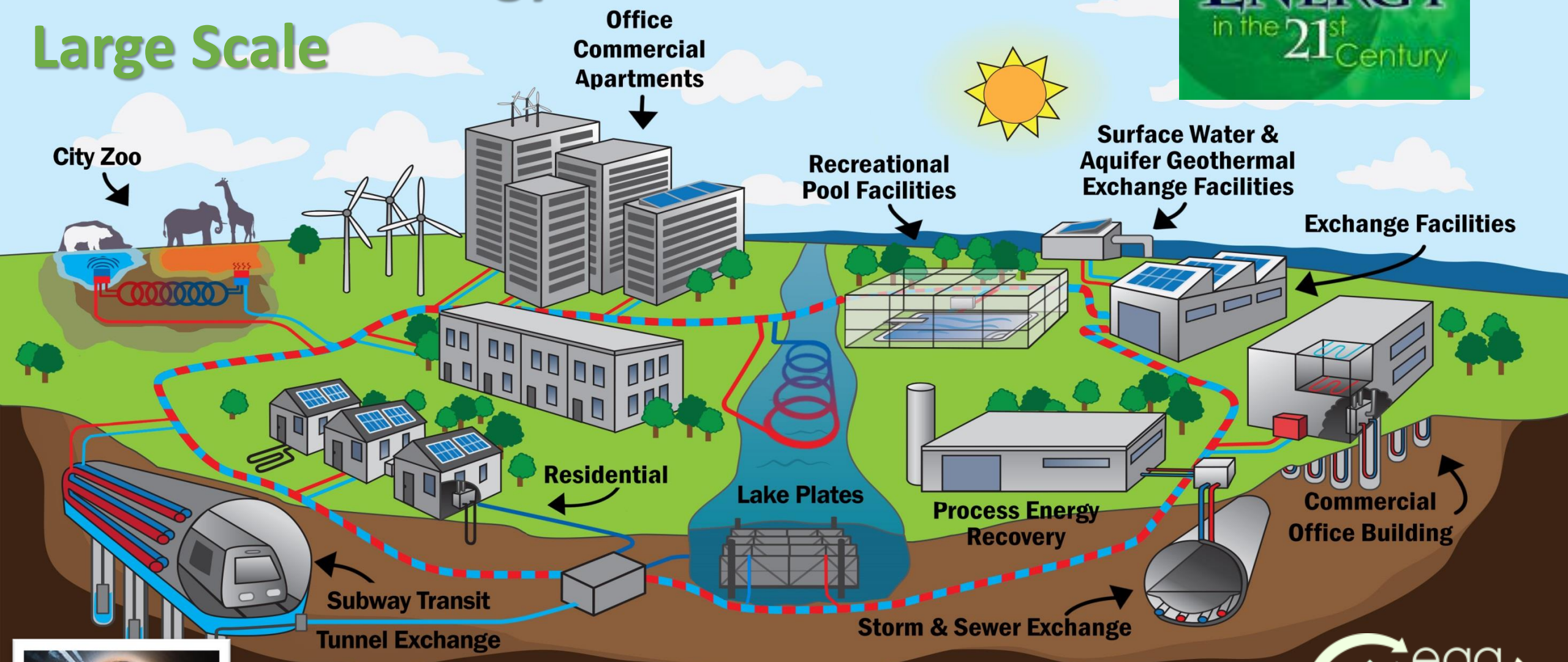
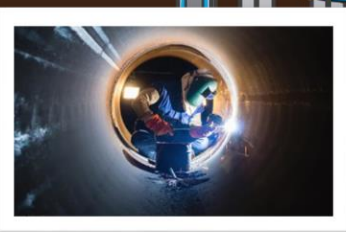


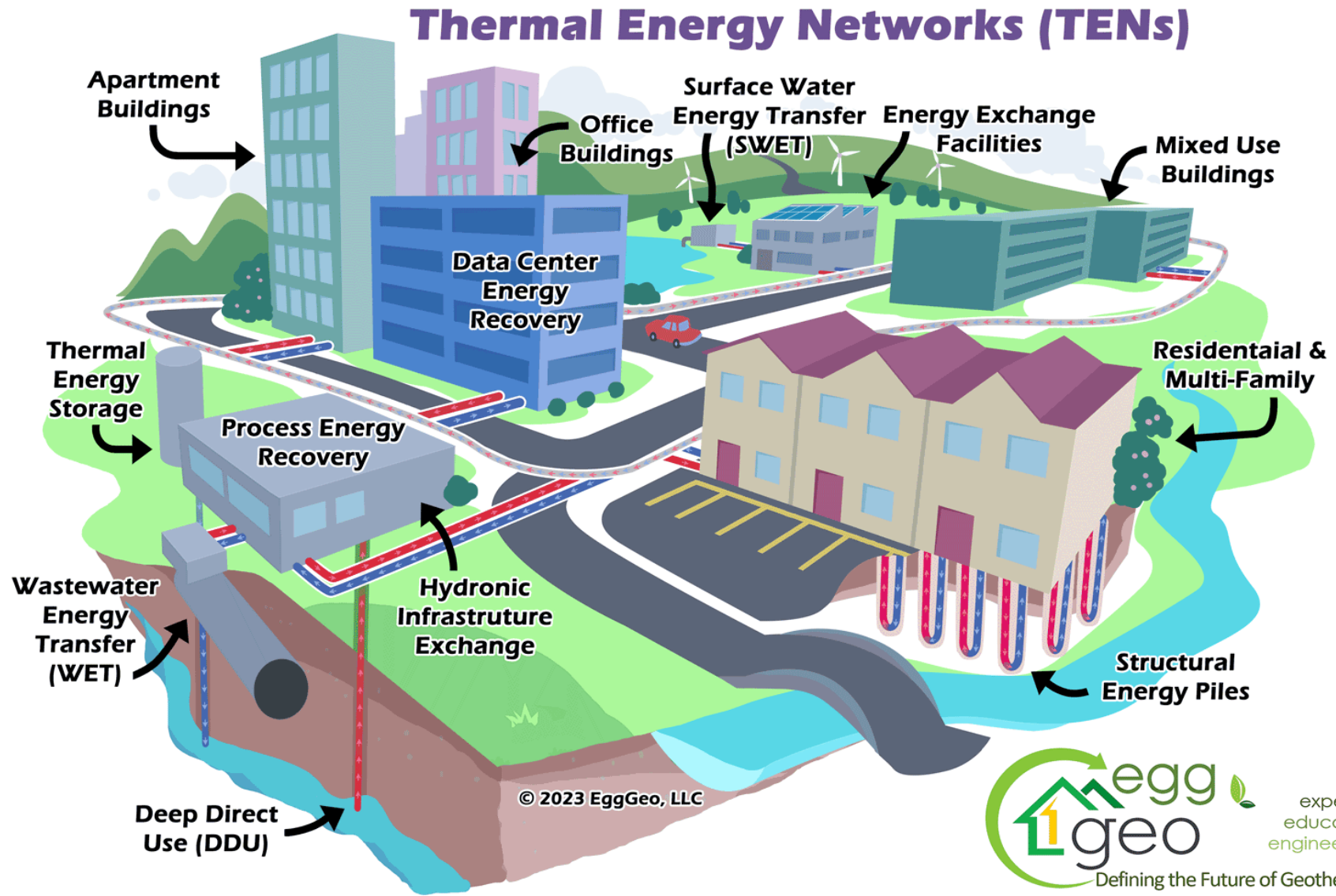
# Geothermal Energy Networks on a Large Scale



Twentieth Annual  
SYMPOSIUM ON ENERGY IN THE 21ST CENTURY



# Geothermal Energy Networks on a Large Scale



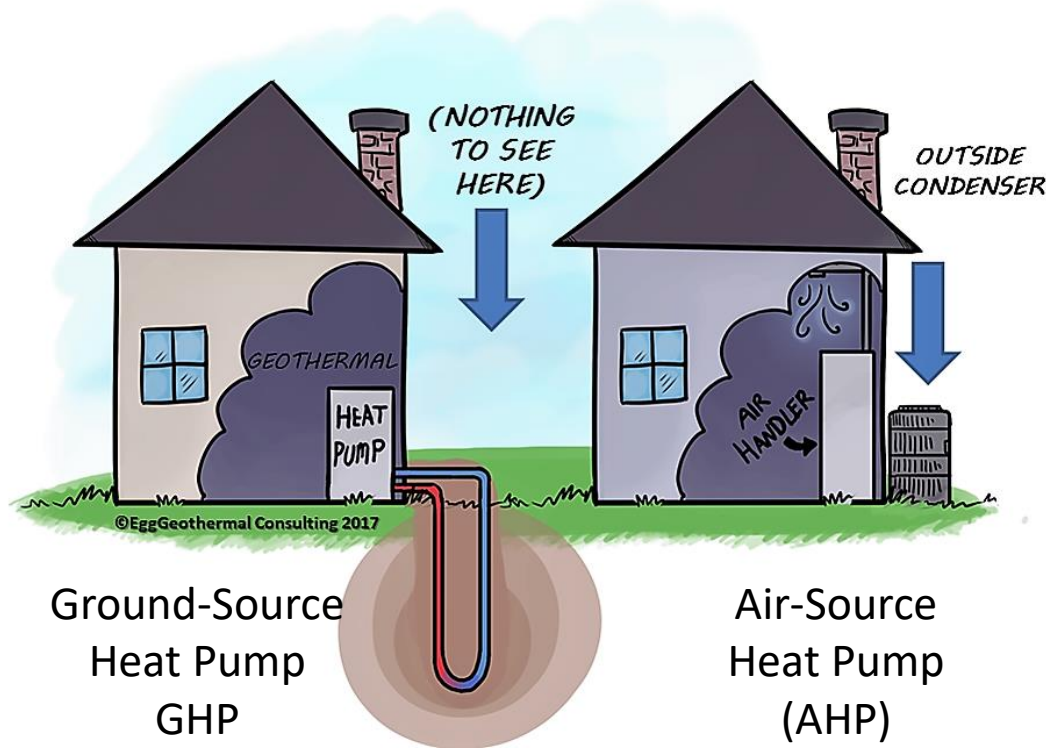
# Both Air Source & Ground Source Heat Pump are All Electric

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

Both use "Renewable Energy"



Nothing outside

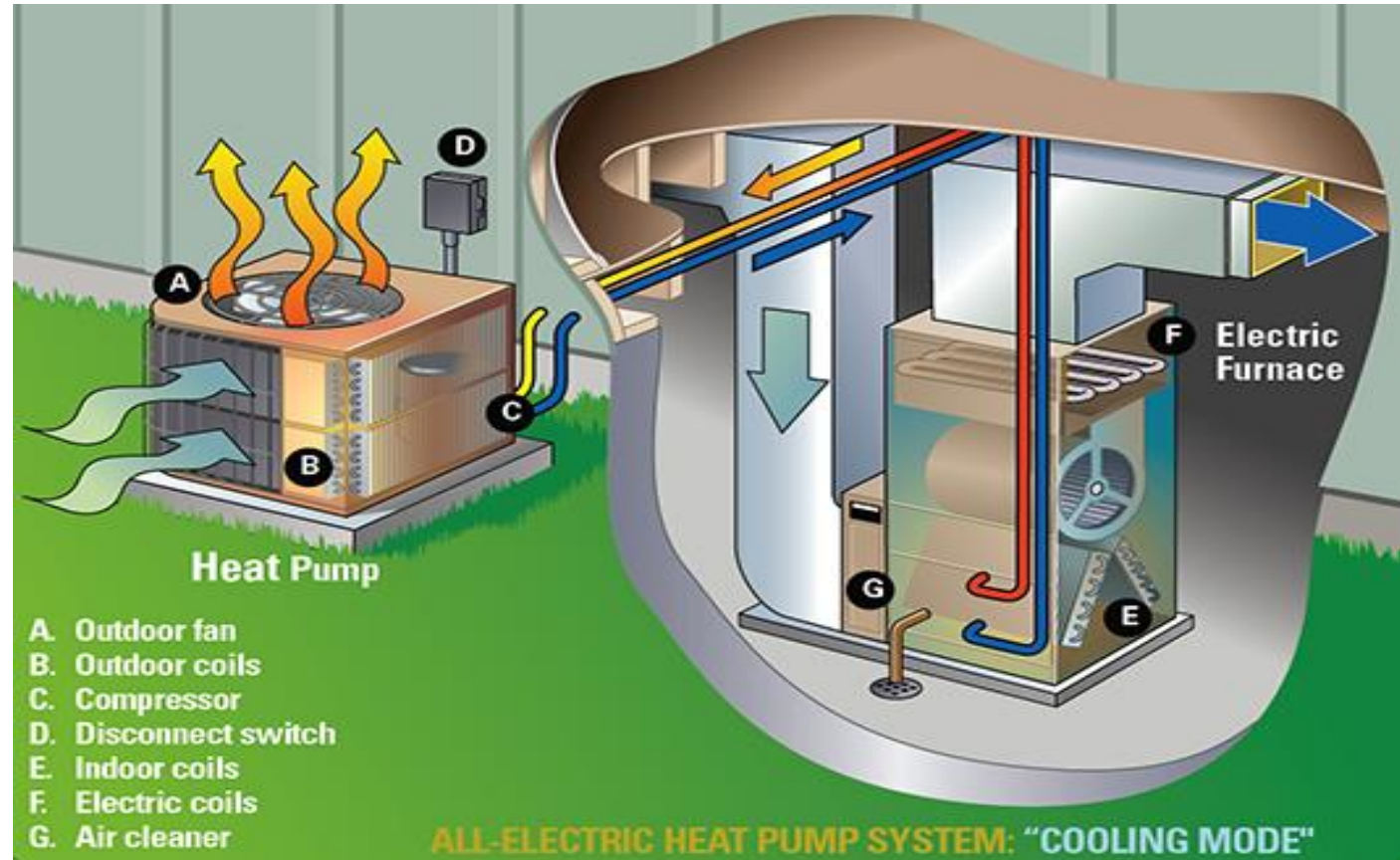
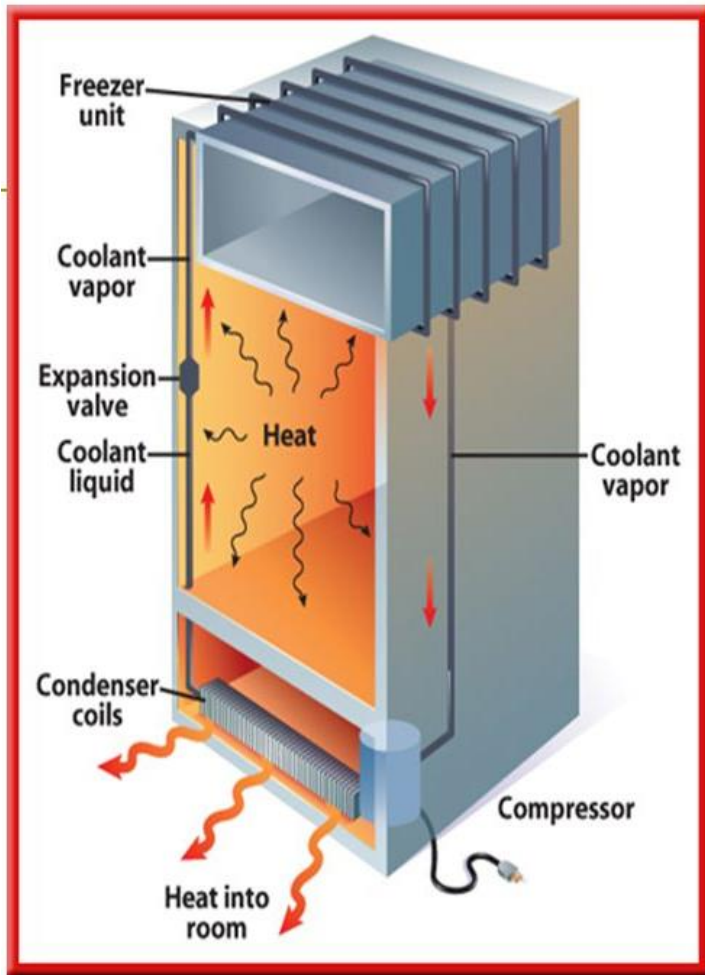


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Remote Outside Condenser

# How to cool & heat spaces by “pumping heat” - exactly like a refrigerator



**Heat Pump = about 3.0 to 5.0 + COP**

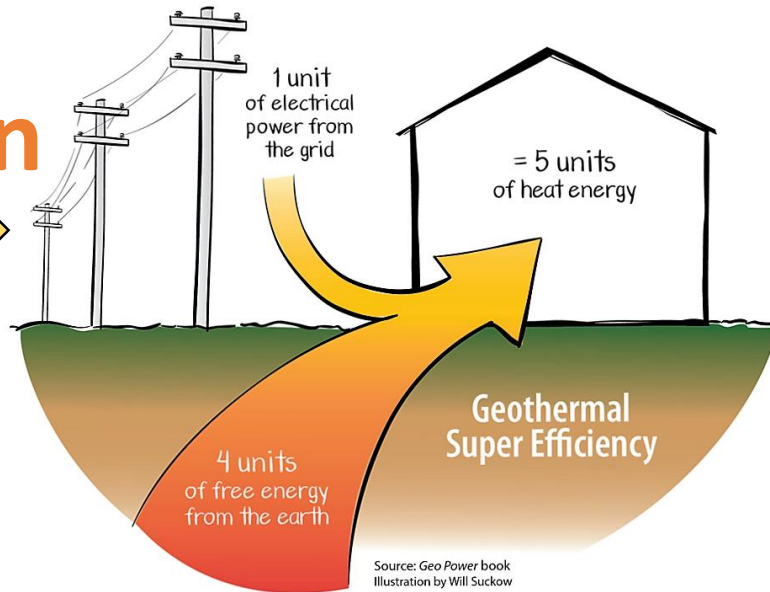
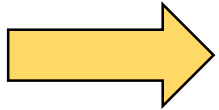
# 1 kW of Electricity = 3412 BTUs/Hr

1 kW in



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

1 kW in



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

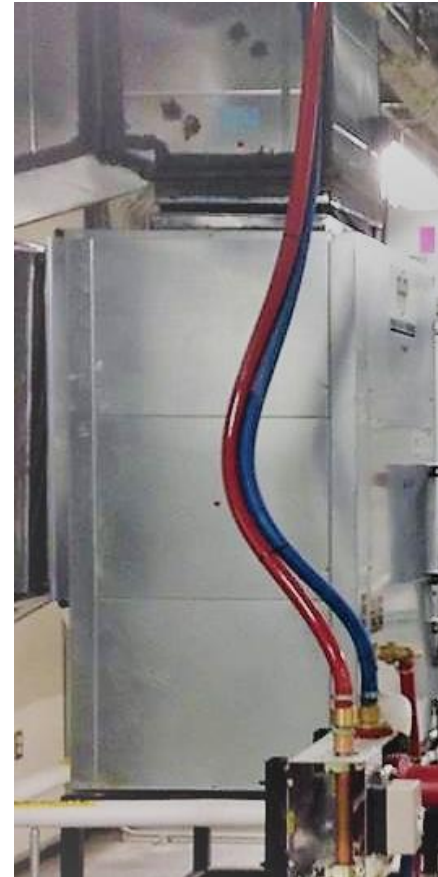
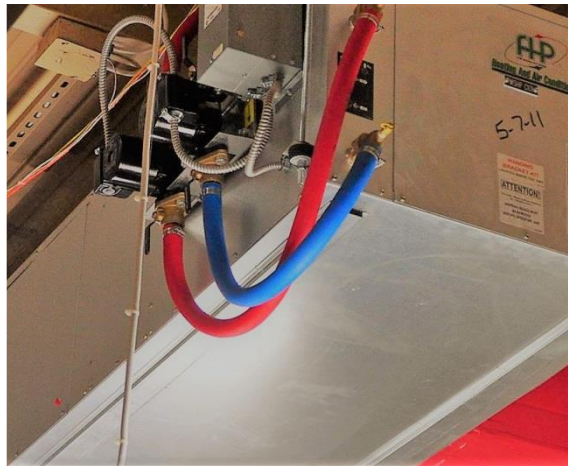
• It takes 20% of the kW to do the same heating with a geothermal heat pump

\*@ 5.0 COP

Source: Geo Power book  
Illustration by Will Suckow

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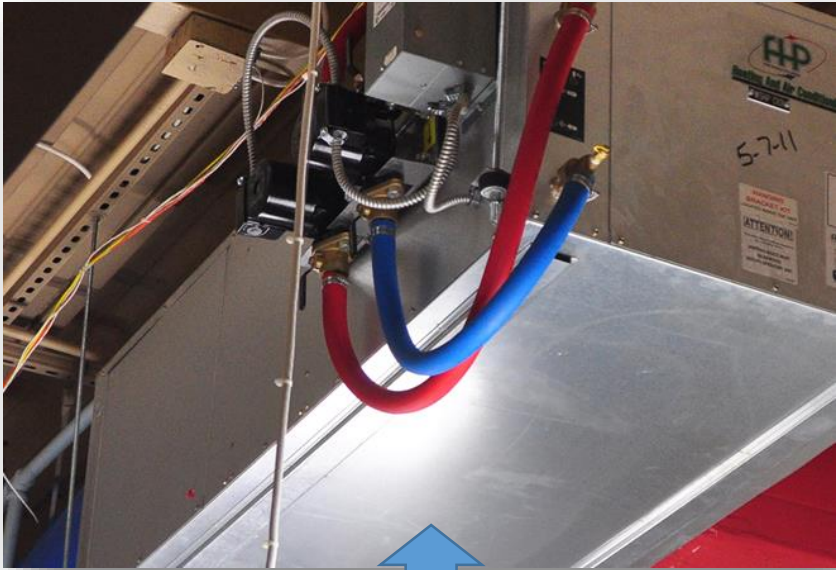
# Like ASHPs GSHPs are also designed to fit every type of structure



# Various Types of Geothermal Heat Pumps (GHPs)



Vertical GHP (water-to-air GHP)



Horizontal; GHP (water-to-air GHP)



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



Modular & Stackable GHPs



# 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

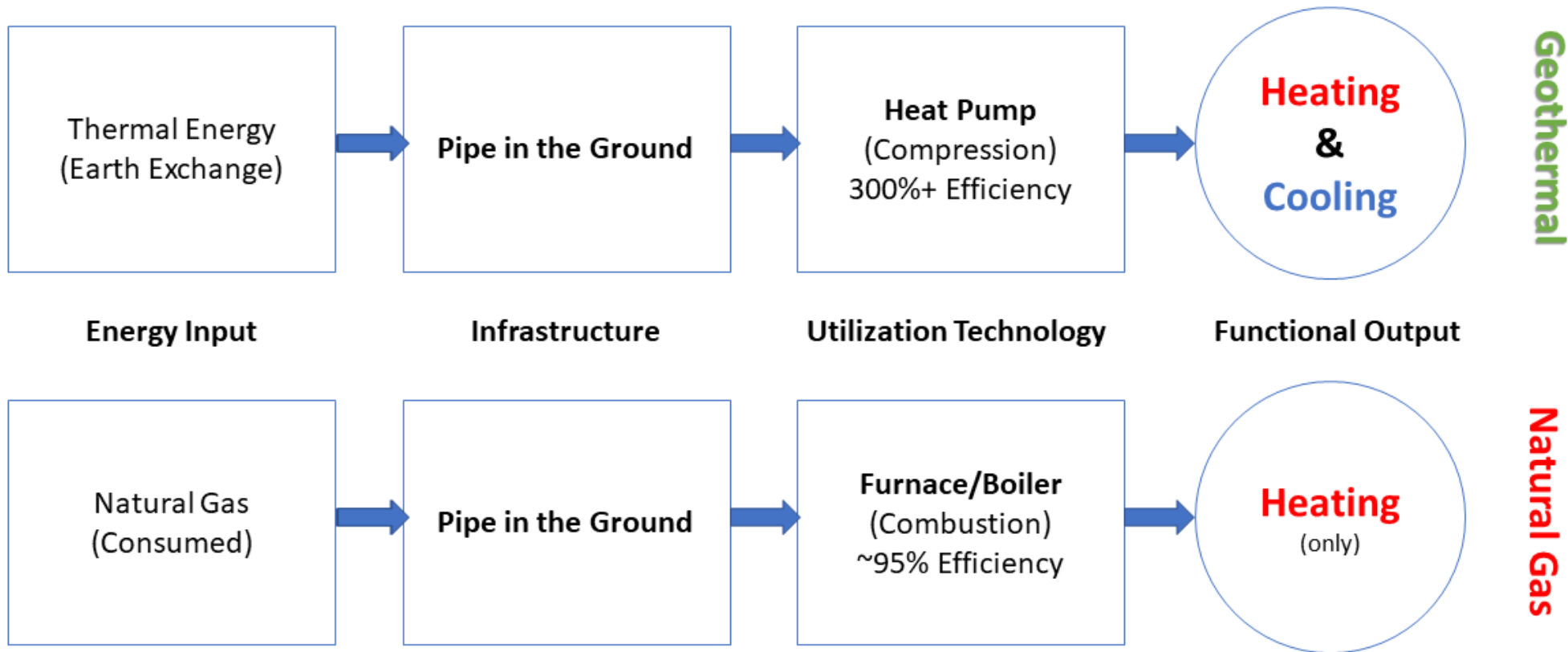


- No more outdoor equipment to replace
- More hurricane and storm resilient (no HVAC equipment outside)
- HVAC system longevity (a benefit of having equipment inside)
- No combustion boilers, cooling towers or furnaces (Decarbonization)
- Noticeably superior comfort in heating and cooling modes
- Remarkable 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**



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this time for  
the UA

**Best practices for the design and engineering of geothermal HVAC systems**

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With a focus on market needs and customer goals, this practical guide explains how to realize the full potential of geothermal HVAC by integrating hydronic systems and controls at maximum capacity. The book explains how to engineer and specify geothermal HVAC for building projects in varying geographic regions. Typical details on control parameters are provided. By using the proven methods in this innovative resource, you will be able to develop highly efficient, long-lasting, and aesthetically pleasing geothermal HVAC systems.

**Jay Egg** is a certified geothermal designer and founder of EggGeothermal, an HVAC services company focused on geothermal technology.

**Greg Cunniff** is an Application Engineering Manager with Taco Hydronics, a manufacturer and world authority in the field of controls and pumping technologies related to geothermal HVAC.

**Carl Orlo** is a geothermal heat pump systems design engineer, serving as Chairman of Water Energy Distributors, Inc. He is a Certified GeoExchange Designer and is sharing his knowledge of 38 years and 14,000 geothermal designs and distribution.

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Instructors:



**Jay Egg, CMC**  
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learn more and register:  
<https://www.eventbrite.com/e/module-1-introduction-to-clean-heating-and-cooling-tickets-153843789917>



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- Installation Scenarios for Heat Pumps
- Air Source Heat Pumps & Ground Source Heat Pumps.
- The Nuts & Bolts of Heat
- Digging Deep into Ground Source Heat Pumps
- So, you're getting a Heat Pump. What now?
- Who Else Has These Heat Pumps?
- What Have We Learned about Clean Heating & Cooling?

Sponsored by SUNY and the New York State Energy Research and Development Authority

# Op Ed and Article in *Standard & Poors*

[https://bit.ly/SandP\\_ThermalEnergyNetworks](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



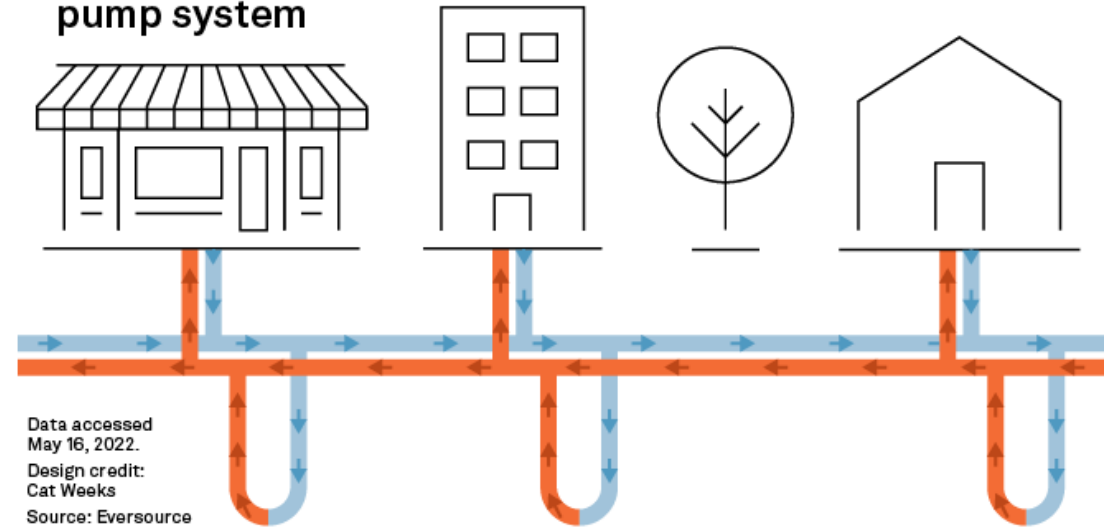
**S&P Global**  
Market Intelligence

## 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.

### Community heat pump system



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

## Newest guide for home buyers – the Live Better Electrically MEDALLION

**MEDALLION HOME**  
**LIVE BETTER ELECTRICALLY**

You'll get more news to help you Live Better Electrically on three popular TV shows:  
Westinghouse-Daily Playhouse—Beginning Oct. 6—CBS Network—Monday—10 P.M. (N.Y.T.).  
General Electric Theater—CBS Network—Sunday—9 P.M. (N.Y.T.).  
Whirlpool—Perry Como, Bob Crosby, The Investigators and Today Is Ours—NBC Network.

**Betty Furness**  
WESTINGHOUSE

**Ronald Reagan**  
GENERAL ELECTRIC

**Fran Allison**  
WHIRLPOOL

This new Medallion assures you a home has been inspected by the local electric utility... meets modern standards for wiring, appliances and lighting. Look for the Medallion. It means a wonderful new way of life for you and your family!

What Sterling is to silver... that's what this Medallion is to a new house! It's the new national symbol of the finest in electrical living. Let these three top TV stars, speaking here for the electrical industry, tell how you save trouble, time, and money by choosing a home that wears the Live Better Electrically Medallion.

**BETTY:** In a Medallion home, you start right off with a modern electric range, plus at least 3 additional major appliances, maybe more. They're installed, ready to go to work the day you move in! Appliances are easier to pay for this way.

**RONNIE:** The lighting in every Medallion home is specially planned, too. It provides better light for better sight, plus new beauty for your home. You also get full Housepower. This means enough power, wiring, circuits, switches, and outlets to handle all the appliances you want to use.

**FRAN:** You'll be glad all your life you bought a Medallion home. Read below what a few of the thousands of new Medallion home owners think of them. Then go see the Medallion homes in your neighborhood. Your electric utility will tell you where they are.

**New Ideas for Better Living**

The new Medallion is backed up by home builders, electric utilities, and electrical manufacturers (Frigidaire, General Electric, Hotpoint, Kelvinator, Thermador, Westinghouse, Whirlpool, and others). This year, utilities will award Medallions to 100,000 new homes—in every style and price range across the country. You'll see lots of new ideas in the Medallion homes on display now!

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

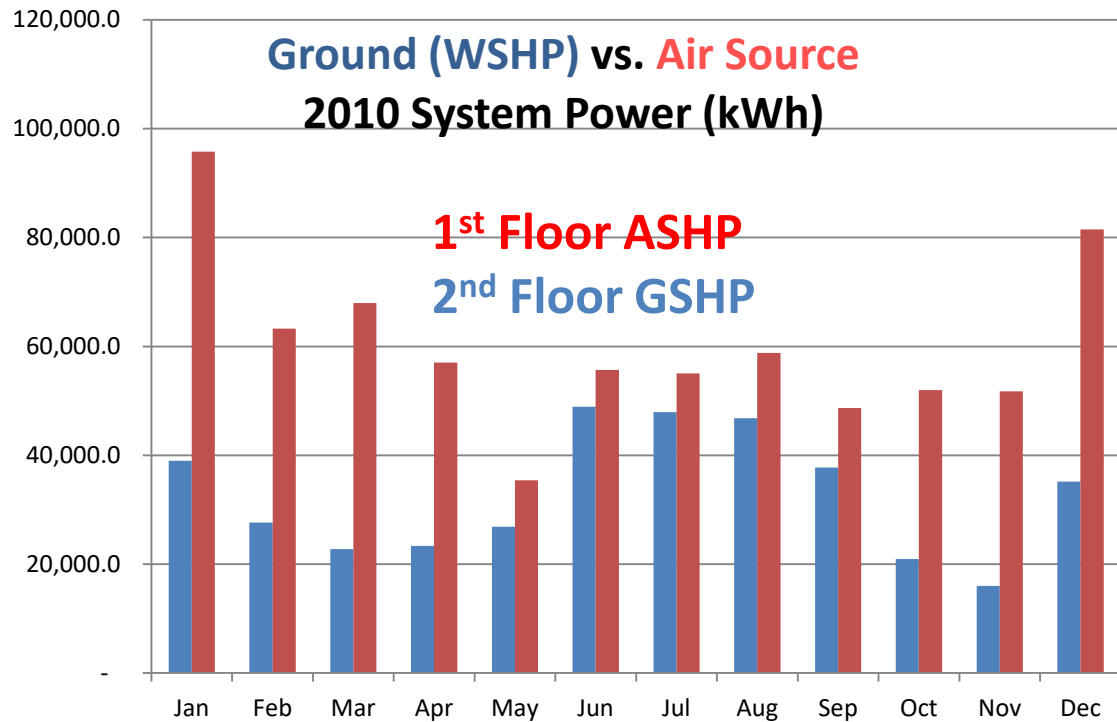


## Decarbonization = Electrification

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



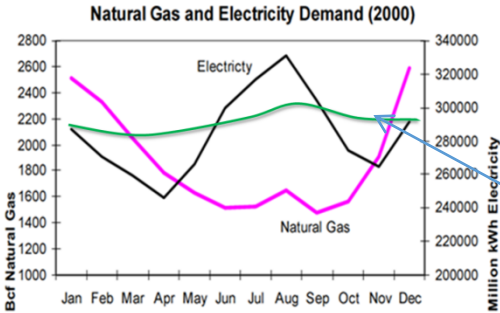
Power Consumption at ASHRAE Bldg, Atlanta



# Electrical Load is “leveled out” using WSHPs

- Utility Benefits

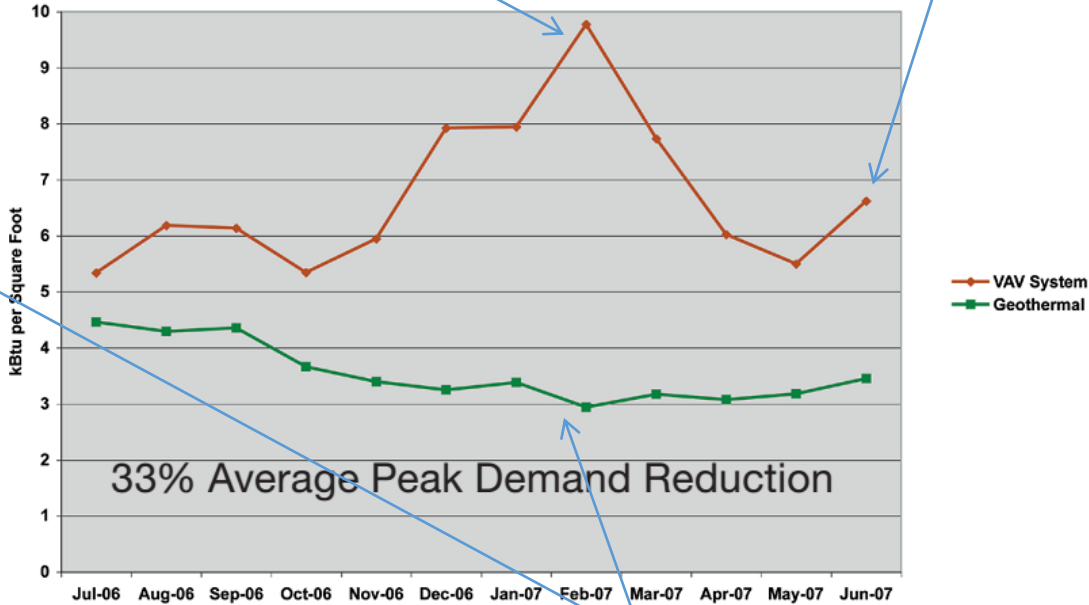
- Highly efficient heating and cooling systems.
- Potentially a cost-effective option to defer capital commitment for utility gas and electric infrastructure.
- Reduces electric peak demand, improves load factor and improves the efficiency of the electric delivery system.
- Gas peak load reductions.



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

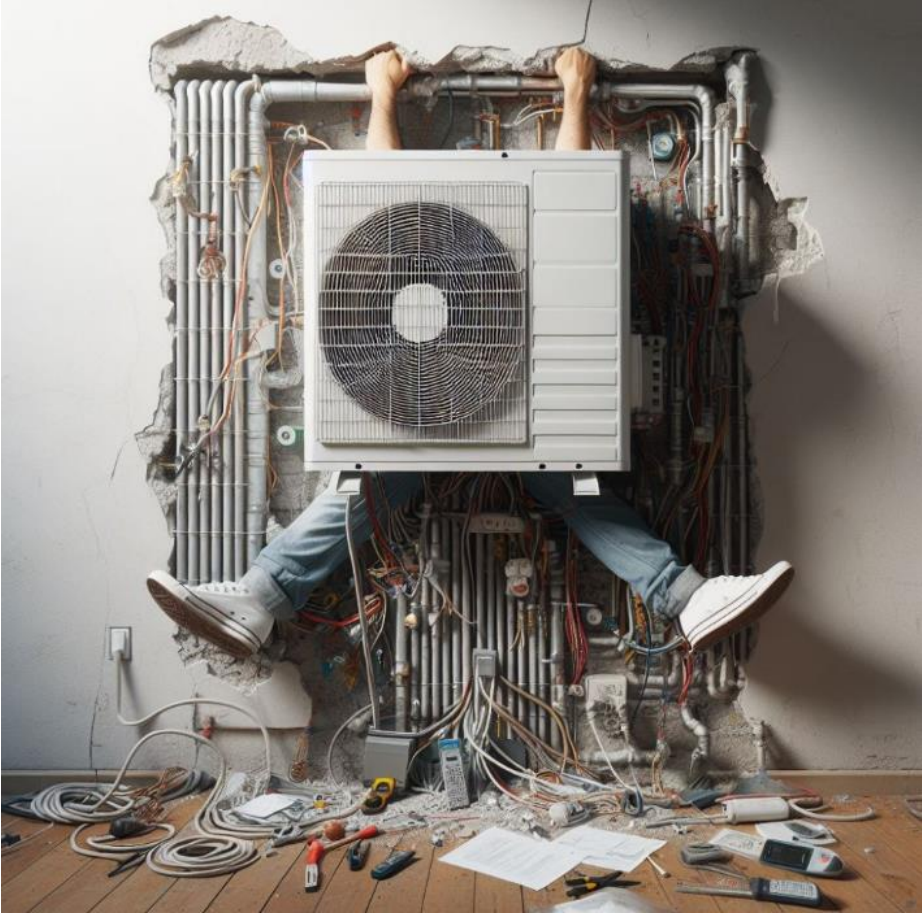


Ground Source Heat-Pumps Shave Both Summer and Winter Peaks

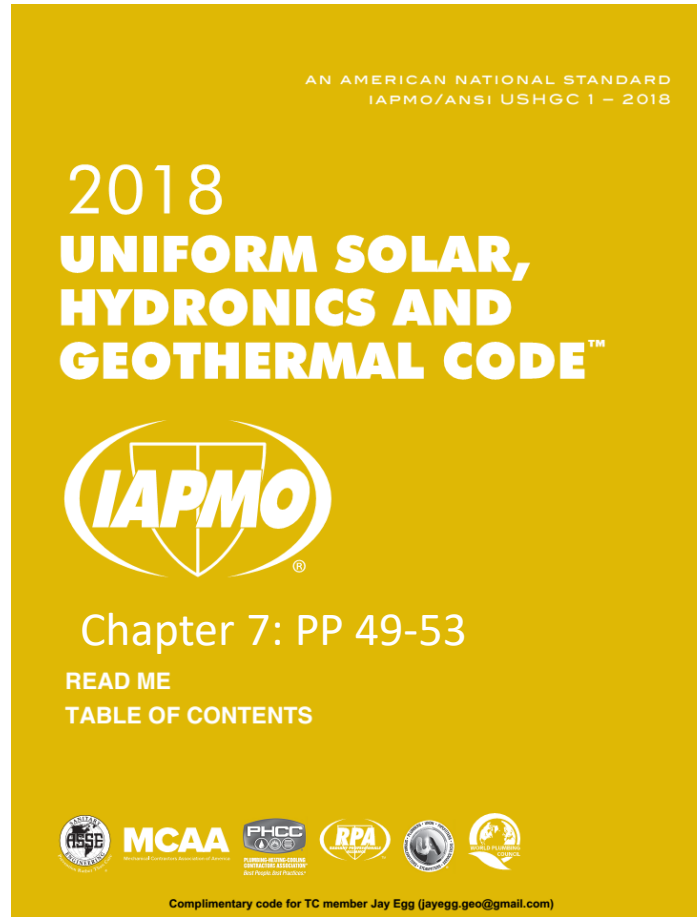
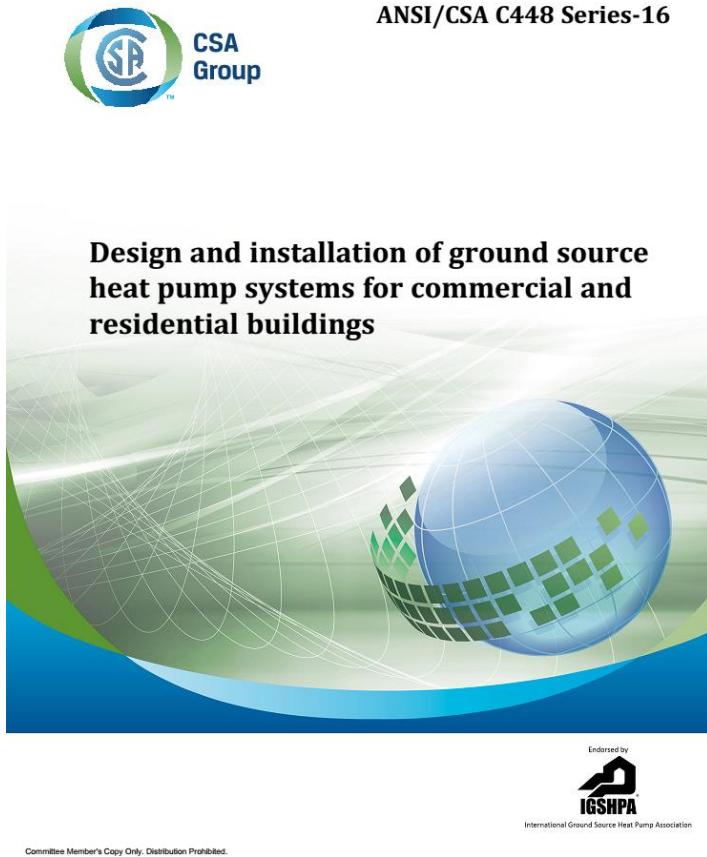
# Geothermal Energy Networks *...eliminate Outdoor Equipment and related hazards*



# 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

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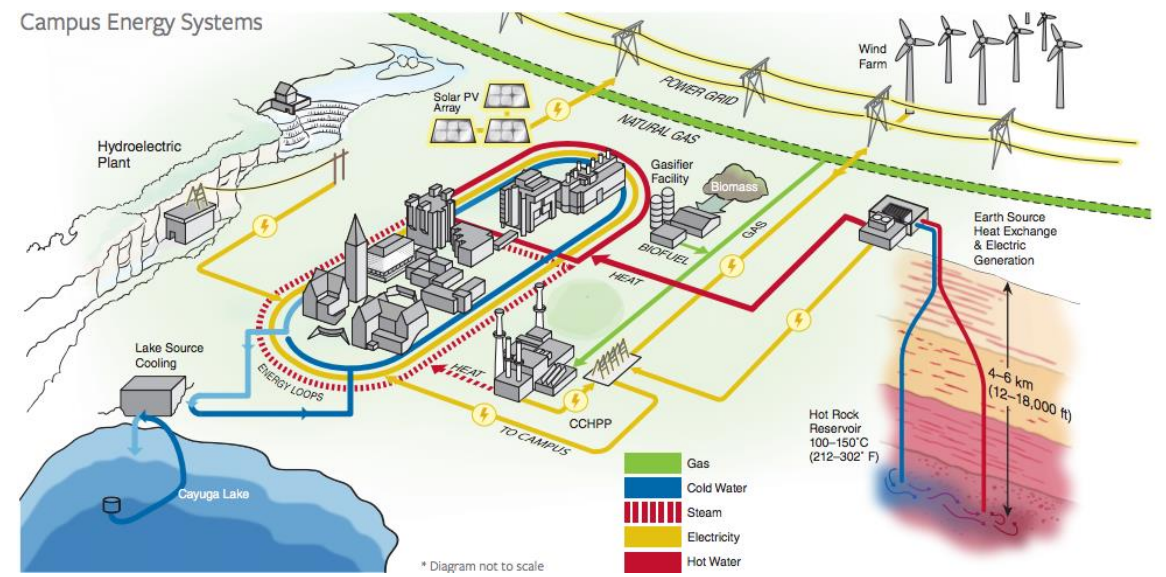
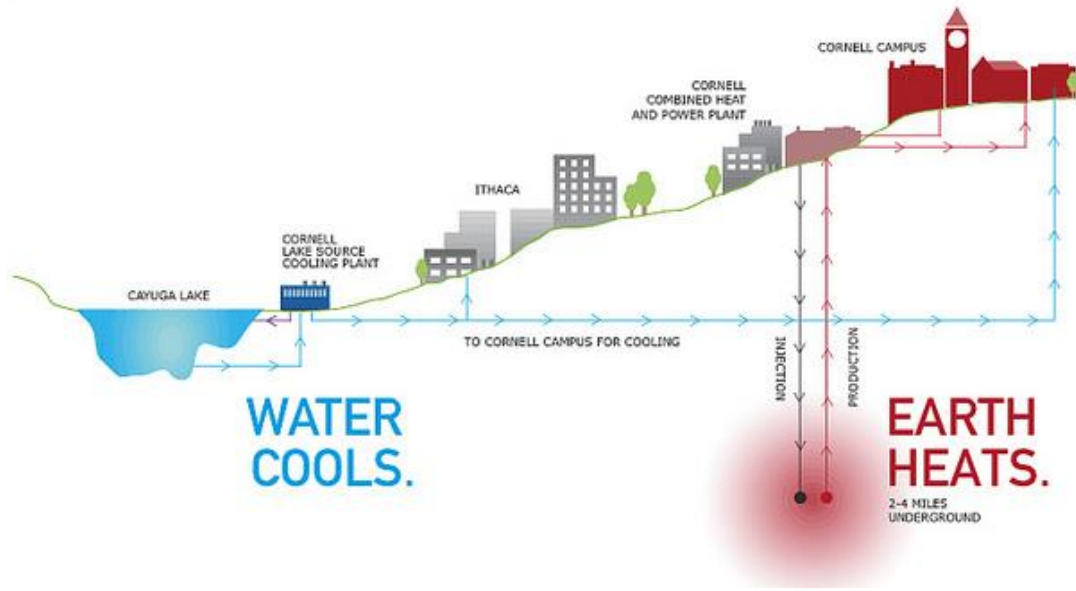
- The result was a reliable system with a 12.5 ton and a 24-ton GHP that will likely last another 60 years.
  - No cooling tower
  - No outdoor condensors
  - Low ambient loads to the compressors (cool mid-70s geothermal exchange water)
  - Simple and reliable
- Other concerns the facility will never 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*)

**HYBRID EGS SYSTEM: UTILIZING EARTH'S NATURAL ENERGY**



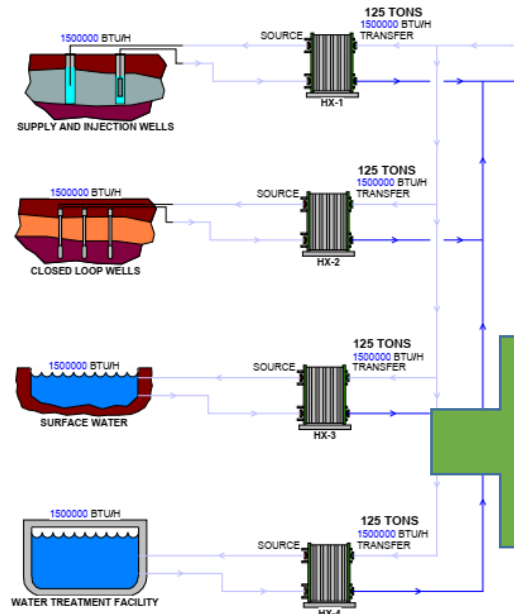
Cornell's Ithaca Campus has a Thermal Energy Network



Cornell's Roosevelt  
Island is also Thermal  
Loop Campus



# Creation of Thermal Energy Networks



- Legend**
- Site Layout**
- Civic Building
  - Office / Institutional
  - Retail / Mixed Use
  - Low Density Apt.
  - Med Density Apt.
  - High Density Apt.

**Infrastructure Sources + Horizontal Piping Infrastructure = Thermal Networks (Skilled Labor Unions)**



# Infrastructure Studies, Coordination & Validation

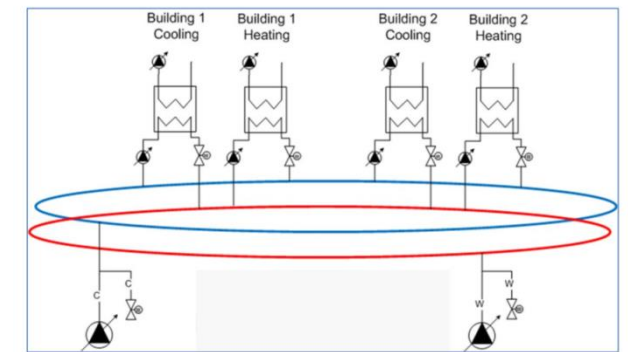
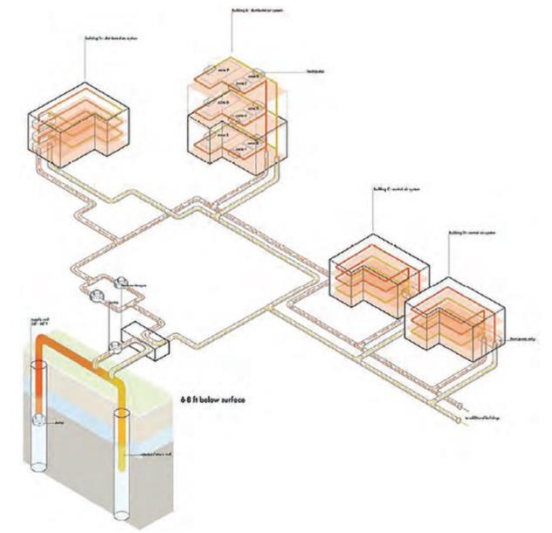


Figure 10 - Two-pipe groundwater distribution, active building connections

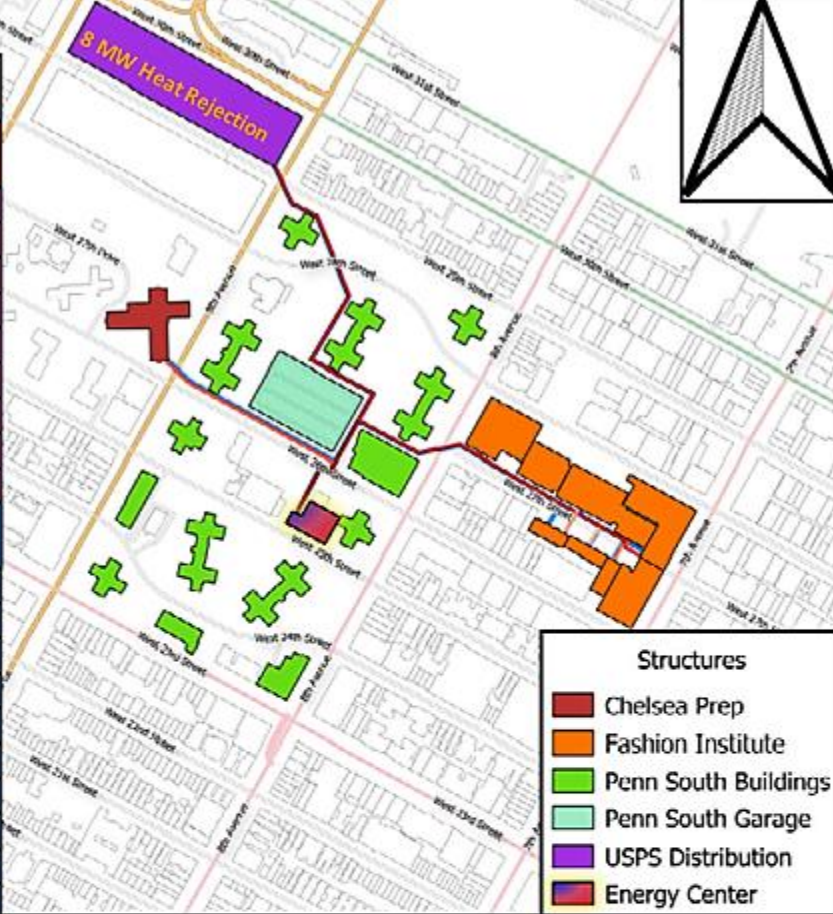
One Way Pipe Catalog

Heating

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

Cooling

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



**Structures**

- Chelsea Prep
- Fashion Institute
- Penn South Buildings
- Penn South Garage
- USPS Distribution
- Energy Center



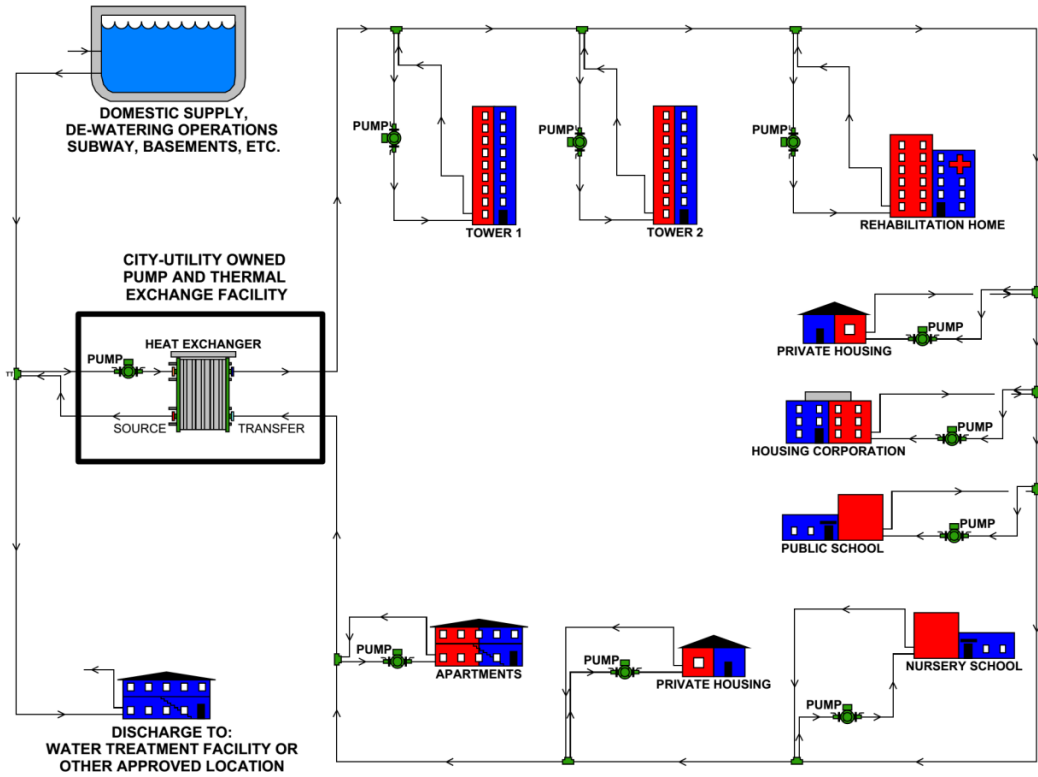
# Thermal Energy Network Modeling Penn South Campus and Adjoining Properties



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

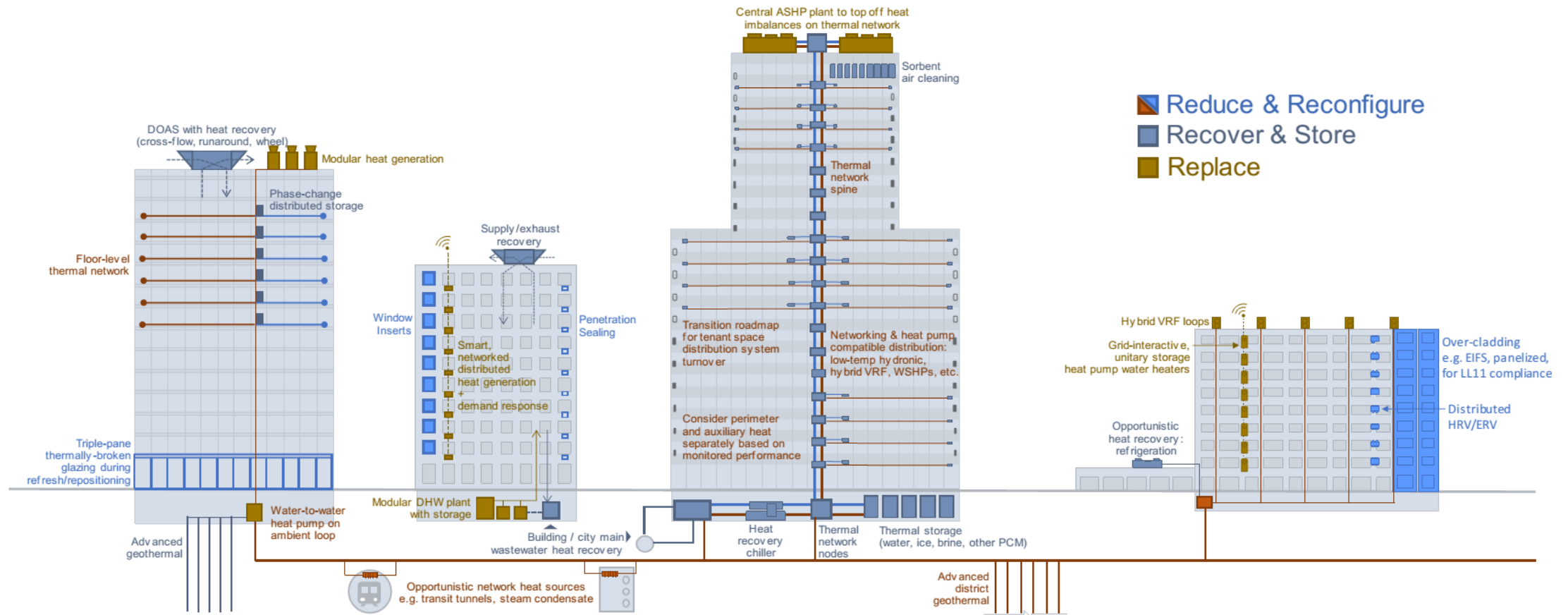
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# City Layout with Simple Hydronic Software

# 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

Wyoming Hyperscale liquid cooled White Box data centers

Wyoming Hyperscale Indoor Farms



scale White Box LLC © 2021 FFKR Architects ©Egg Geo LLC 2021



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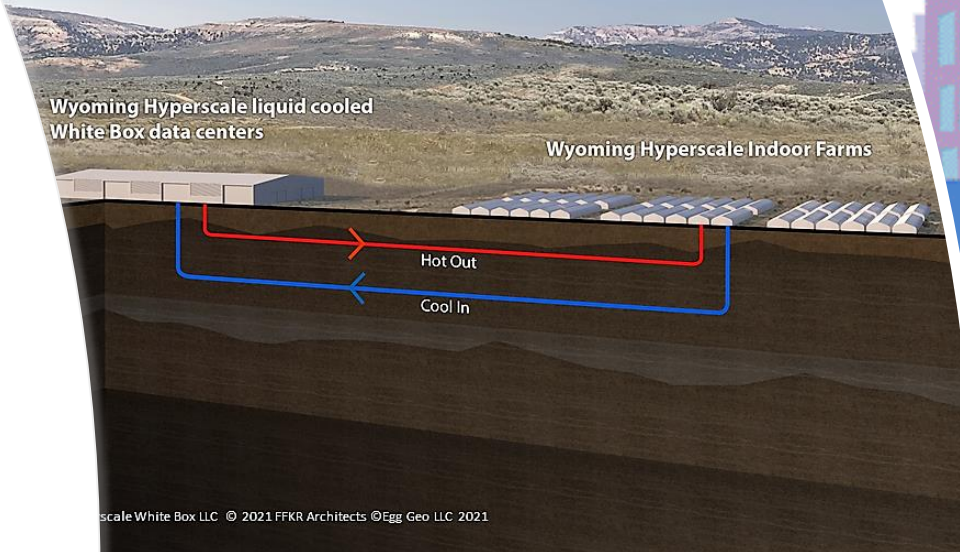


Harvesting

Energy Transfer Station

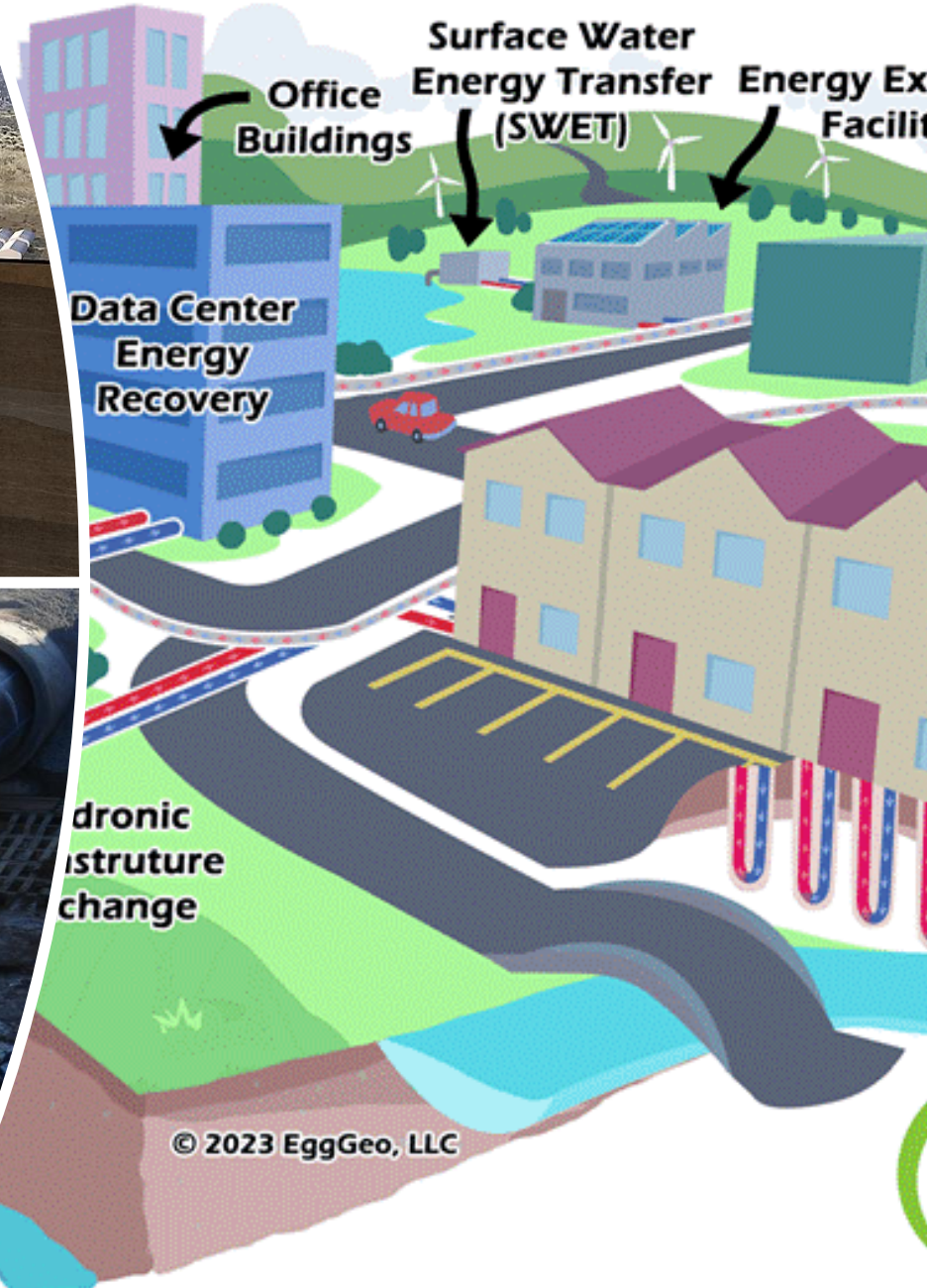
Insulated and Shallow-buried Water Pipes

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



© 2024 Egg Geo, LLC

# Thermal Energy Network



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



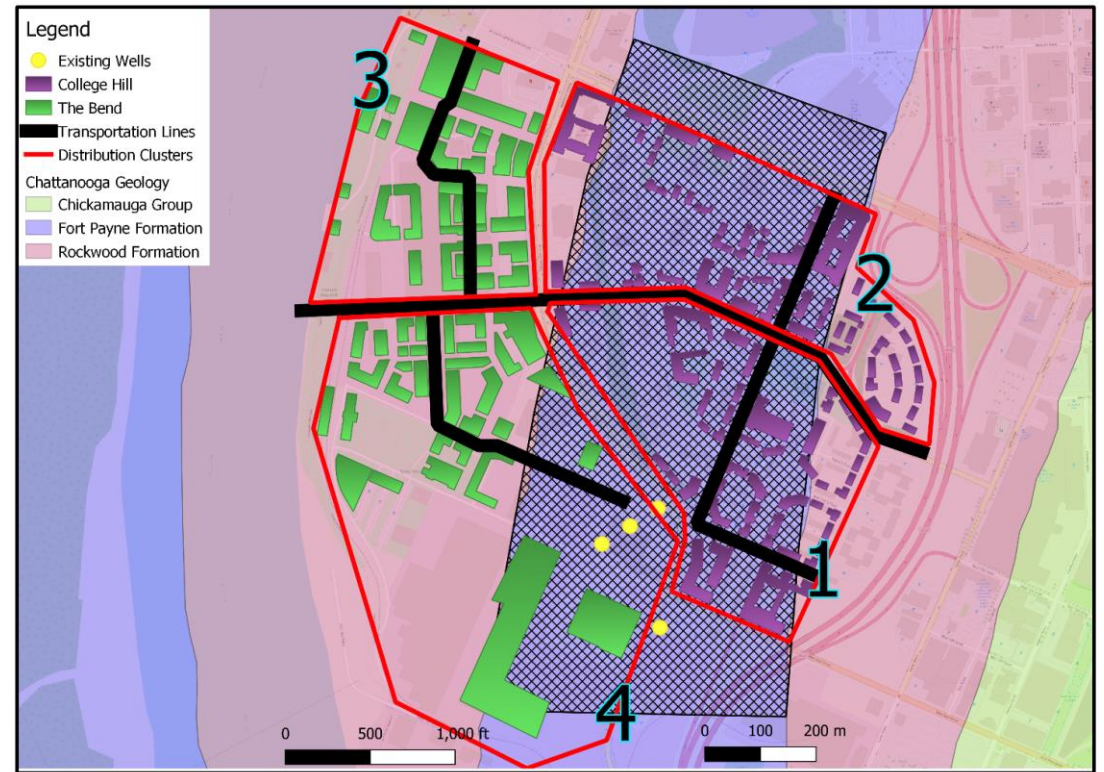
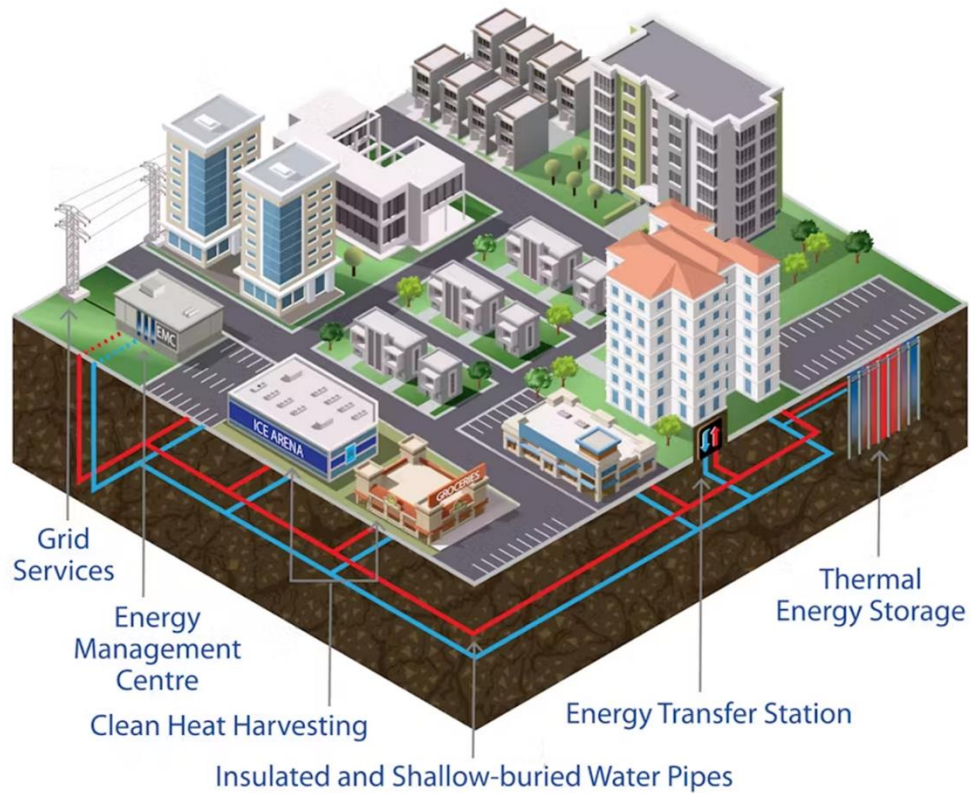
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# Thermal Energy Network

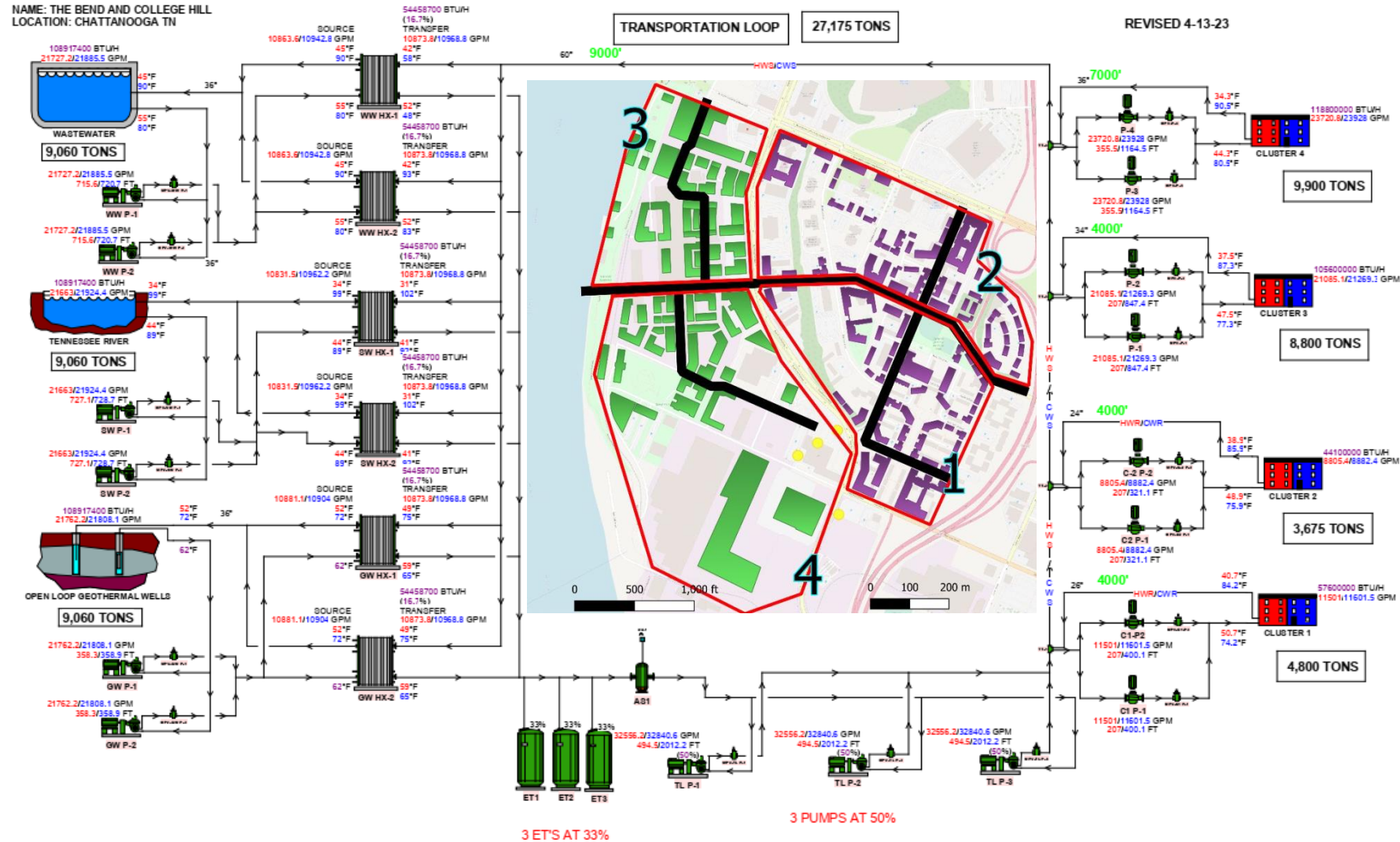


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# Thermal Network Integration for City Centers

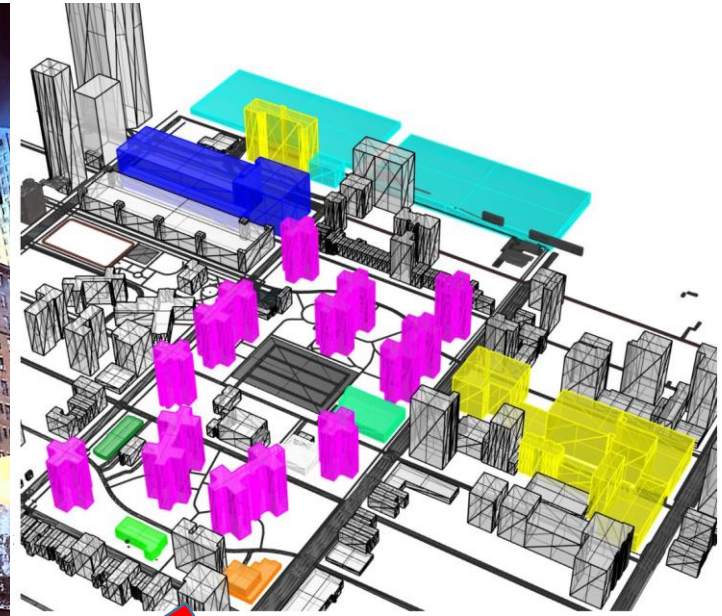
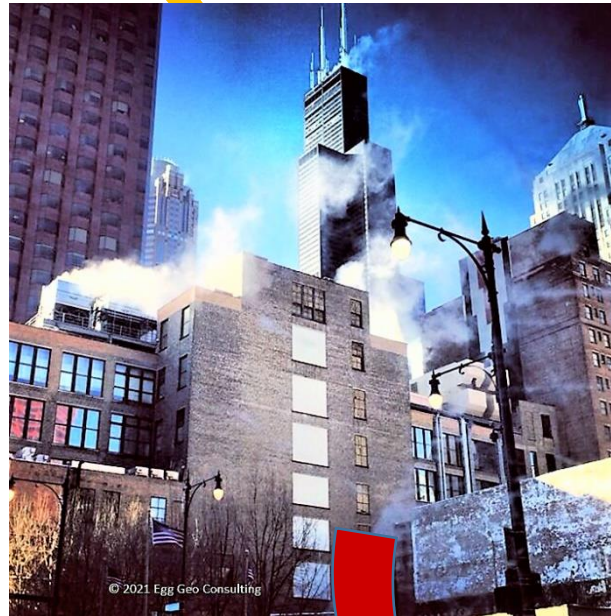


# Thermal Network Integration for City Centers

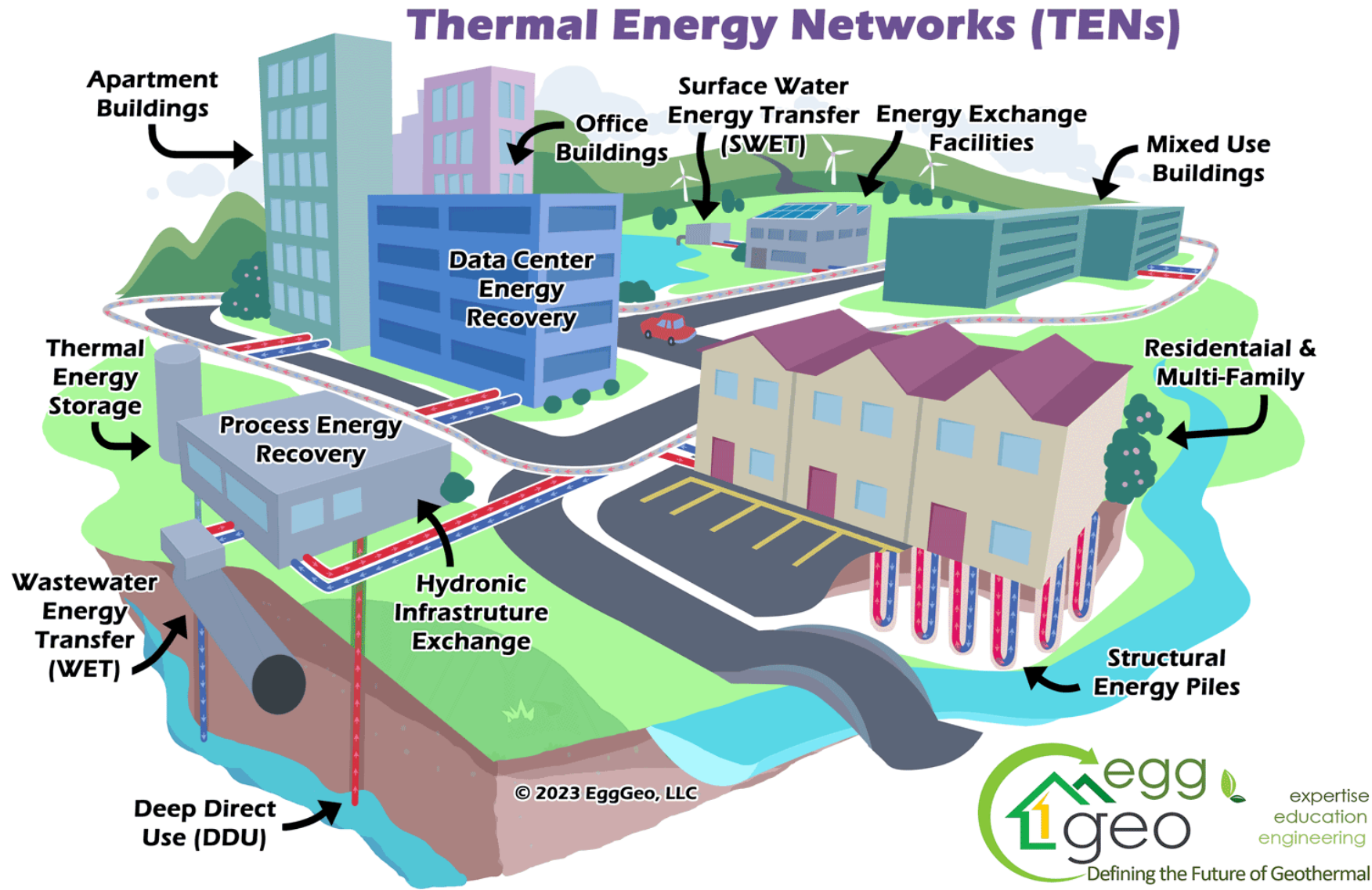


Heat Energy  
Expelled  
from  
Cooling  
Towers is  
Piped to the  
Residential  
Apartments

## Thermal Energy Network Concept: “TEN”



# Geothermal Energy Networks on a Large Scale



# *Defining the Future of Geothermal*



Main Website



Defining the Future of Geothermal

