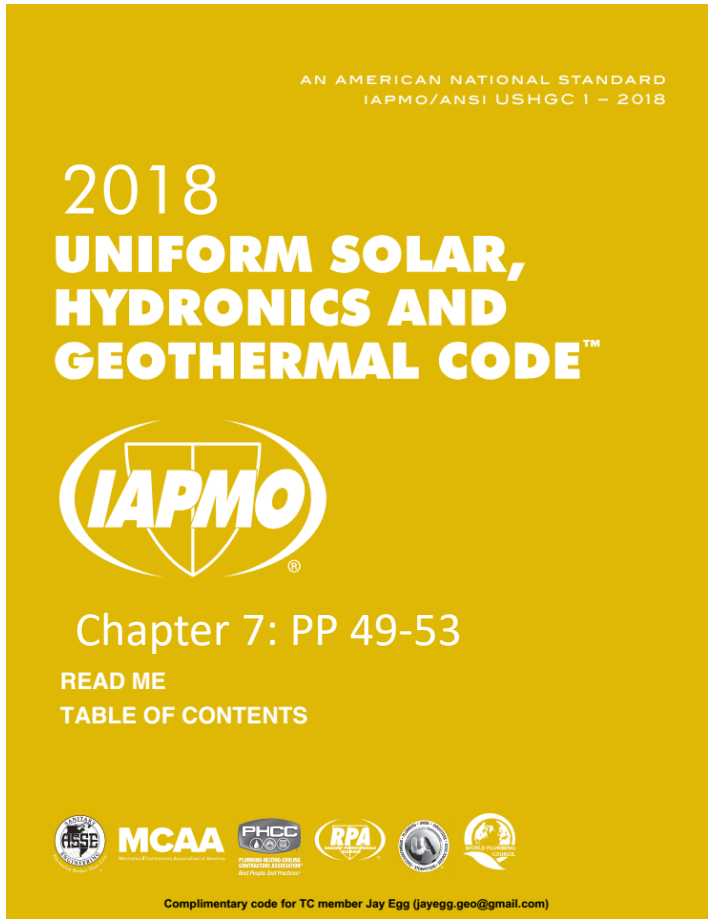
…*eliminate Outdoor Equipment and related hazards*

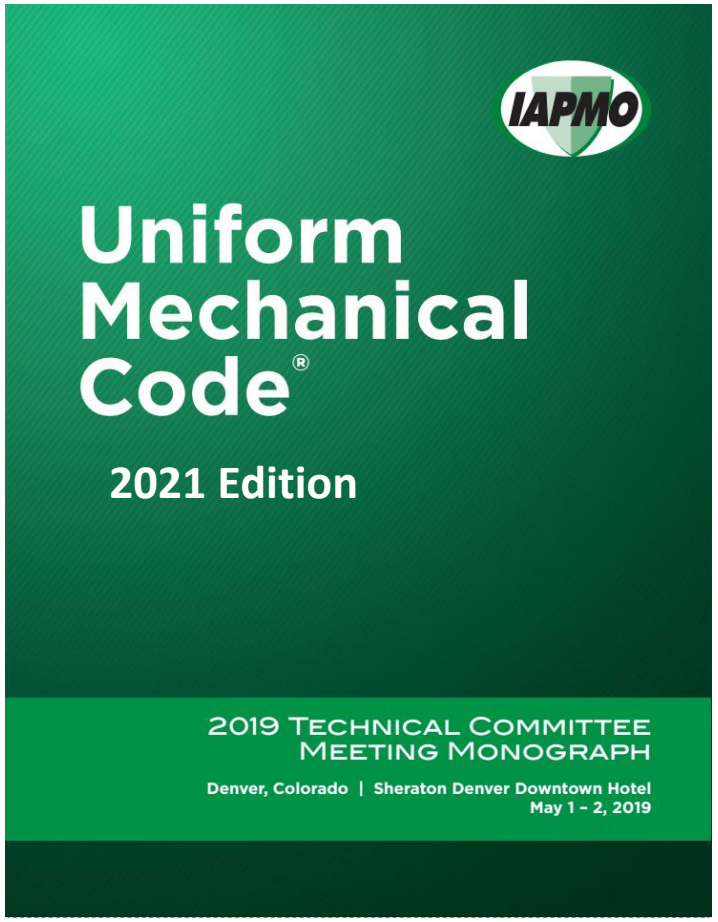
Appliances ASHPs



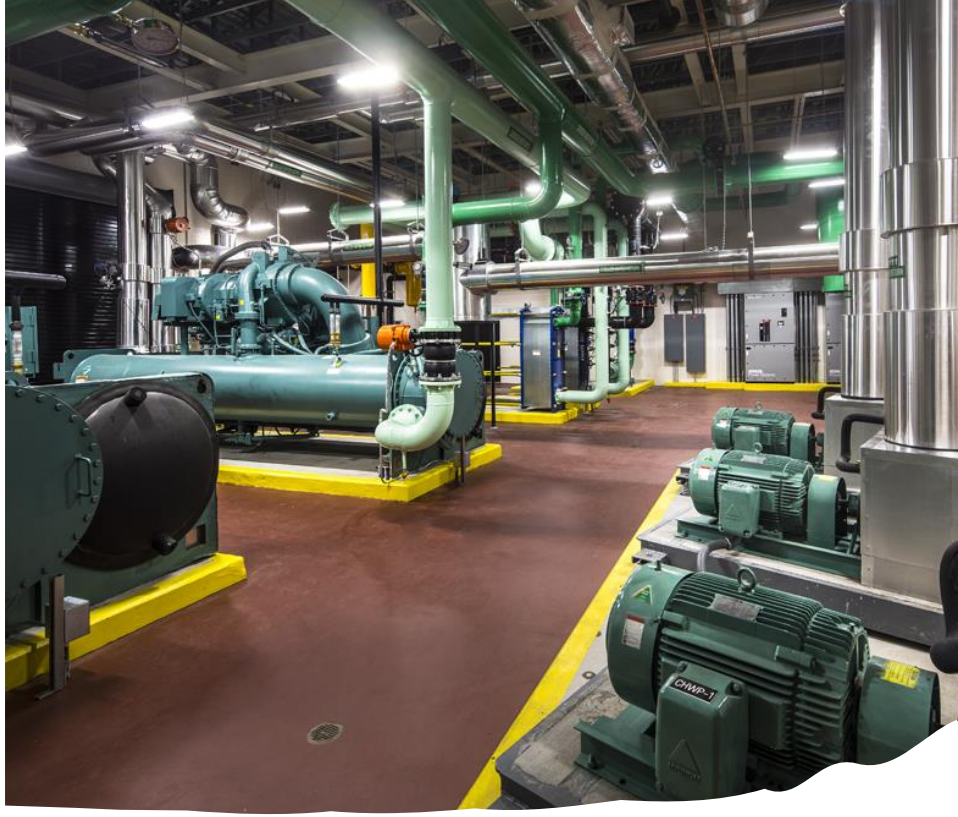
Thermal Energy Networks: *Codes are aligning*







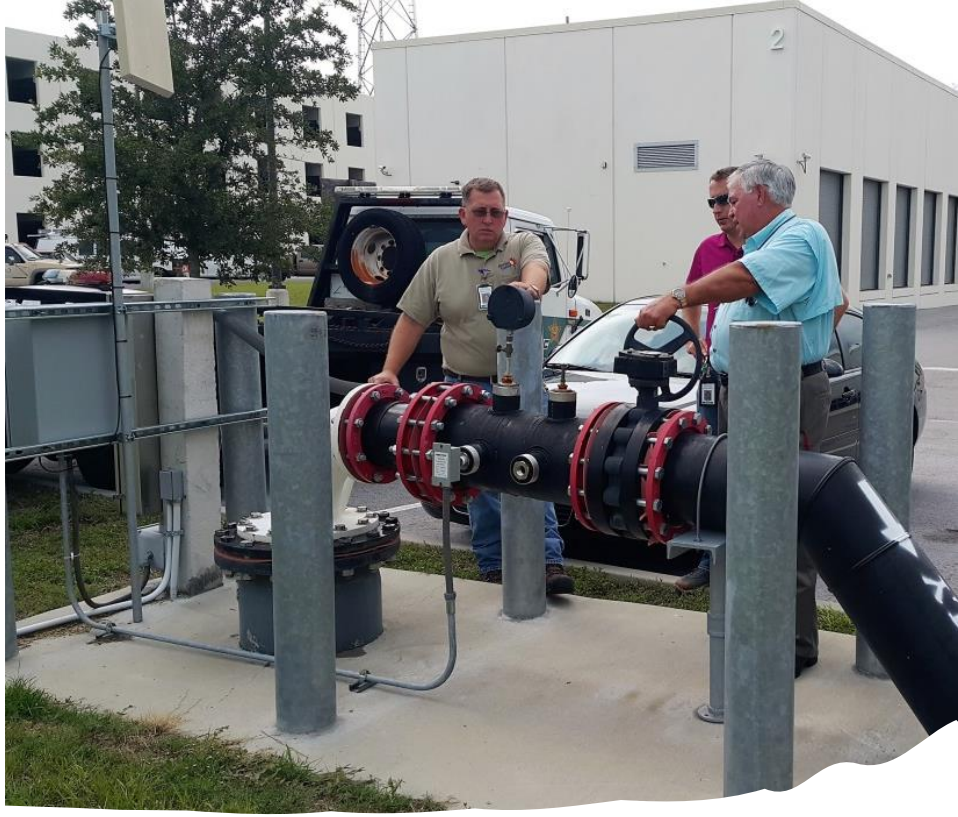
Egg Geo is on the IAPMO USHGC and the UMC 2021 Tech Committee



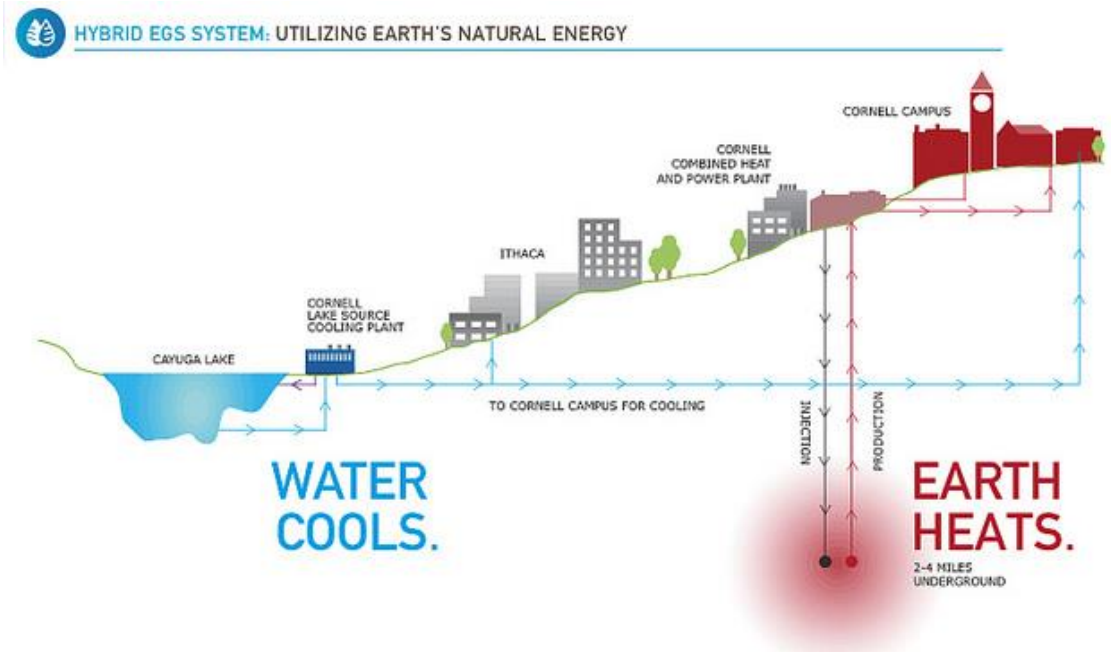
Public School Geothermal Central Energy Plant *(Replaces Boiler & Chiller System)*

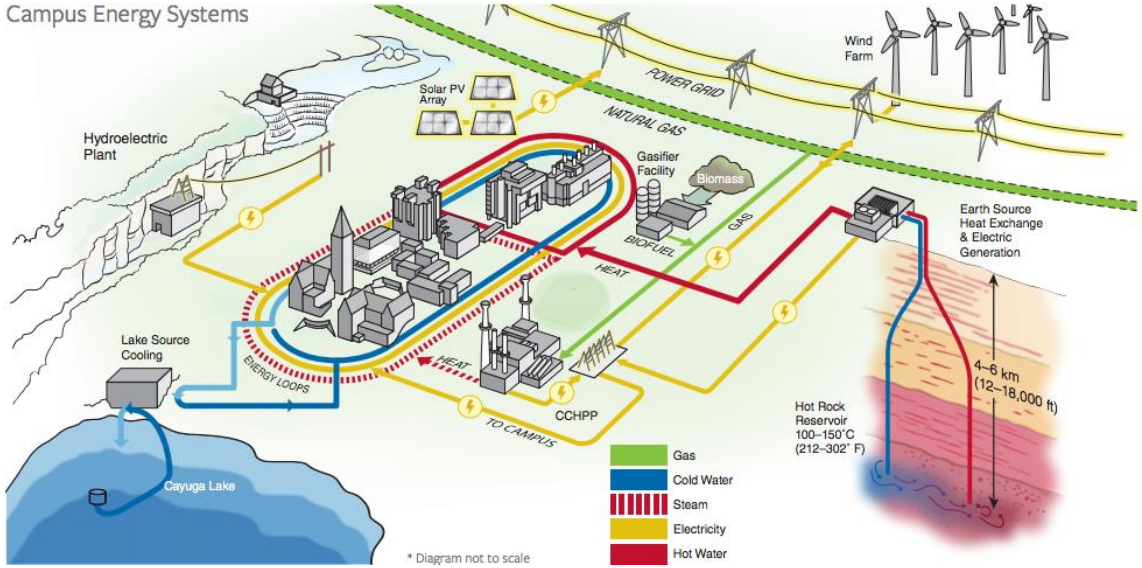
Tampa Church Example

- The result was a reliable system with a 12.5 ton and a 24-ton GHP that will likely last another 60 years.
    - No cooling tower
    - No outdoor condensors
    - Low ambient loads to the compressors (cool mid-70s geothermal exchange water)
    - Simple and reliable
- Other concerns the facility will never have:
    - Outside noise
    - Vandalism
    - Storm damage
    - Gas/propane charges (GHPs eliminate the need for boilers and Heat Strips)



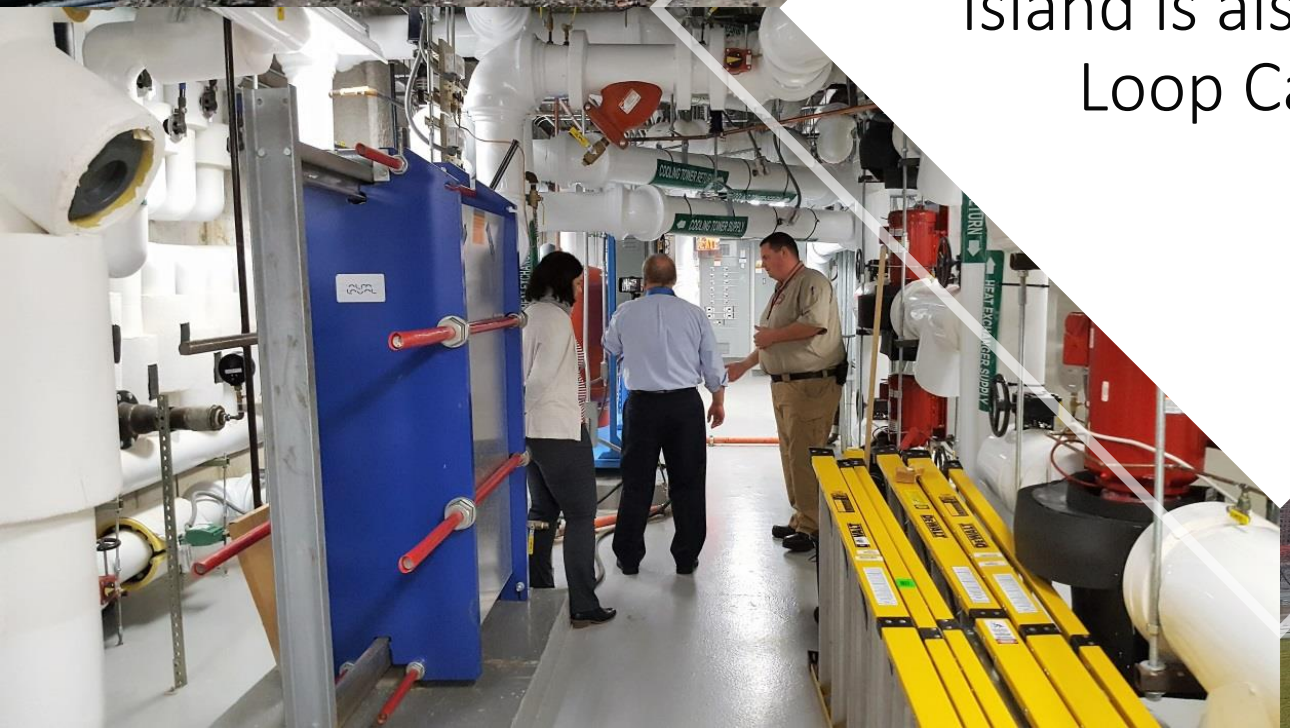
911 Emergency Operations Center & Public Safety Complex *(GW Exchange Replaces Boiler & Cooling Tower)*

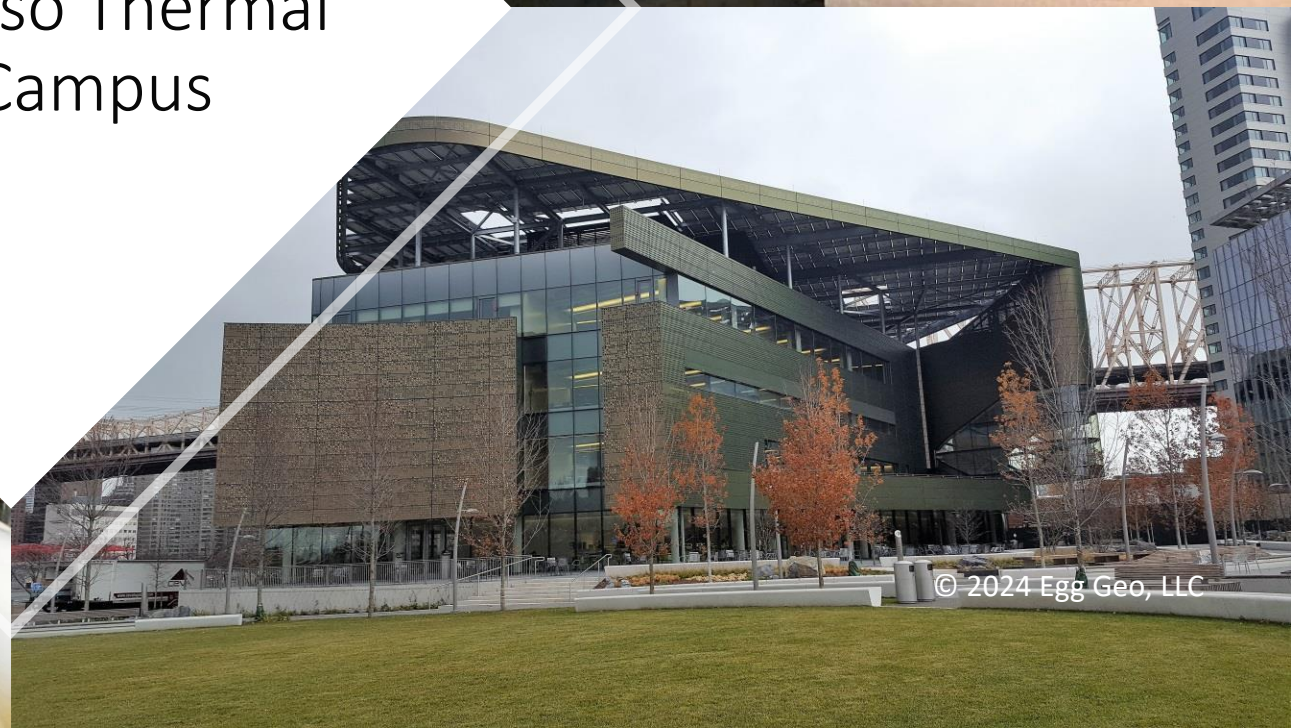




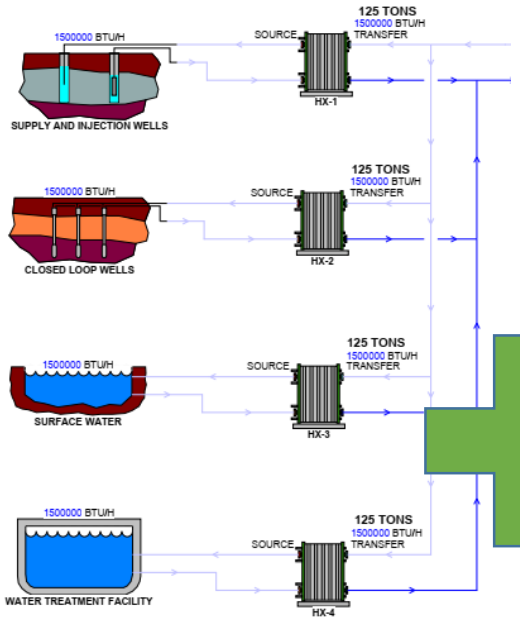
Cornell's Ithaca Campus has a Thermal Energy Network

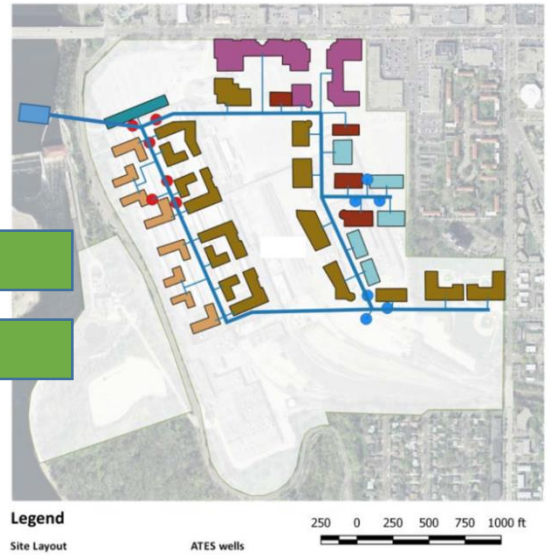
Cornell's Roosevelt Island is also Thermal Loop Campus





Creation of Thermal Energy Networks





Infrastructure Sources + Horizontal Piping Infrastructure = Thermal Networks

(Skilled Labor Unions)

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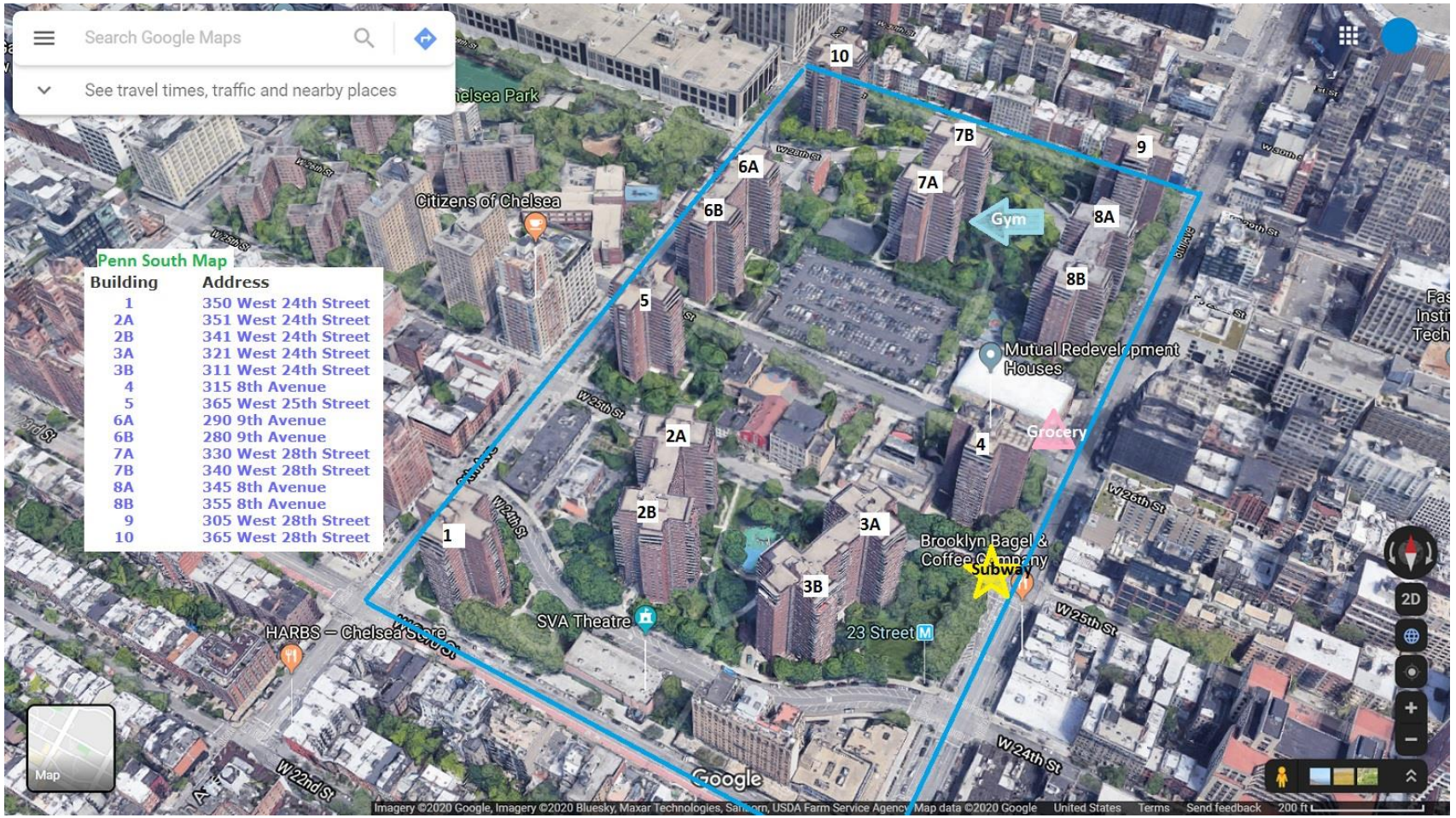
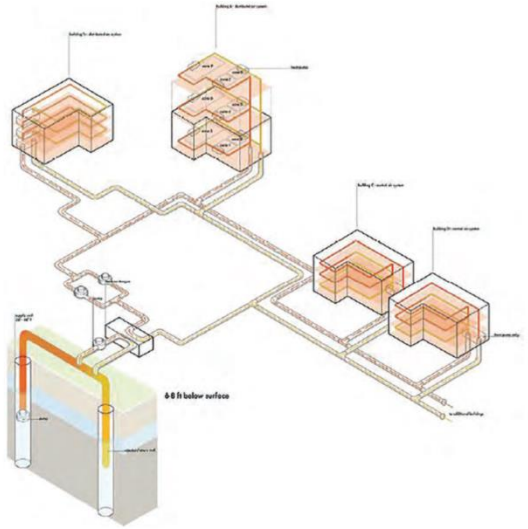
Infrastructure Studies, Coordination & Validation





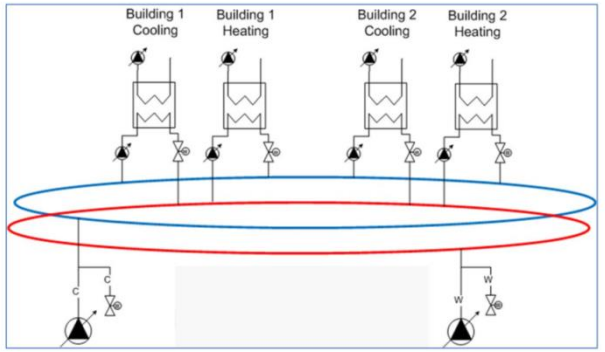
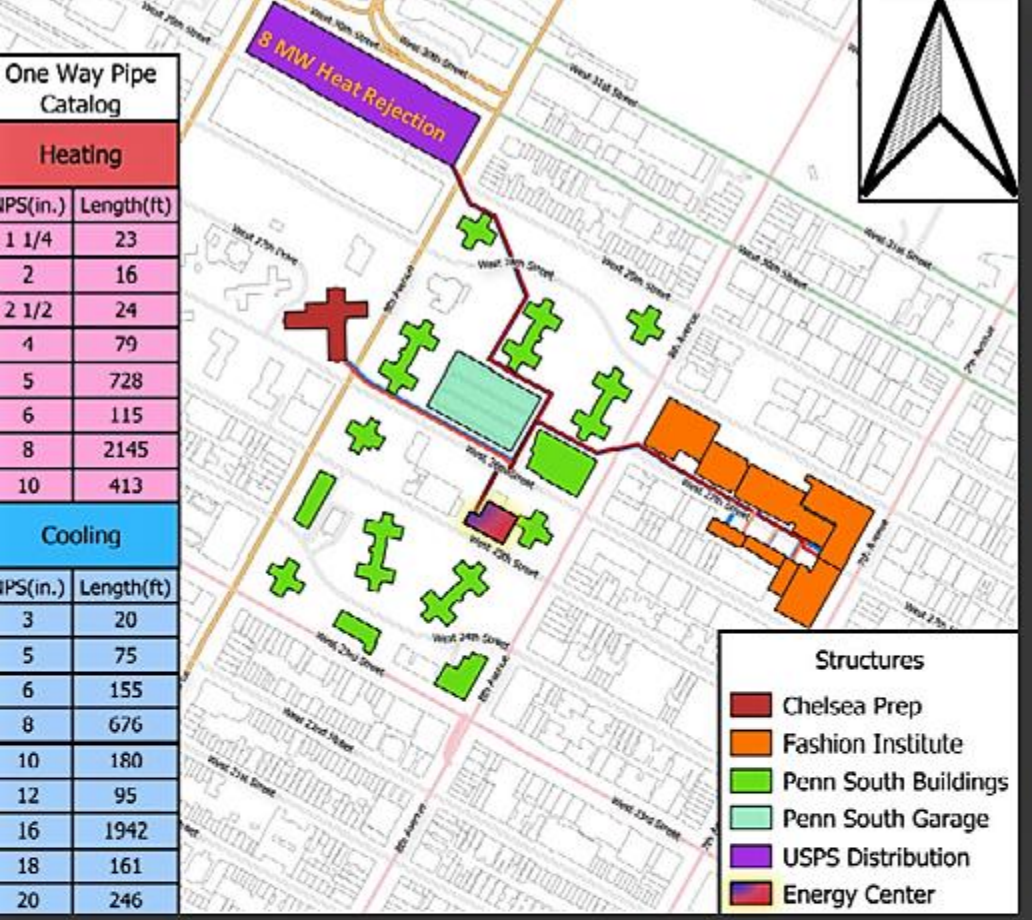


Figure 10 - Two-pipe groundwater distribution, active building connections



One Way Pipe Catalog

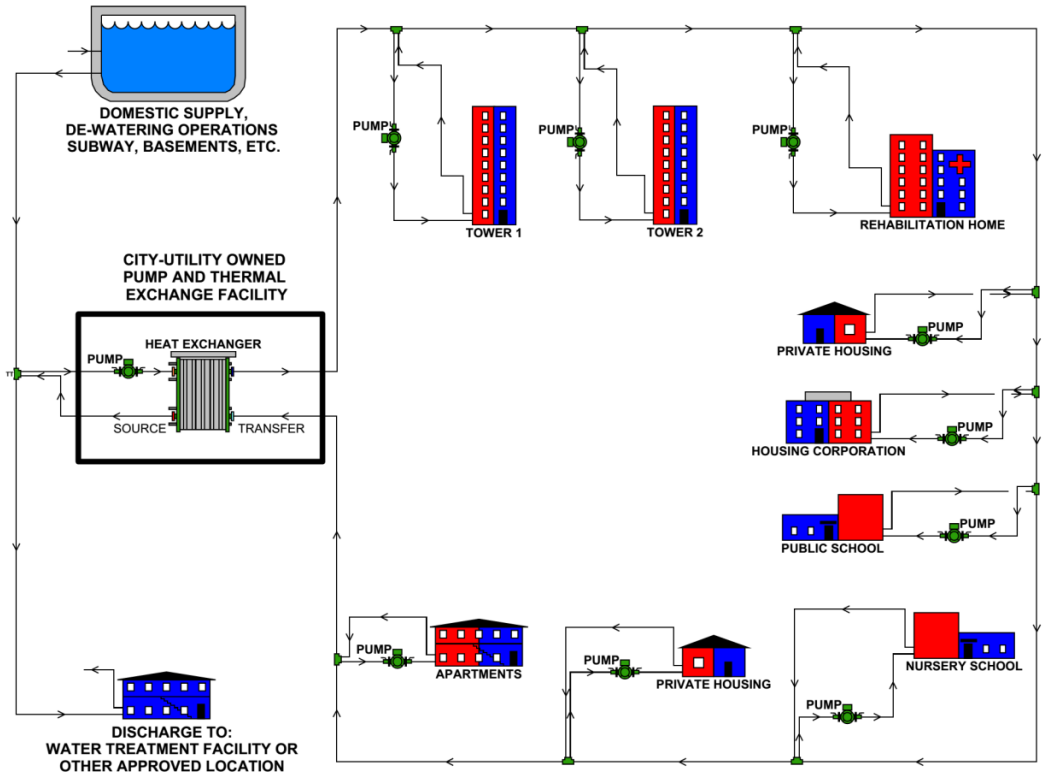
Heating	
NPS(in.)	Length(ft)
1 1/4	23
2	16
2 1/2	24
4	79
5	728
6	115
8	2145
10	413

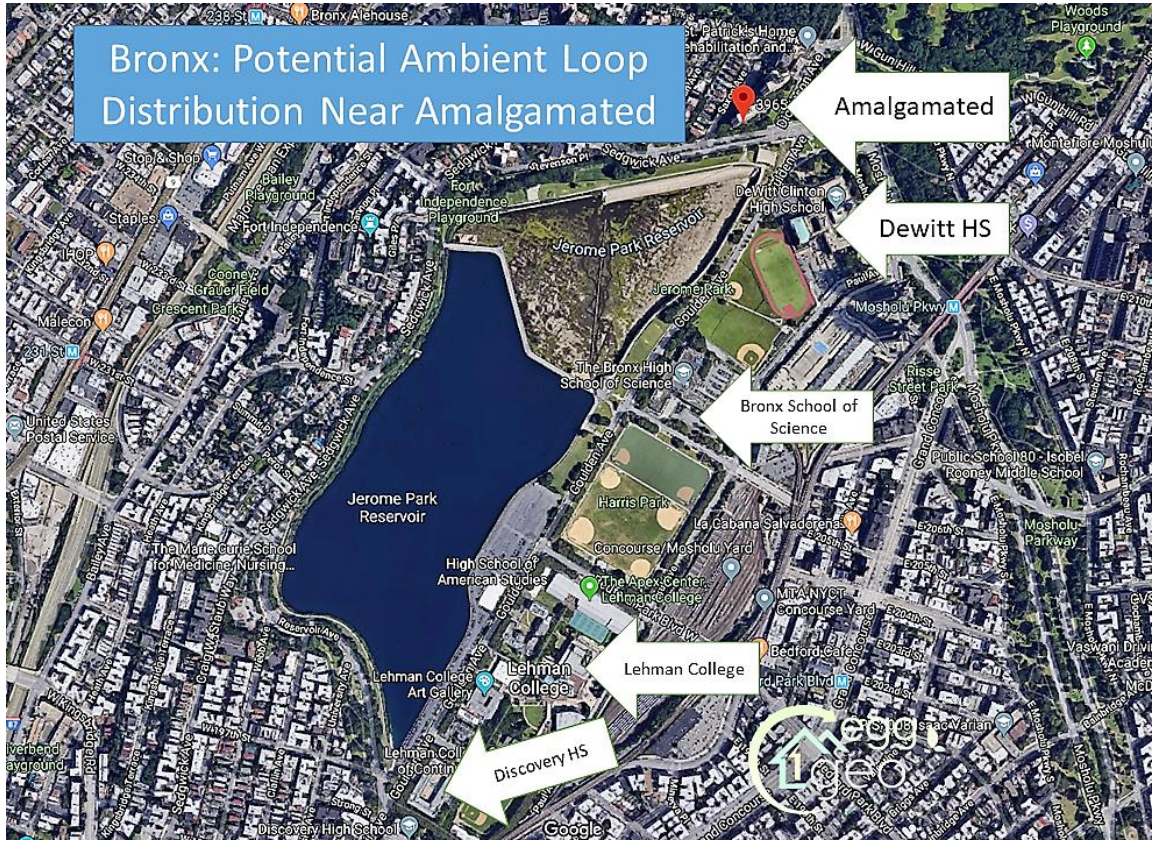
Cooling	
NPS(in.)	Length(ft)
3	20
5	75
6	155
8	676
10	180
12	95
16	1942
18	161
20	246

Thermal Energy Network Modeling

Penn South Campus and Adjoining Properties

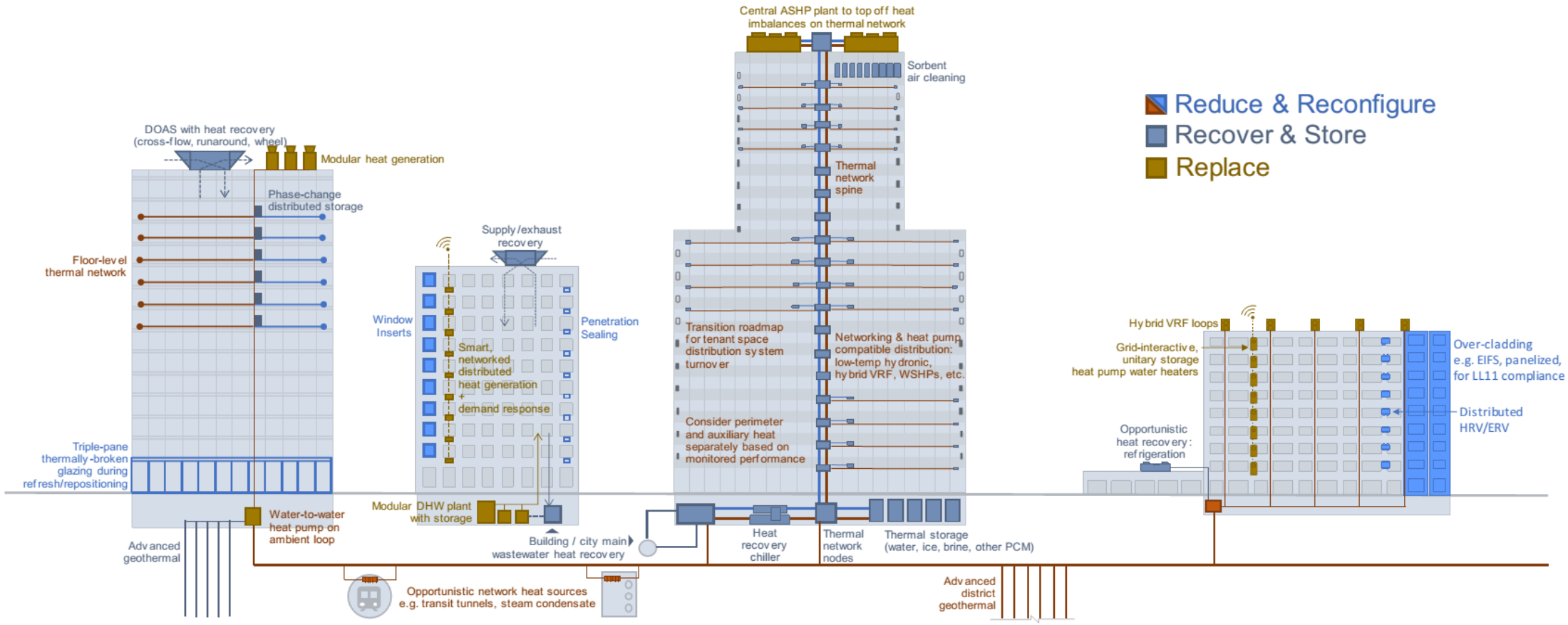
Thermal Energy Network Infrastructure will be installed by our Nation's Pipefitters



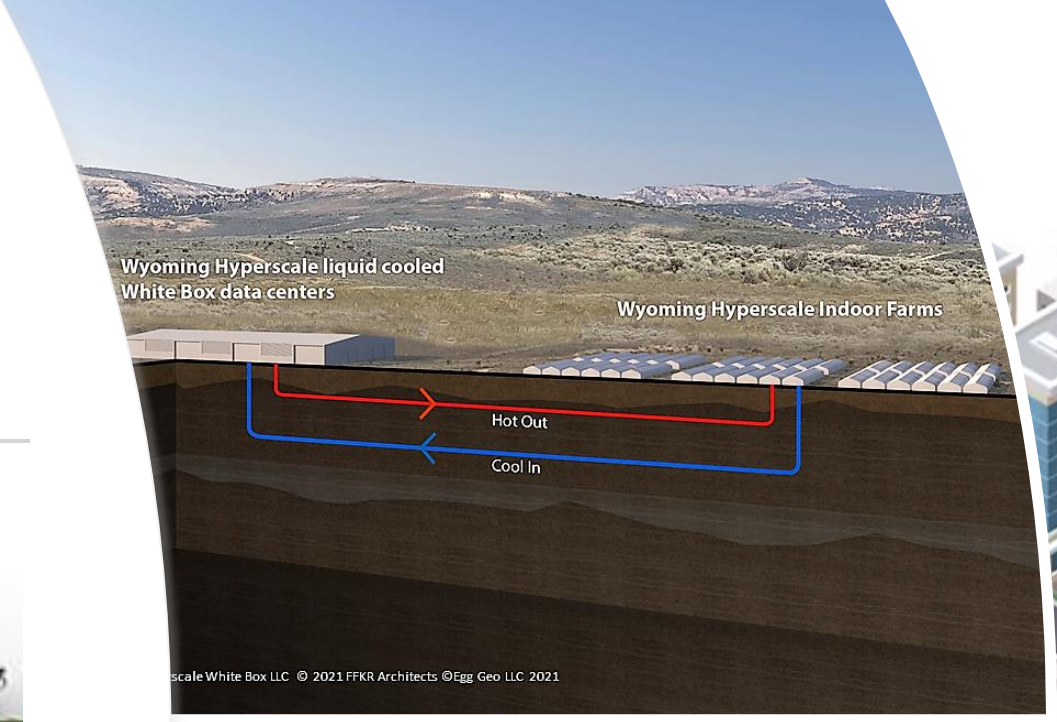


City Layout with Simple Hydronic Software

Thermal Energy Networks - Empire State; Developed for NYSERDA



The heat generated by the datacenter will be used to power an adjacent Indoor Farms operation, which will feed the local community and give them access to fresh produce



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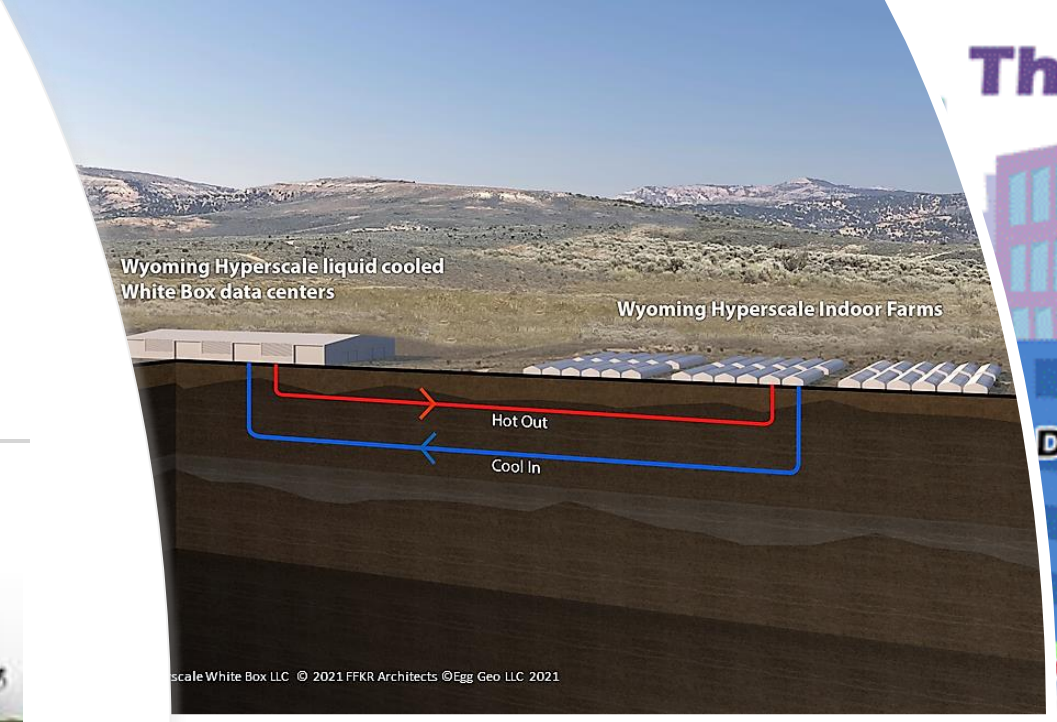

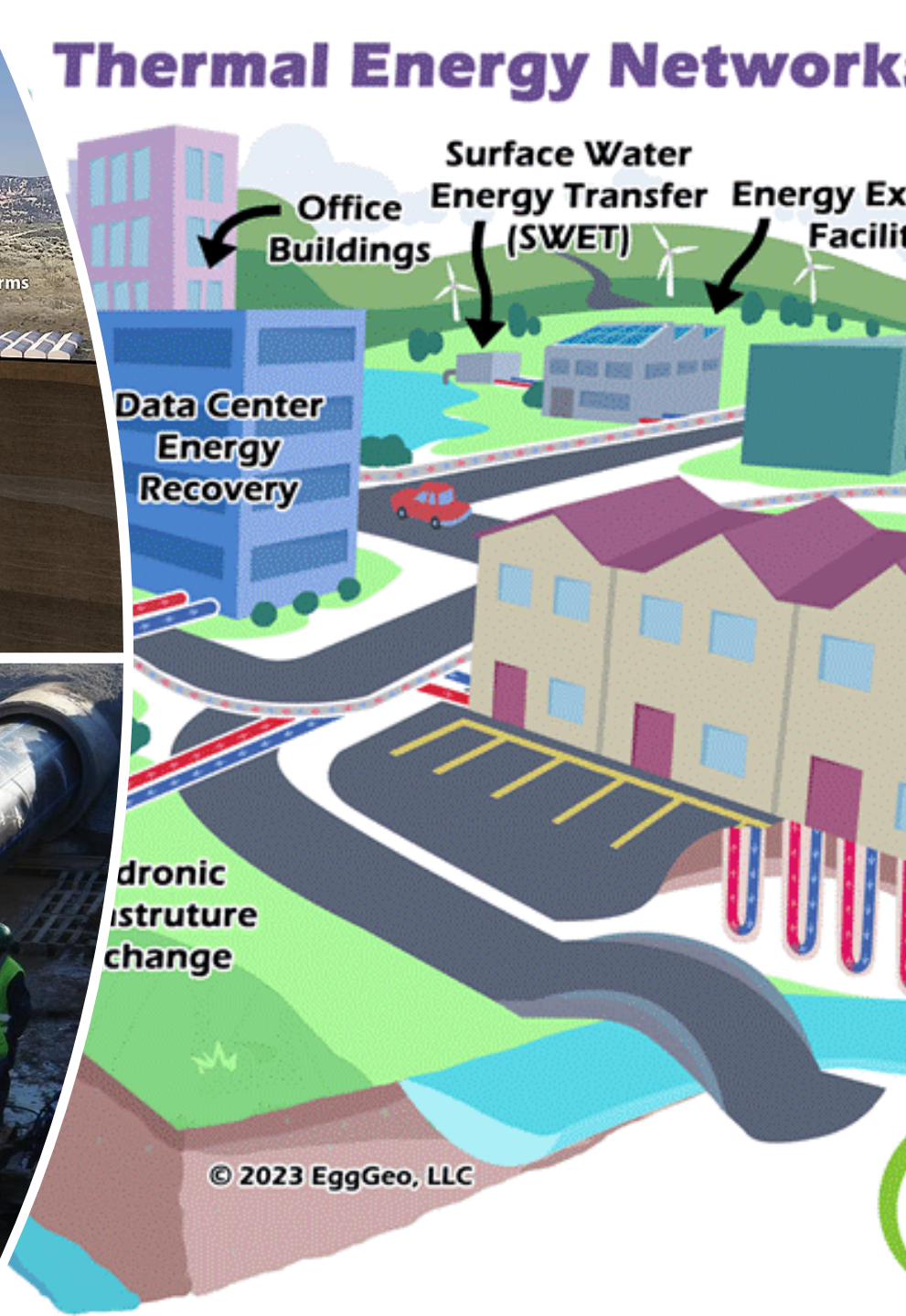

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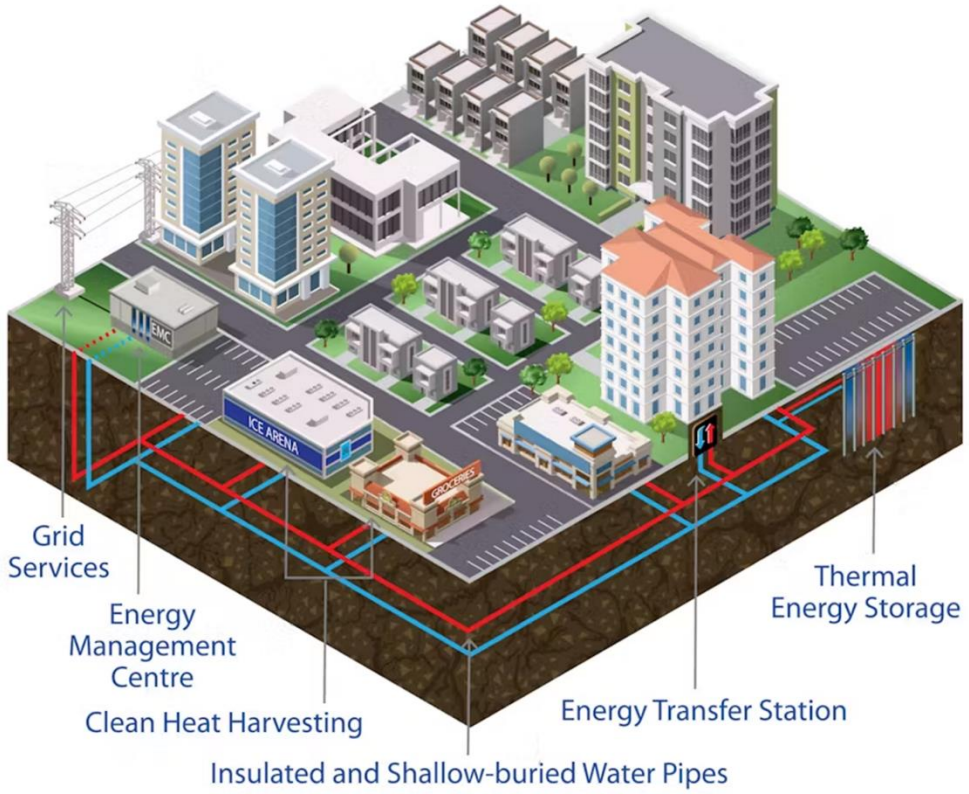
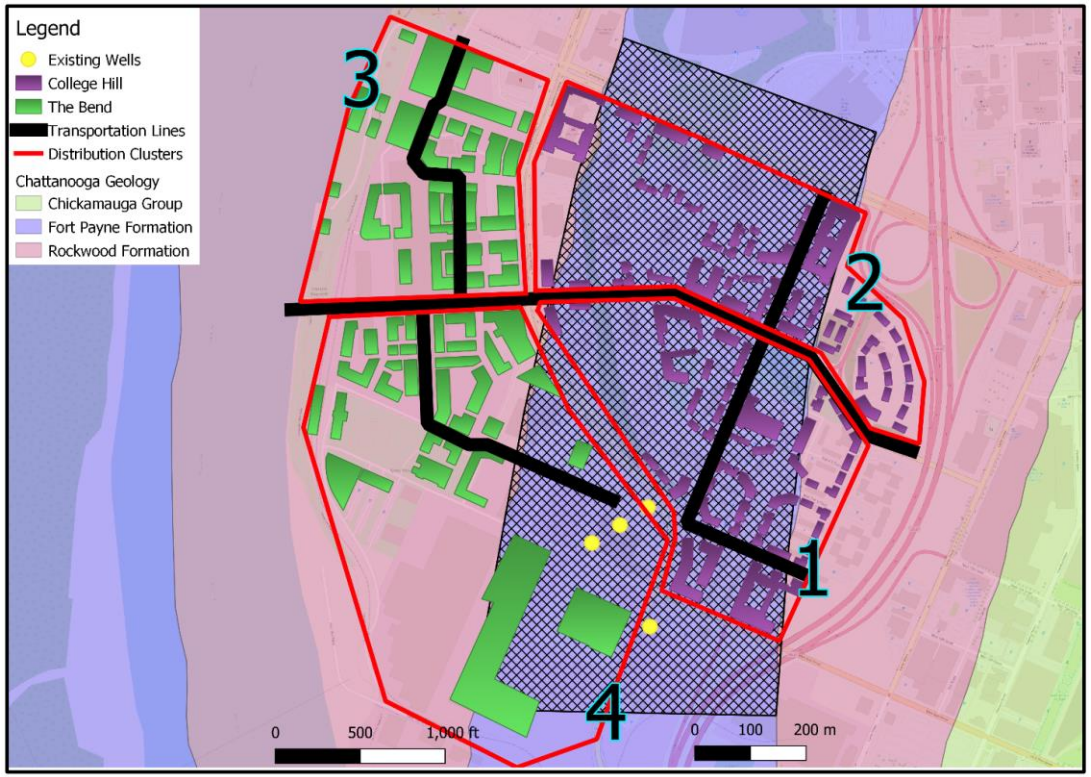
Thermal Network Integration for City Centers





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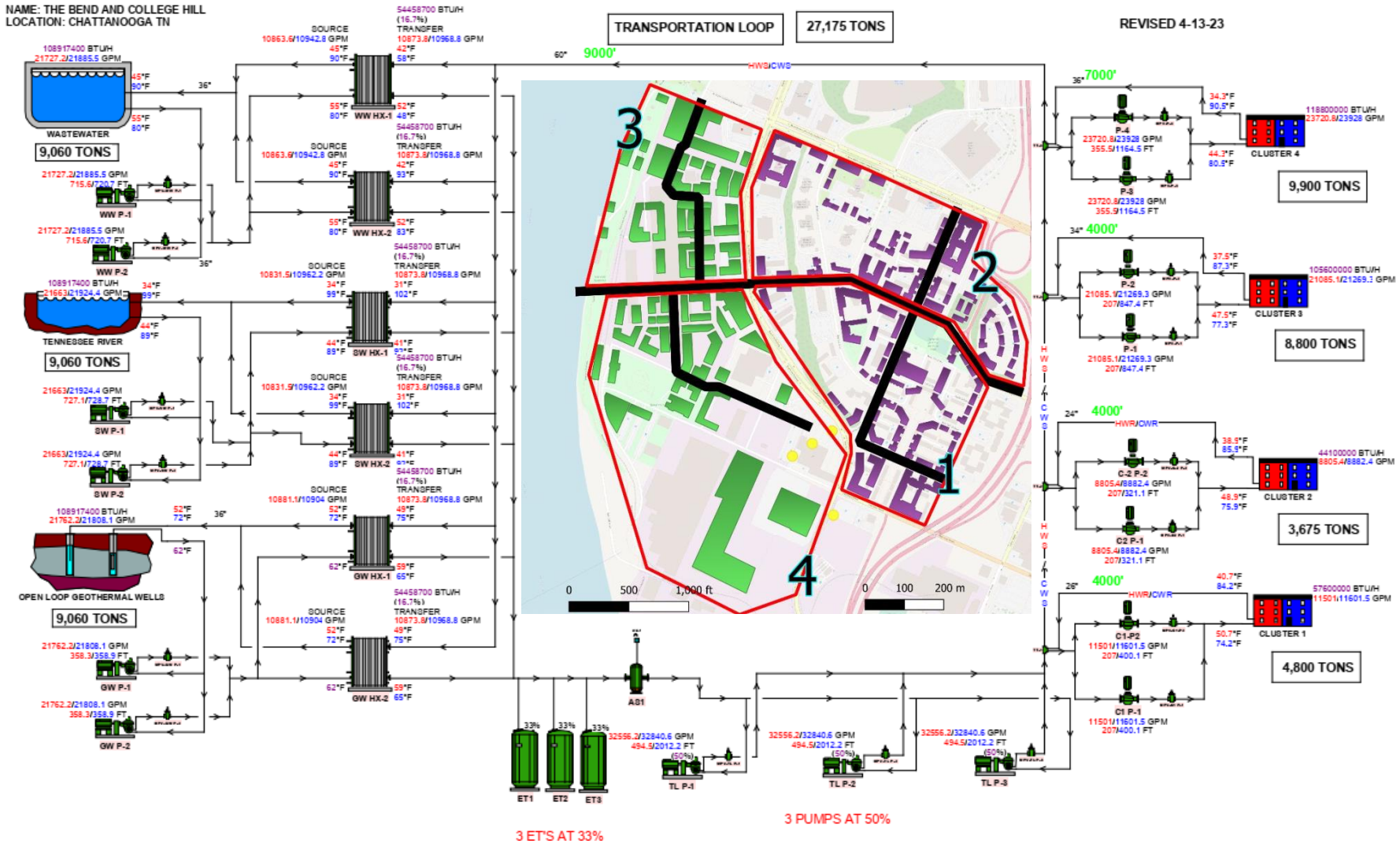
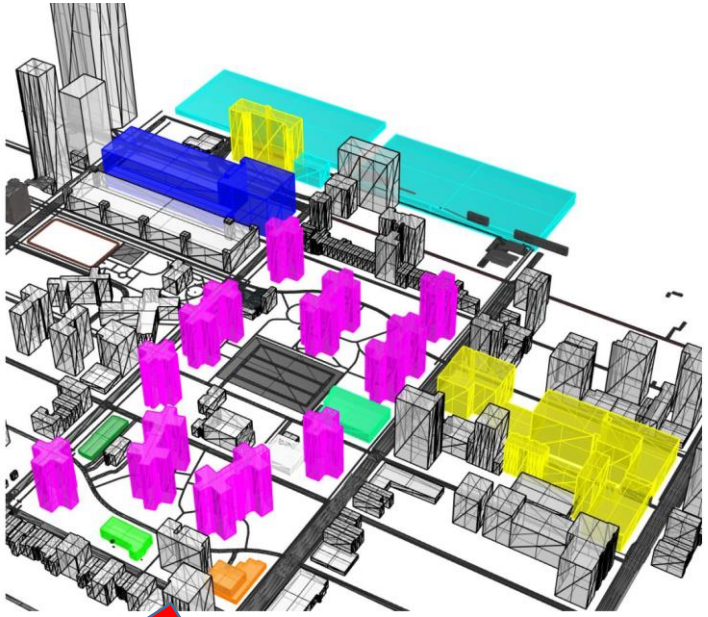


Heat Energy Expelled from Cooling Towers is Piped to the Residential Apartments

Thermal Energy Network Concept:

"TEN"



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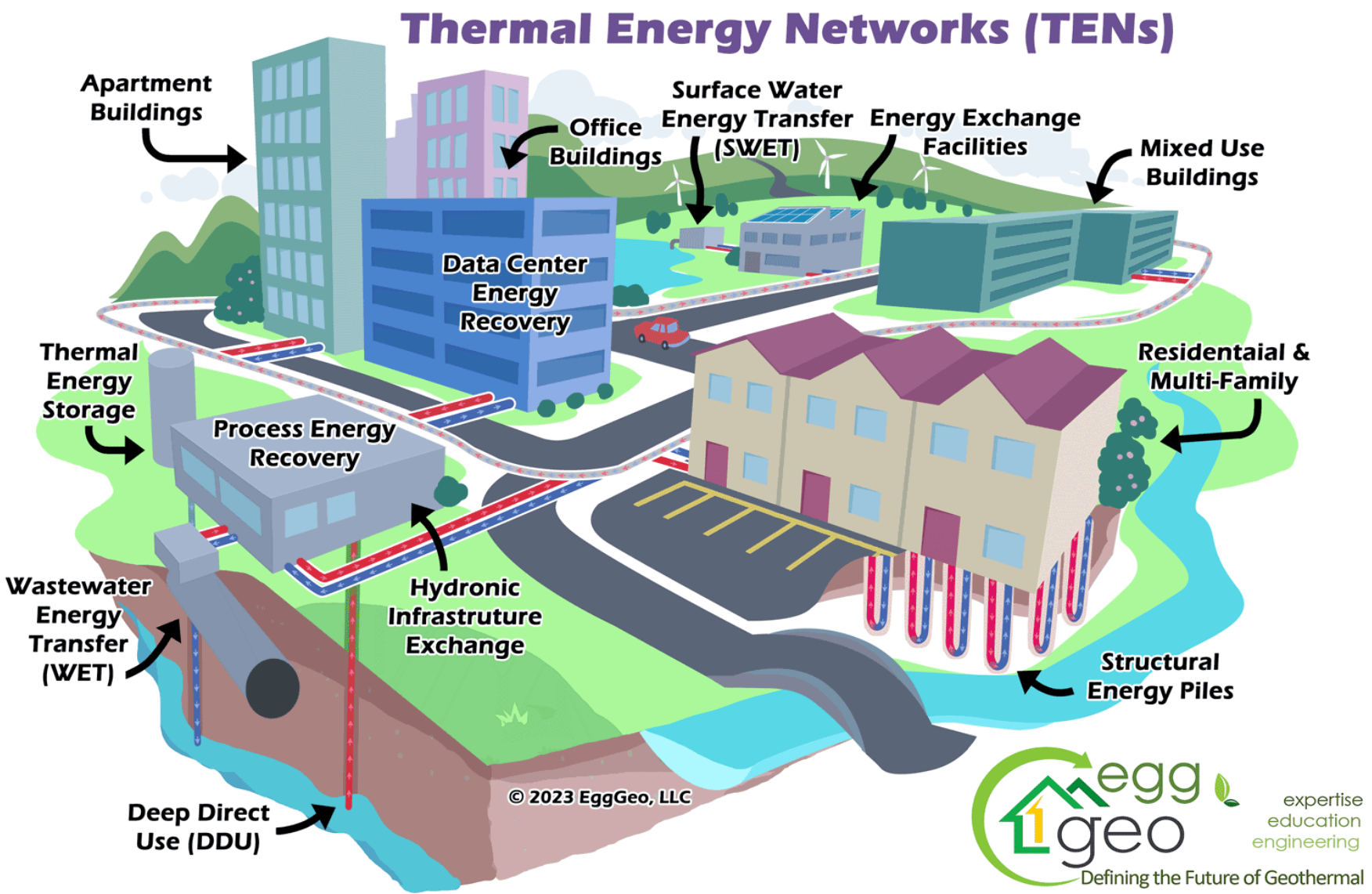

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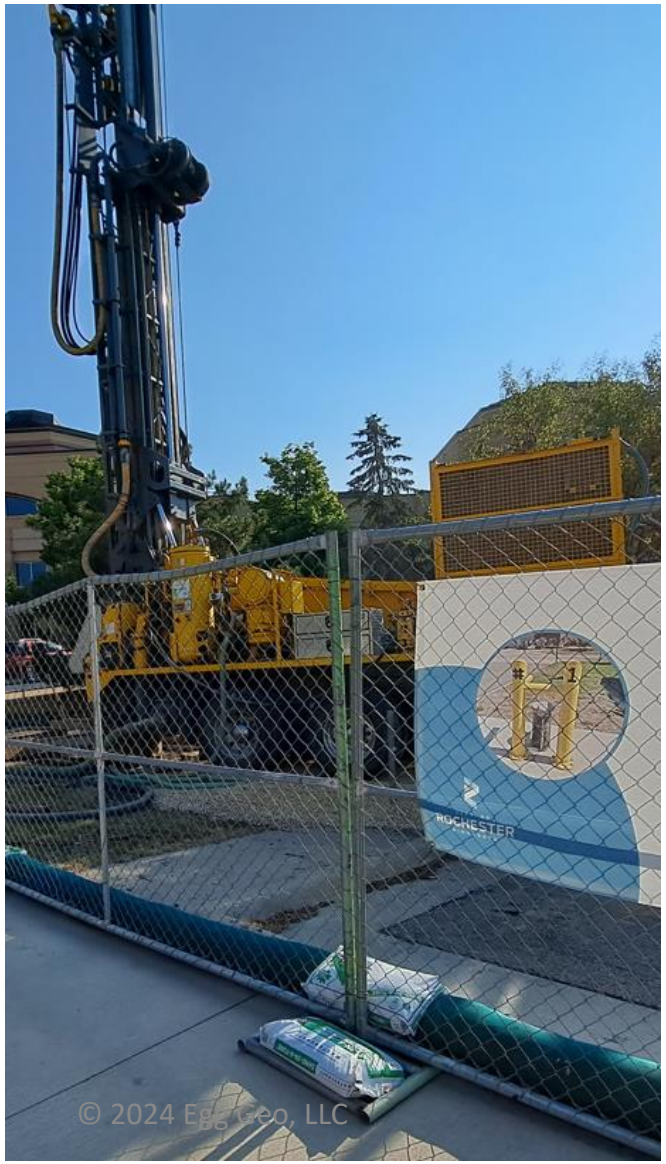

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Main Website