

# Caroline / Speedsville Town Meeting

Designing a Thermal Energy Network



# Site tour begins in Caroline in April 2023



# No existing infrastructure underground



# Meeting in Speedsville with Mark Witmer and Pat Jordan



**Geothermal Heating & Cooling**  
**Caroline Town Office Building**

Using The Constant Temperature Of The Earth To Heat And Cool

6 feet underground, the earth temperature is approximately 50 degrees year-round. A geothermal system concentrates the energy in the earth with a compressor to create higher temperatures for heating. The system can cool the building, moving heat back to the earth.

Three loops of pipe buried underground carry an anti-freeze and water solution that transfers heat to and from the geothermal furnace.

At the Town Office, the geothermal loops are in the water table. This provides excellent heat transfer plus the water carries new heat energy constantly, increasing performance.

Since the earth is the main source of energy, the system is very efficient. For each unit of energy used to run the system, we get more than 4 units of heat - that's over 400% efficient.

In the spring and fall we don't need as much heat as the middle of winter. The system starts operating in first-stage and if more heating is needed switches to second stage. Matching the needs of the building this way increases comfort and efficiency. It does the same in cooling mode.

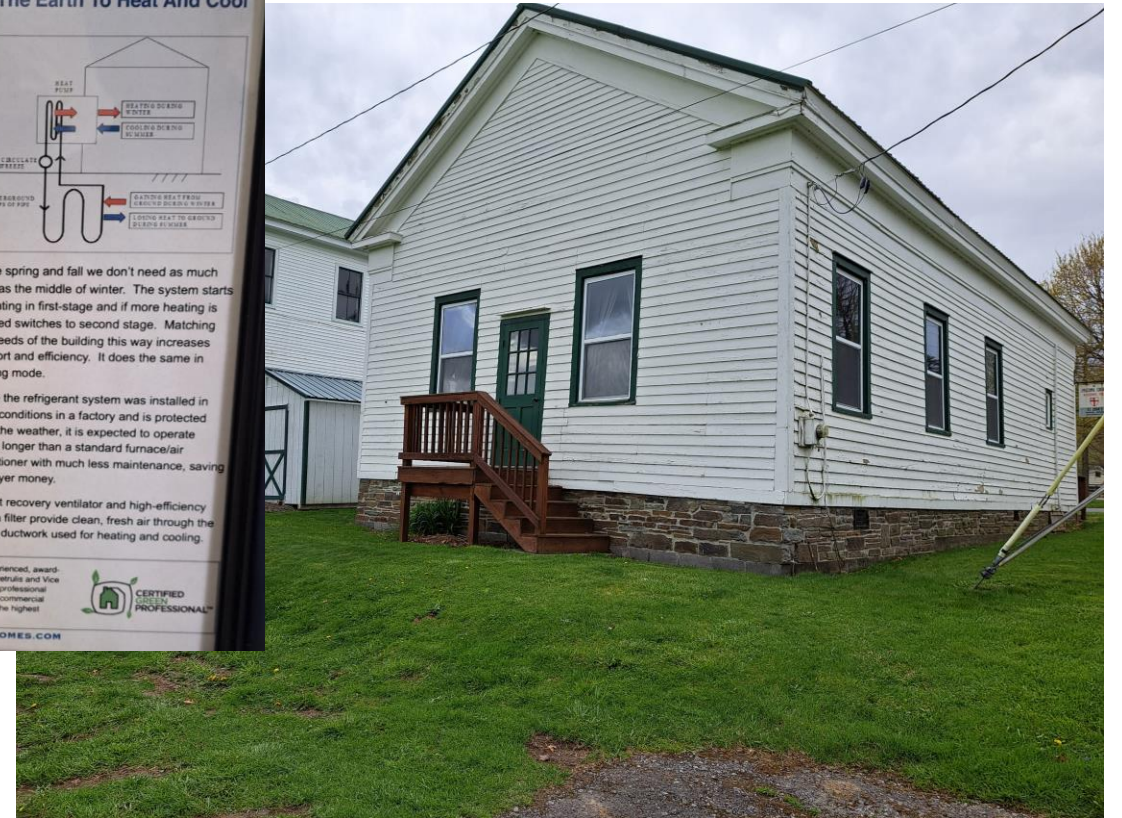
Since the refrigerant system was installed in ideal conditions in a factory and is protected from the weather, it is expected to operate years longer than a standard furnace/air conditioner with much less maintenance, saving taxpayer money.

A heat recovery ventilator and high-efficiency media filter provide clean, fresh air through the same ductwork used for heating and cooling.

**CAYUGA COUNTRY HOMES** is the area's most experienced, award-winning, ENERGY STAR® builder. President Cheryl Petrusek and Vice President Brooke Greenhouse work with a dedicated, professional team to design and build high-quality homes and light-commercial buildings with an industry-leading focus on delivering the highest value in quality and service to our clients.

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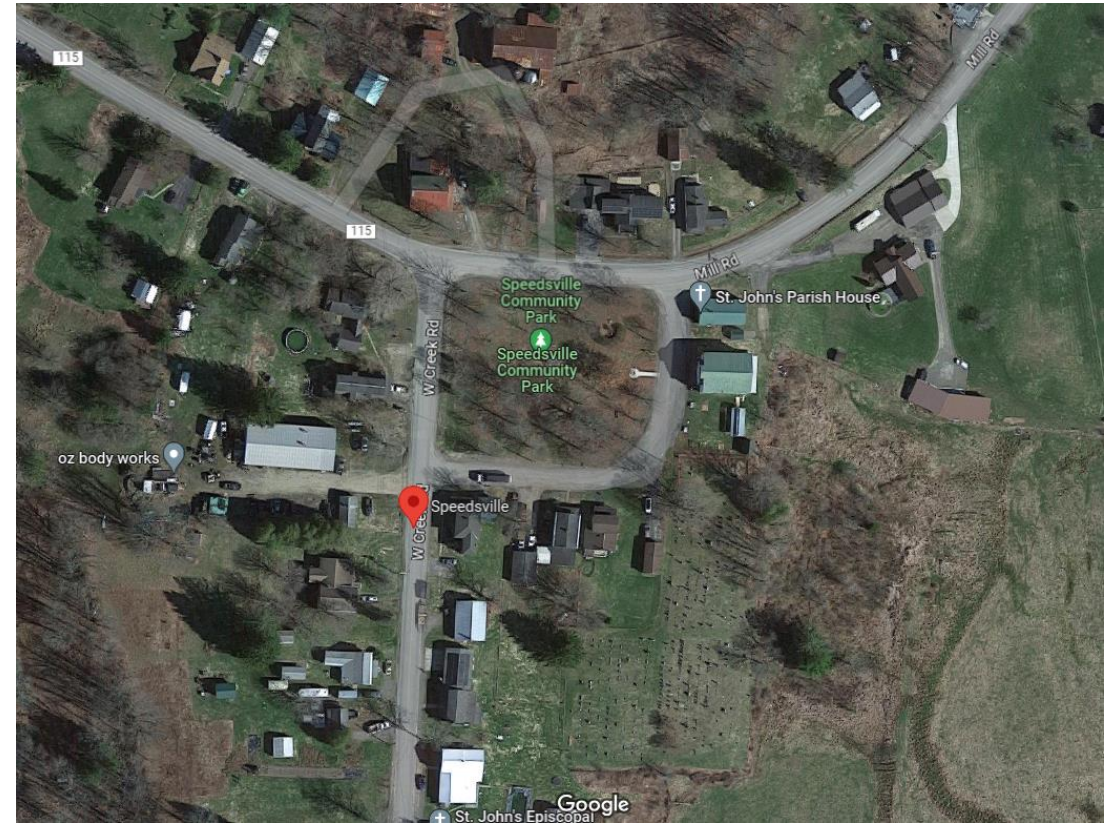
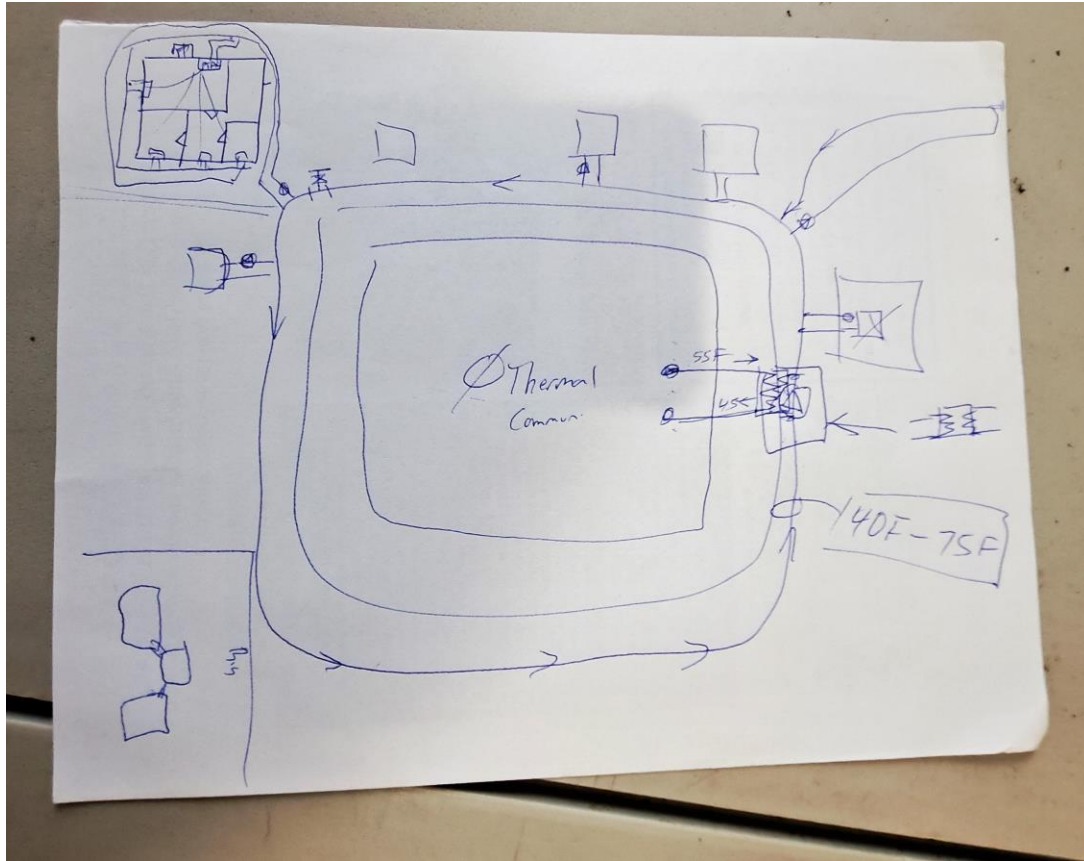


# Video Tour of Speedsville Park



<https://www.dropbox.com/s/66k5x56a25l832q/2023-04-25%2011.25.28.mp4?dl=0>

# Speedsville Community Park Loop + potential additional rings



# Reporting to NYSERDA

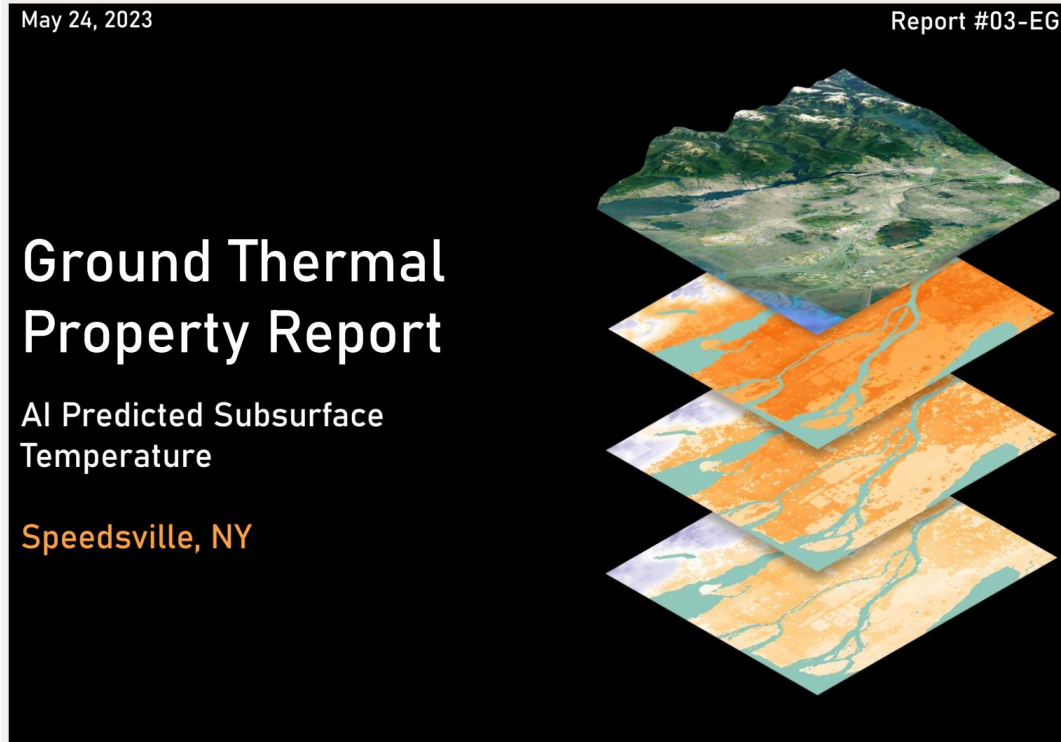
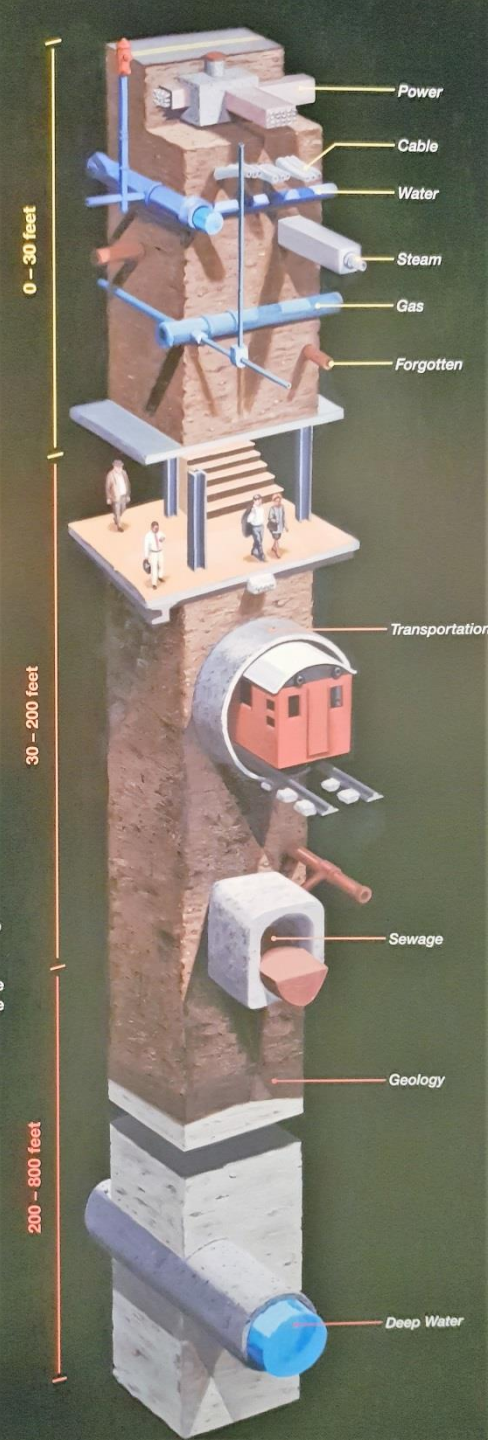
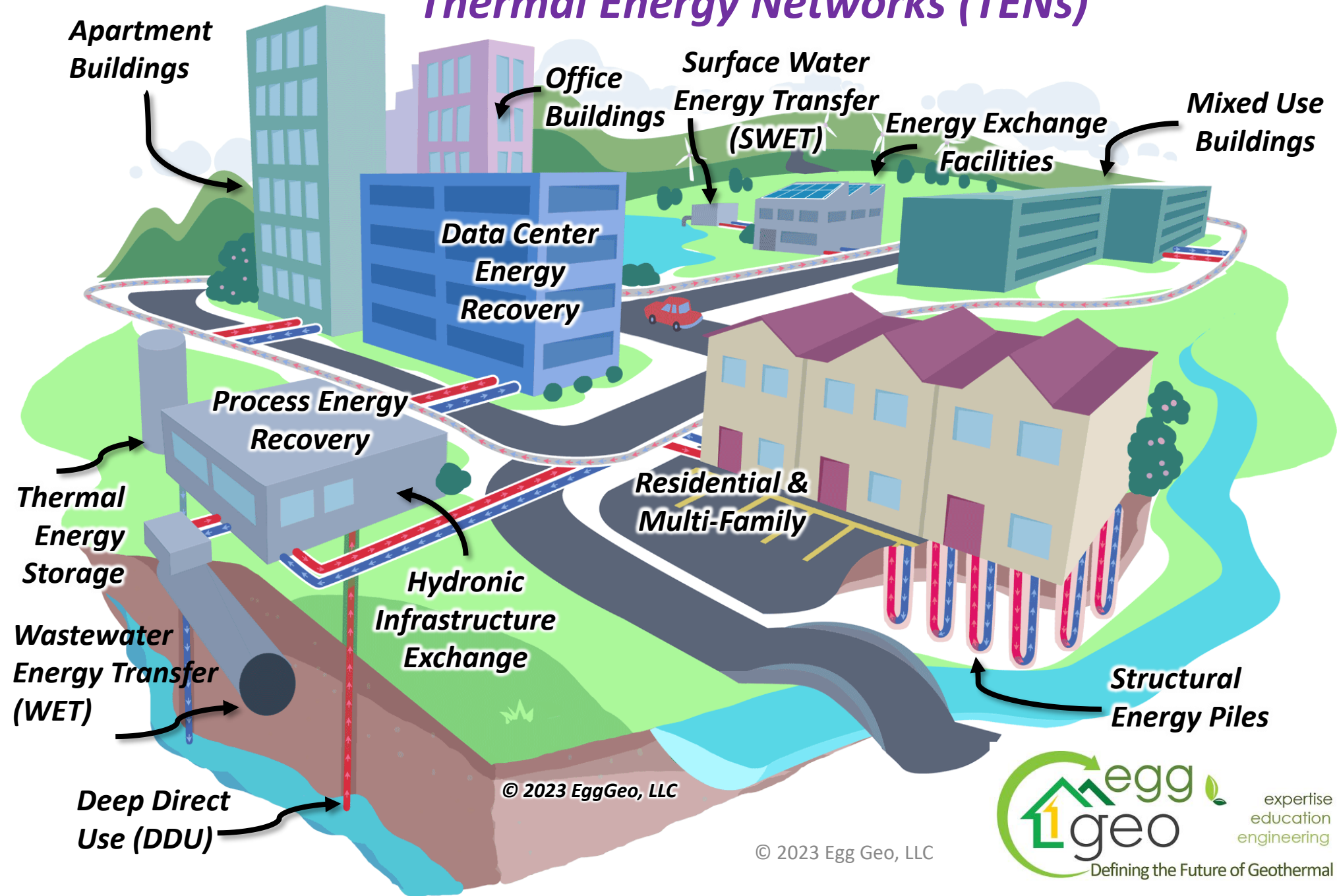


Figure 2 Building geometries for Speedville.



Figure 3 Preliminary thermal and electrical loads for the Speedville service area, as preparation for FlexTech community geothermal application.

# Thermal Energy Networks (TENs)





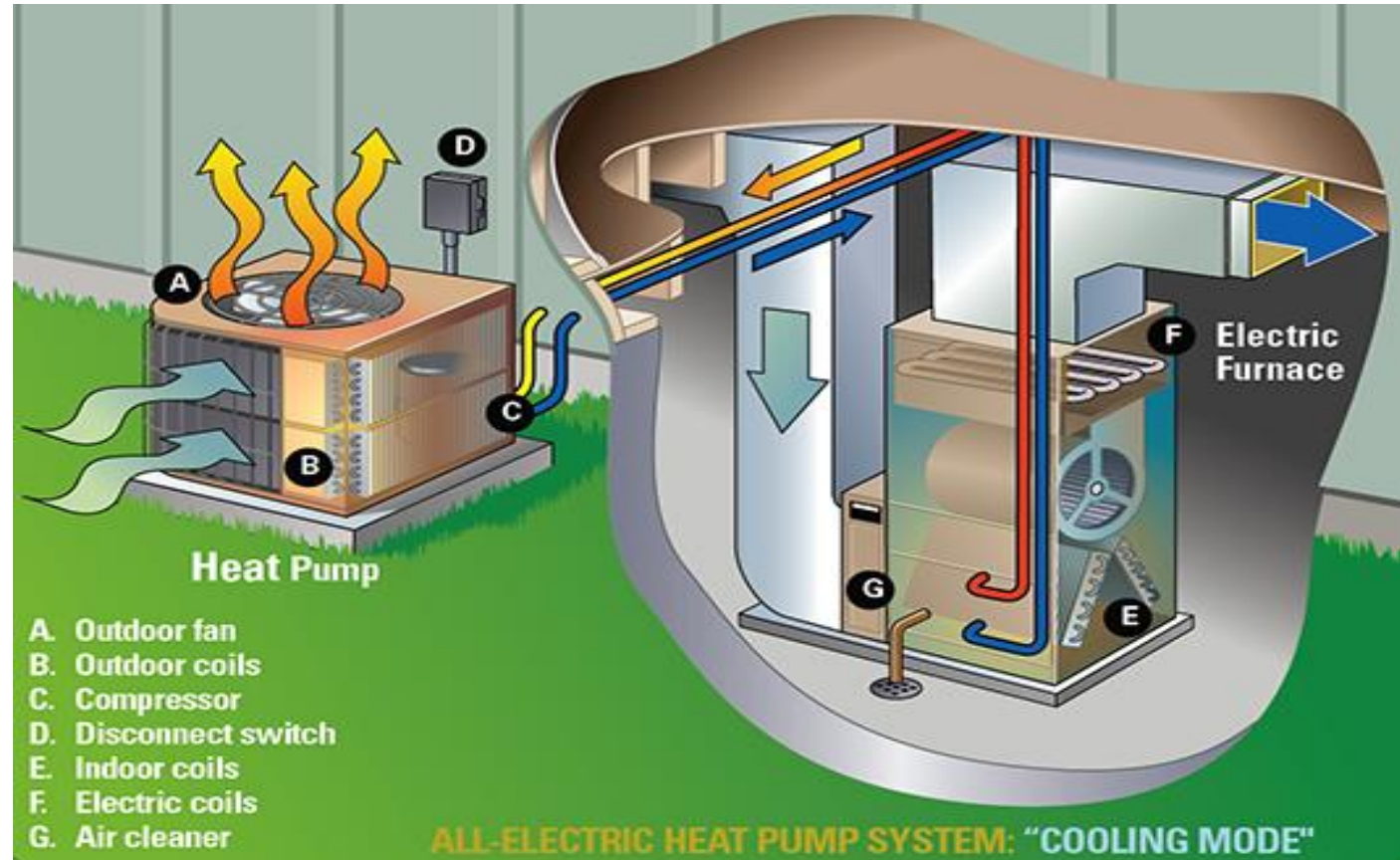
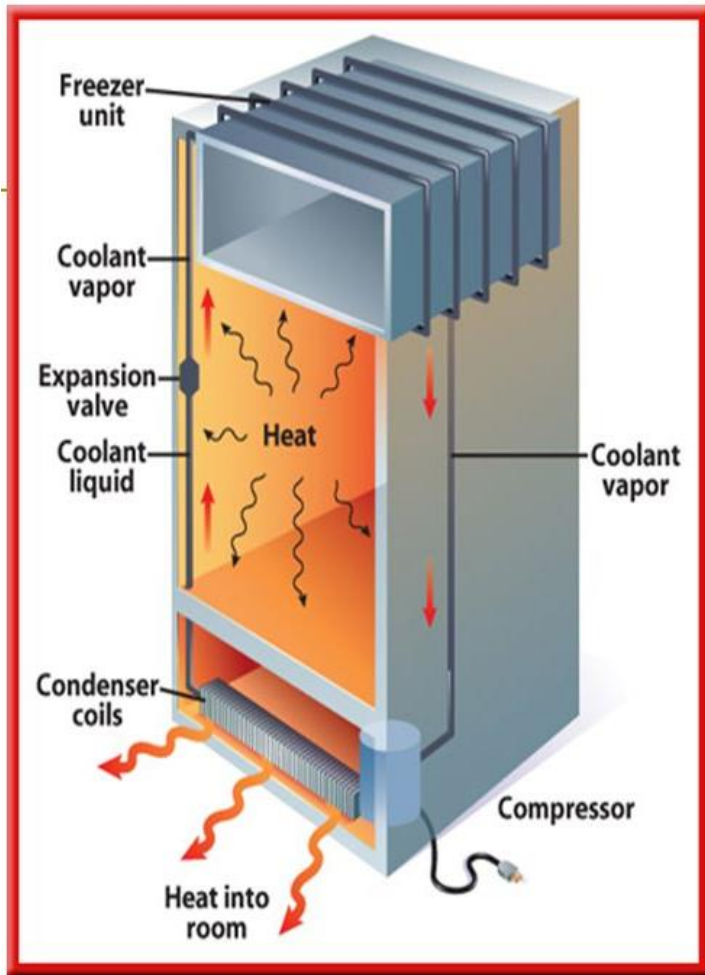
# What is a Thermal Energy Network?

**Thermal Energy Networks are utility-scale infrastructure projects that connect multiple buildings into a shared network with sources of thermal energy like geothermal boreholes, surface water, and wastewater.**



- **JOBS:** Transferability for gas utility workers
- **COST:** Lower energy bills
- **SAFE and RELIABLE:** Non-combustible and consistent energy flow
  - **EQUITY:** Renewable thermal energy delivered to all customers
- **HEALTH:** Improved indoor and outdoor air quality (no combustion in the building)
  - **GRID:** Flattens the peak loads on the electricity grid
  - **CLIMATE:** A major reduction in carbon emissions from buildings

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

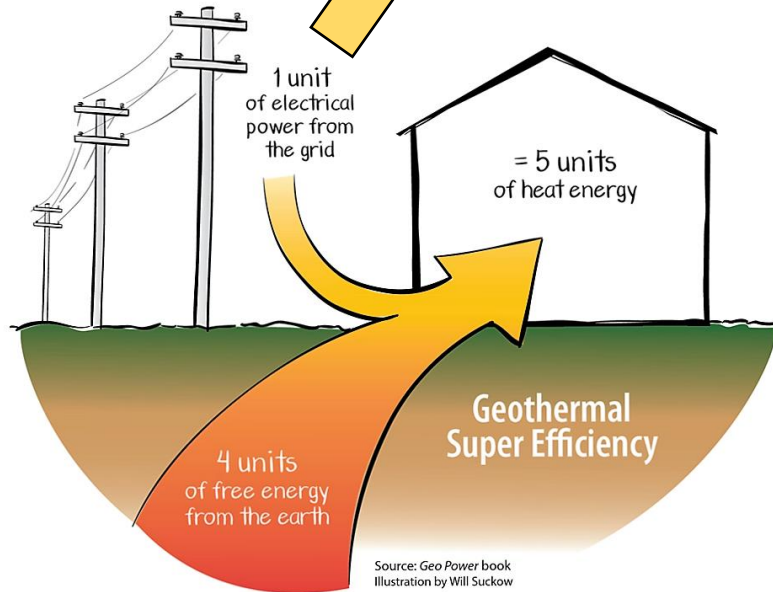


**Heat Pump = about 3.0 to 5.0 + COP**

# 1 kW of Electricity = 3412 BTUs



= 3,412 BTUs of heat  
(Space Heater)



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

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

\*@ 5.0 COP

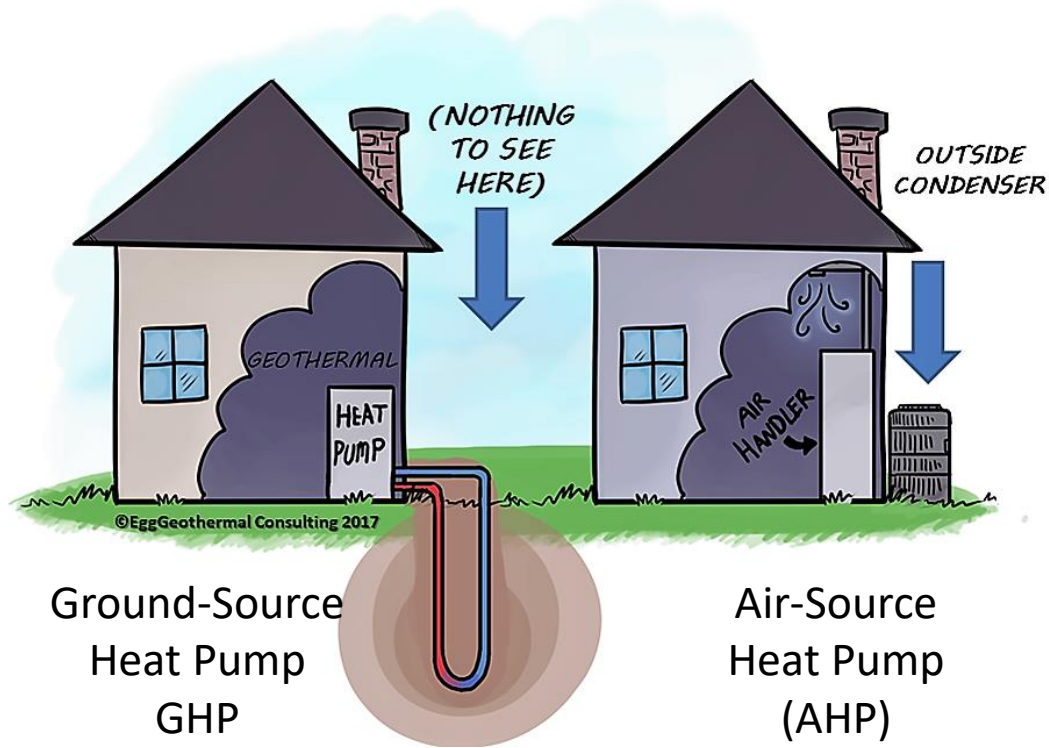
# Both Air Source & Ground Source Heat Pump are All Electric

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

Both use "Renewable Energy"



Nothing outside



Ground-Source  
Heat Pump  
GHP

Air-Source  
Heat Pump  
(AHP)

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Remote Outside Condenser

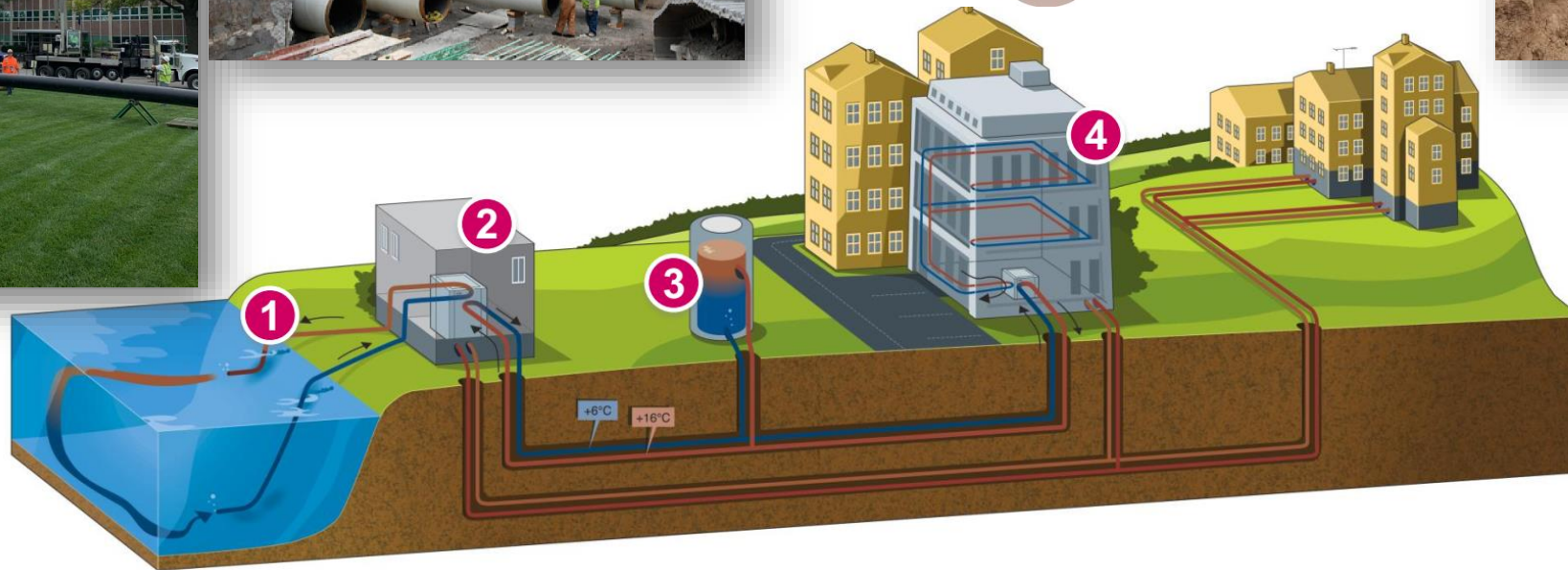
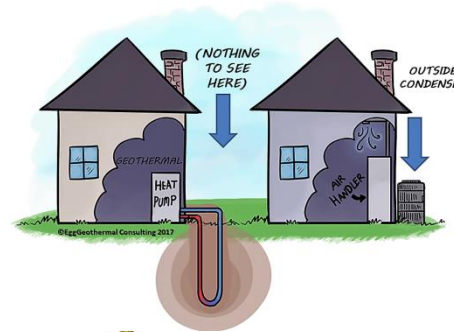
# District Geothermal Energy Networks

...make geothermal heat pumps a reality for all

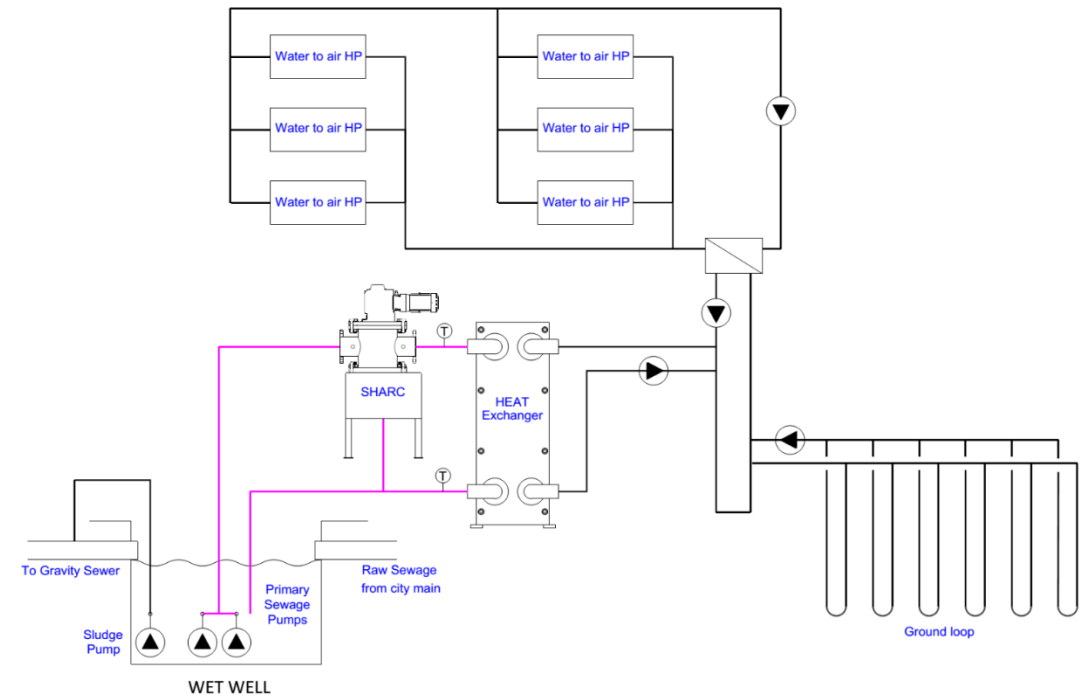


- No more outdoor equipment to replace
- More hurricane and storm resilient (no HVAC equipment outside)
- HVAC system longevity (a benefit of having equipment inside)
- No combustion boilers, cooling towers or furnaces (Decarbonization)
- Noticeably superior comfort in heating and cooling modes
- Remarkable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

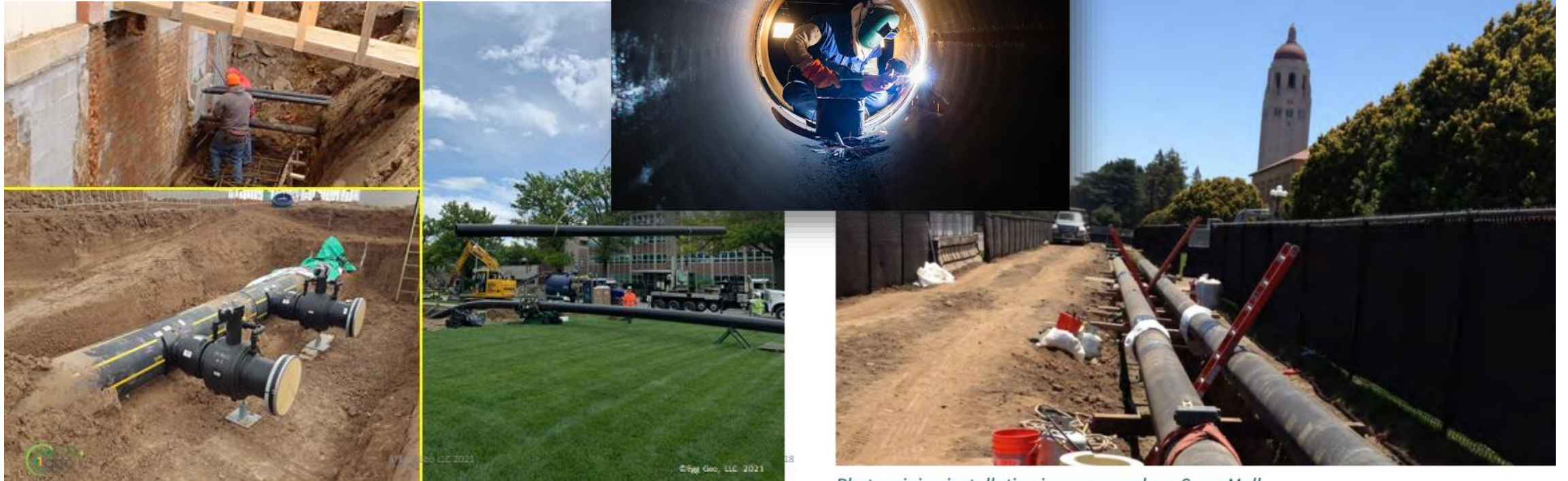
# TENs share energy between structures using pipes between buildings and their Geothermal Heat Pumps



# WET Development: These apartments will soon get their heat from wastewater



# *Geothermal Energy Networks* will be installed by our Nation's piping trade unions [https://youtu.be/SMdpHc\\_tI-o](https://youtu.be/SMdpHc_tI-o)

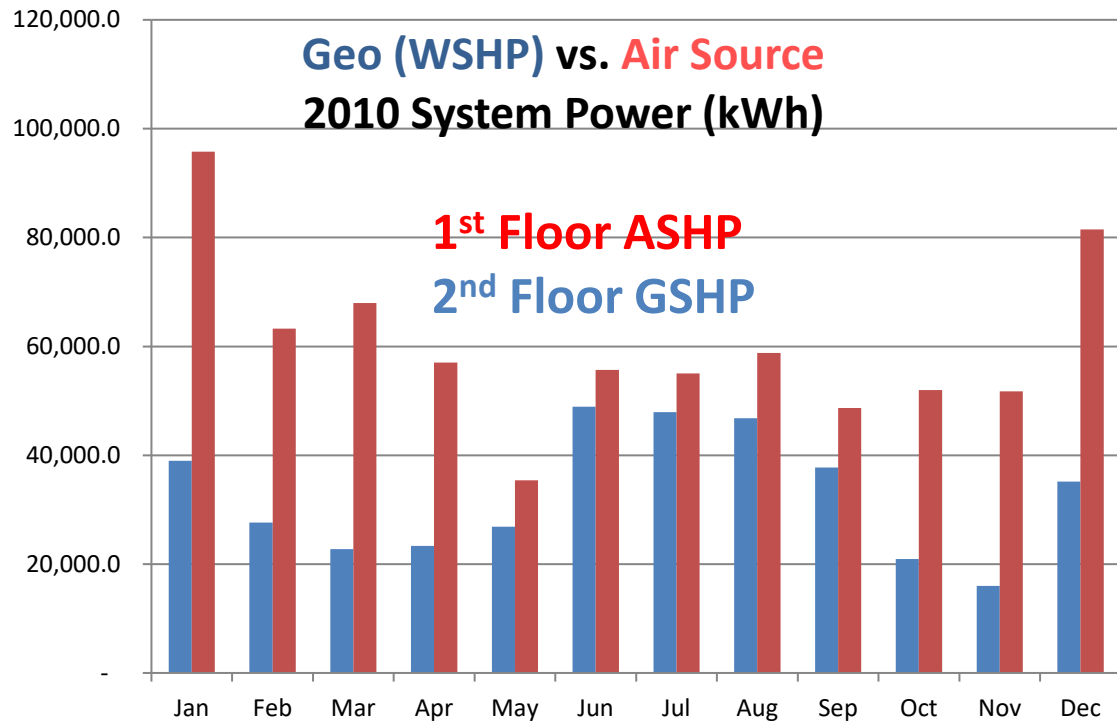


*Photo: piping installation in progress along Serra Mall.*



# Understanding efficiency; the ASHRAE Building in Atlanta

Ground-coupled HPs consume less energy than air-source HPs, but can be more expensive (Earth Coupling)



Power Consumption at ASHRAE Bldg, Atlanta



# “...a 21st century replacement for the gas grid...” <https://bit.ly/42ru9LQ>

**Networked ground source heat pumps could reduce electricity demand by 24TWh a year**

*By Lena Dias Martins*



Networked GSHPs could also reduce Britain's annual peak electricity demand by up to 36GW. Image: Kensa Group.

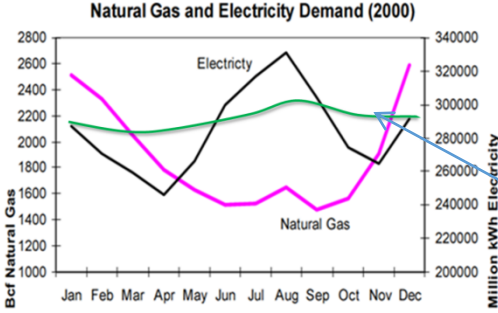
The *Low Carbon Heat Study* listed four additional key findings from its research:

- Annual peak electricity demand in Britain could be reduced by up to 36GW
- Up to £15.1 billion could be saved in electricity costs every year from now to 2050
- Networked GSHPs can be 20% cheaper (£290) a year to install and operated than air source heat pumps (ASHPs)
- Networked GSHPs consume 40% less electricity than ASHPs to provide the same amount of heat

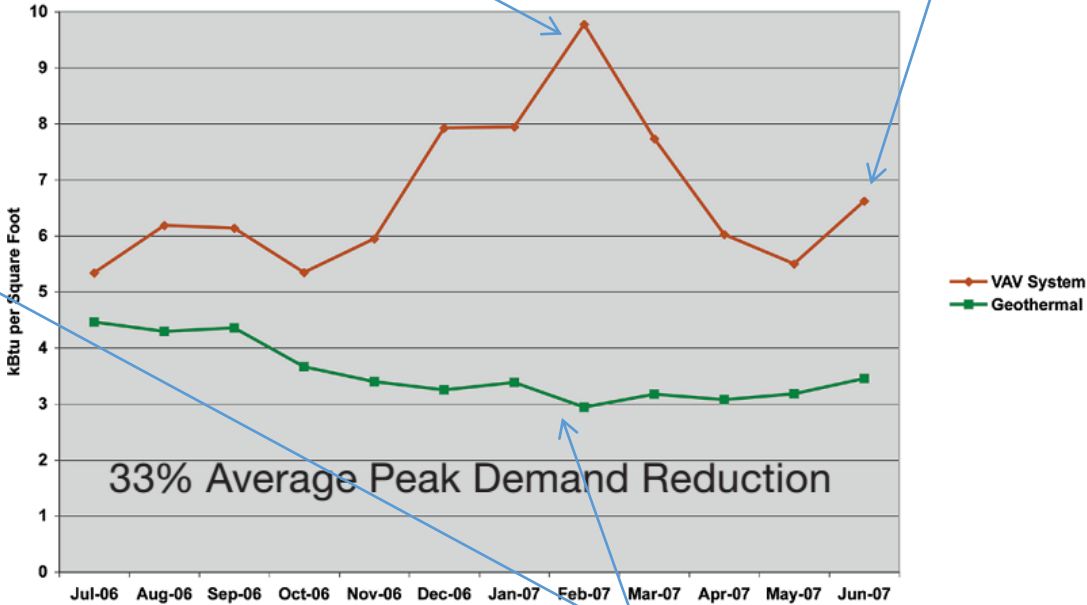
# Electrical Load is “leveled out” using GHPs

## Benefits of Geothermal Heating and Cooling nationalgrid HERE WITH YOU. HERE FOR YOU.

- 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.

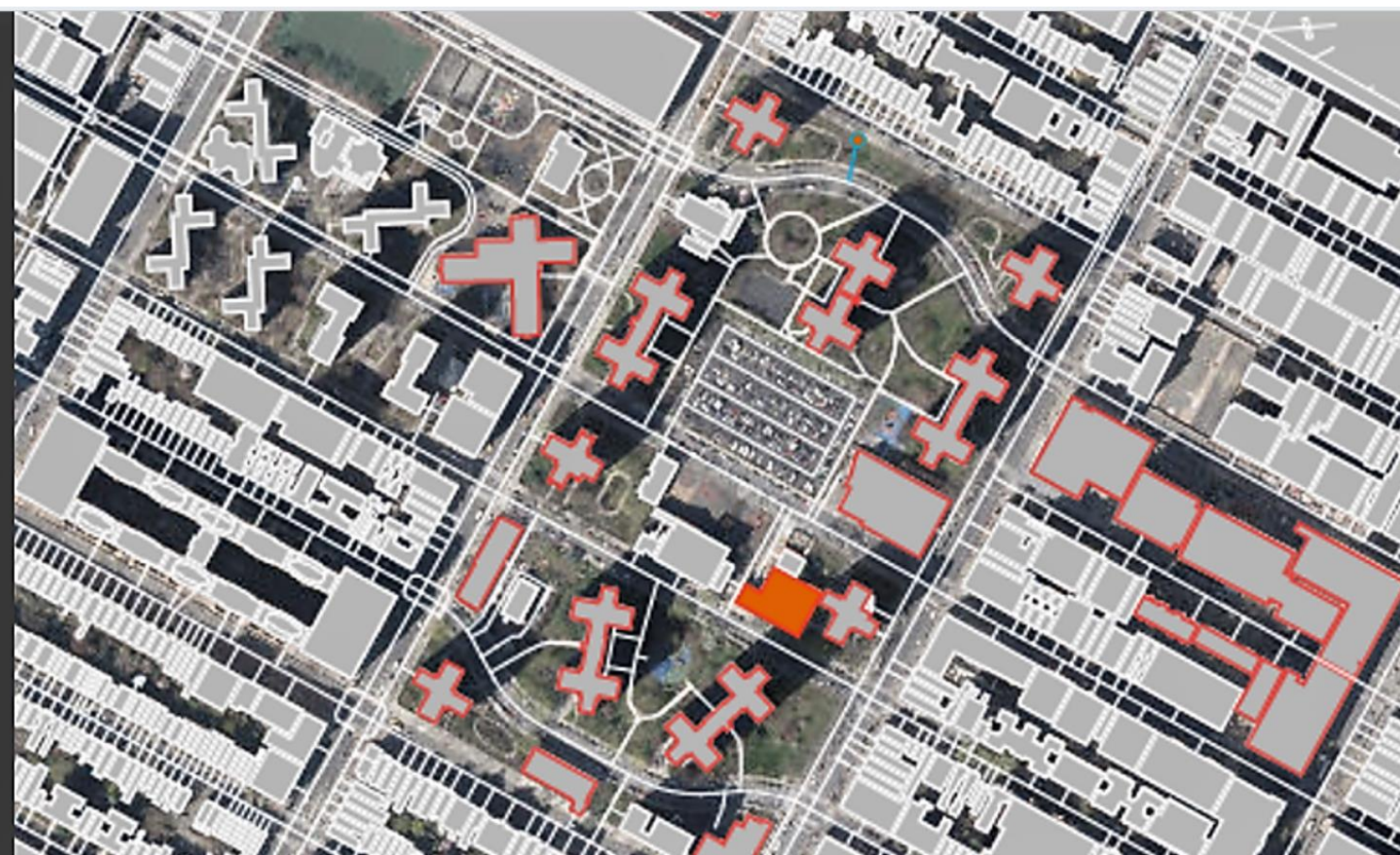
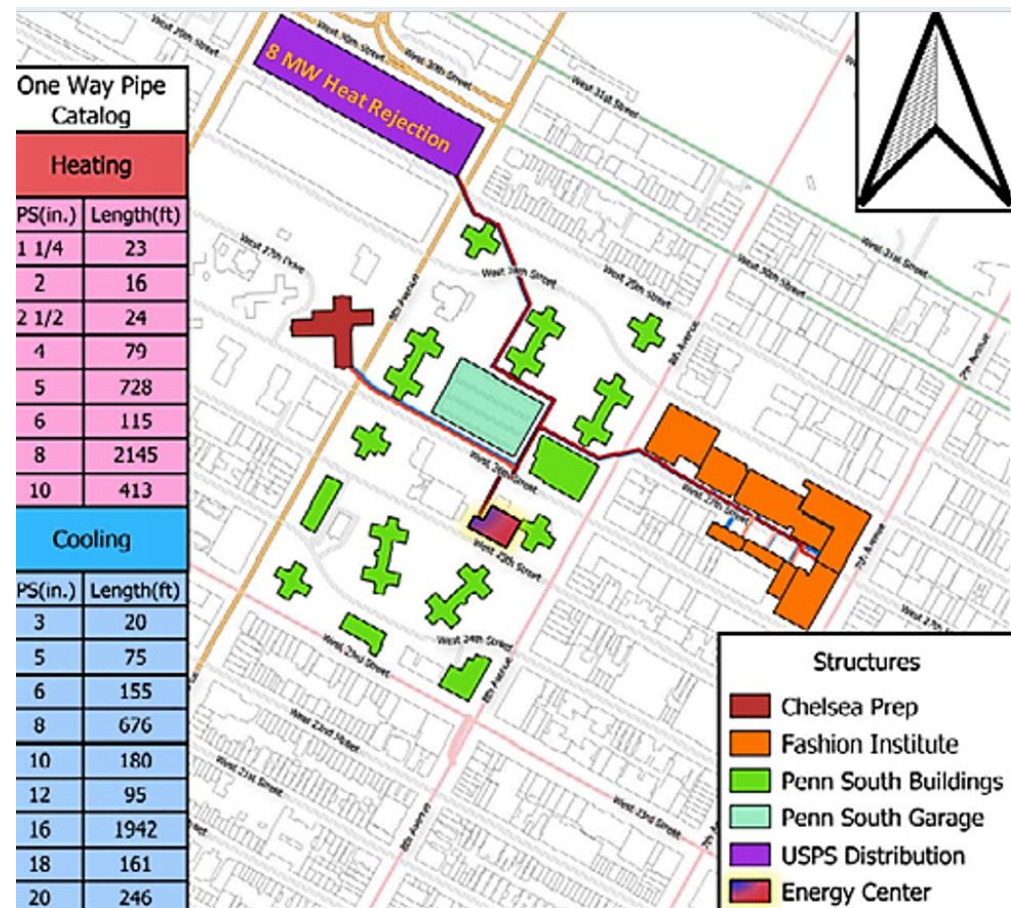


Air Source Heat-Pumps tend to “peak” in the winter, as well as the summer



Ground Source Heat-Pumps Shave Both Summer and Winter Peaks

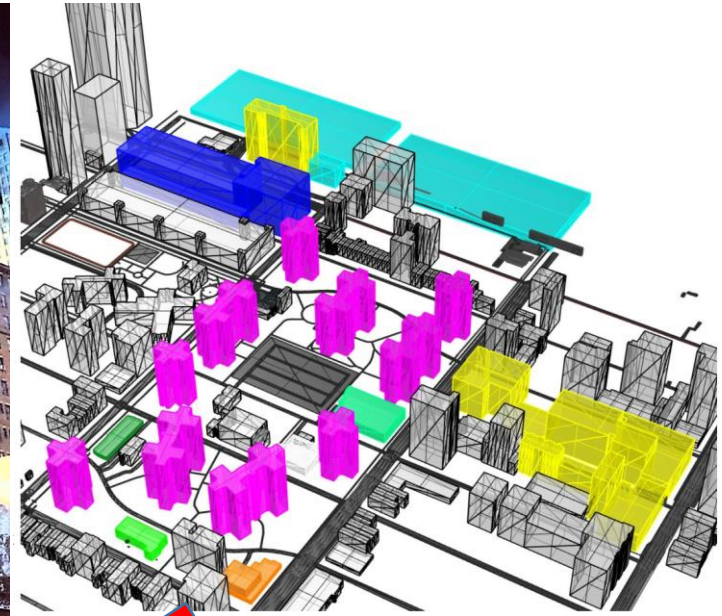
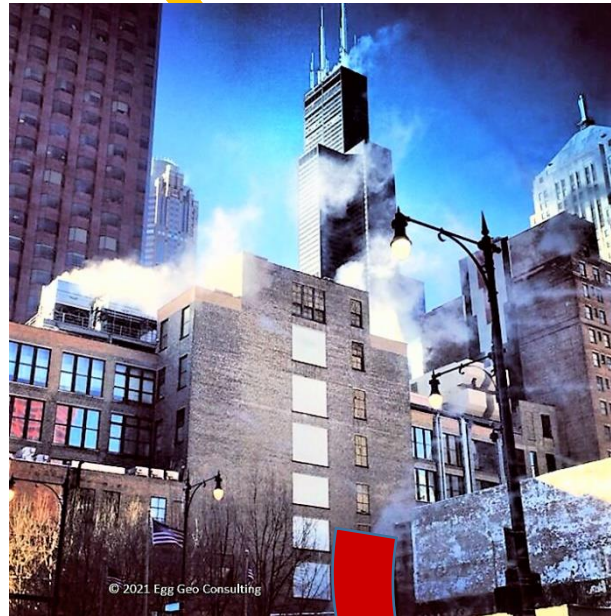
Combination Gas-Heat & Electric-Cooling Peaks in the Summer



# Thermal Energy Network Modeling Penn South Campus and Adjoining Properties

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

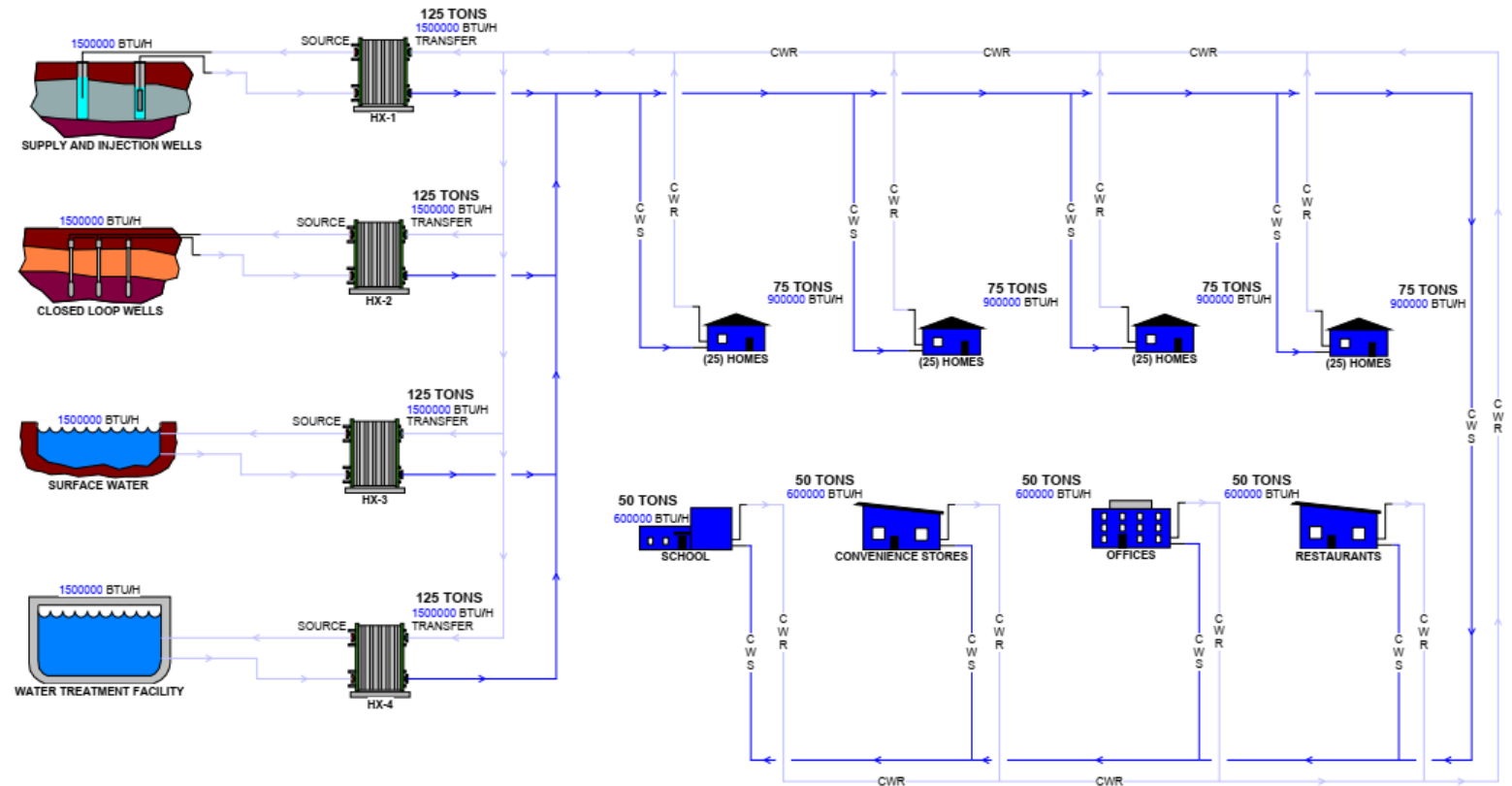
## Thermal Energy Network Concept: “TEN”



# Types of Geothermal Exchange Networks Between Buildings and Blocks in Communities

## Utility & Infrastructure Fluid Energy Sources

- Raw Water (pre Drinking Water Treatment)
- Wastewater (Dirty)
- Wastewater Effluent (Cleaned)
- Irrigation Water (Greywater)
- Dewatering Operations (Subways, Subgrade Parking Garages, etc.)
- Drinking Water Energy
- Data Centers



# EGG GEO

TASK 3

## FLOW DIAGRAM

WELL DATA TO BE VERIFIED BY HYDROGEOLOGICAL TESTING

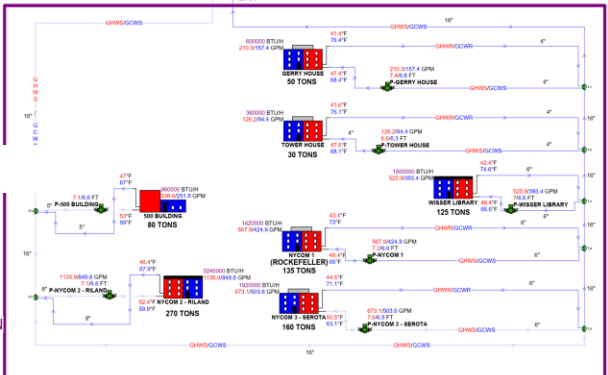
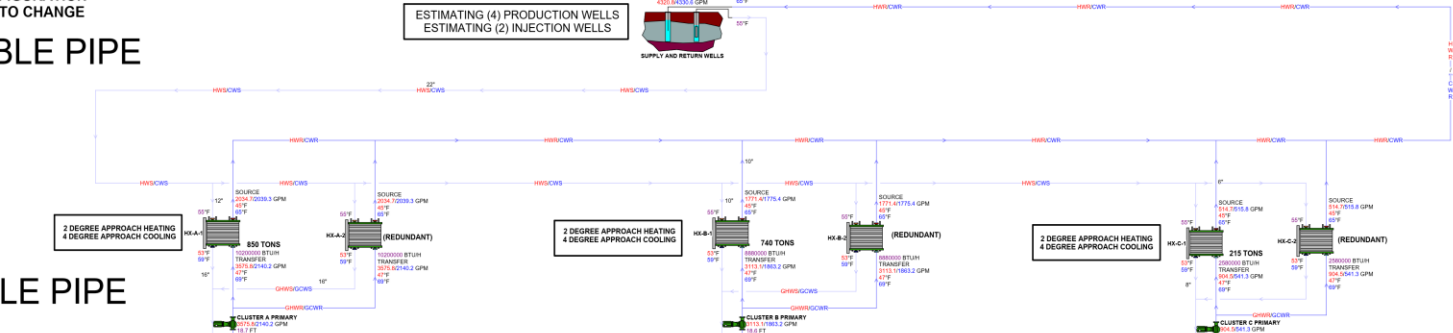
WELL CONFIGURATION SUBJECT TO CHANGE

## DOUBLE PIPE

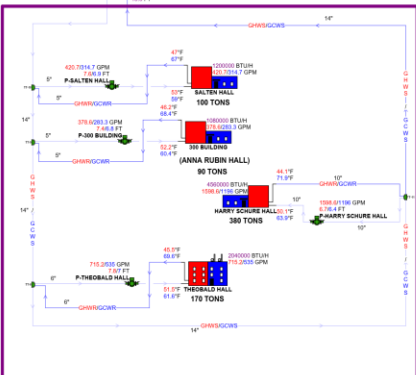
## SINGLE PIPE

2,580 TOTAL TONS  
1,805 CONNECTED TONS  
4,330 GPM

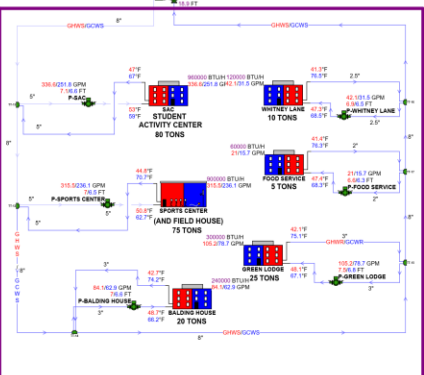
ESTIMATING (4) PRODUCTION WELLS  
ESTIMATING (2) INJECTION WELLS



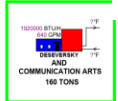
MEDICAL BUILDINGS = 850 TONS  
**A CLUSTER**



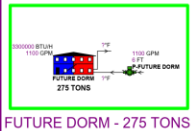
TECHNICAL BUILDINGS = 740 TONS  
**B CLUSTER**



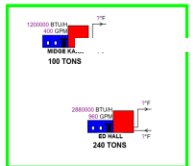
UTILITY BUILDINGS = 215 TONS  
(40 TONS OF MISC HEATING FOR SHOPS NOT INCLUDED)  
**C CLUSTER**



DE SEVERSKY AND COMMUNICATION ARTS - 160 TONS LOCATED APPROX. 2,000 FEET FROM OTHER BUILDINGS



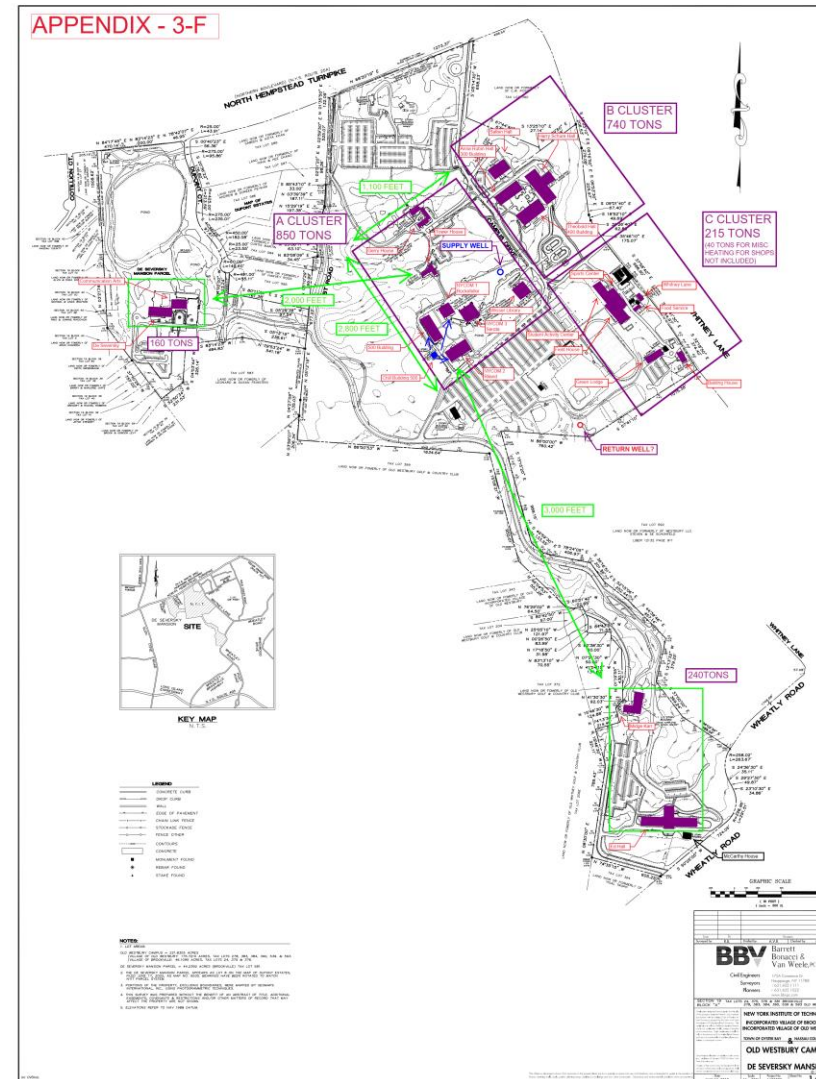
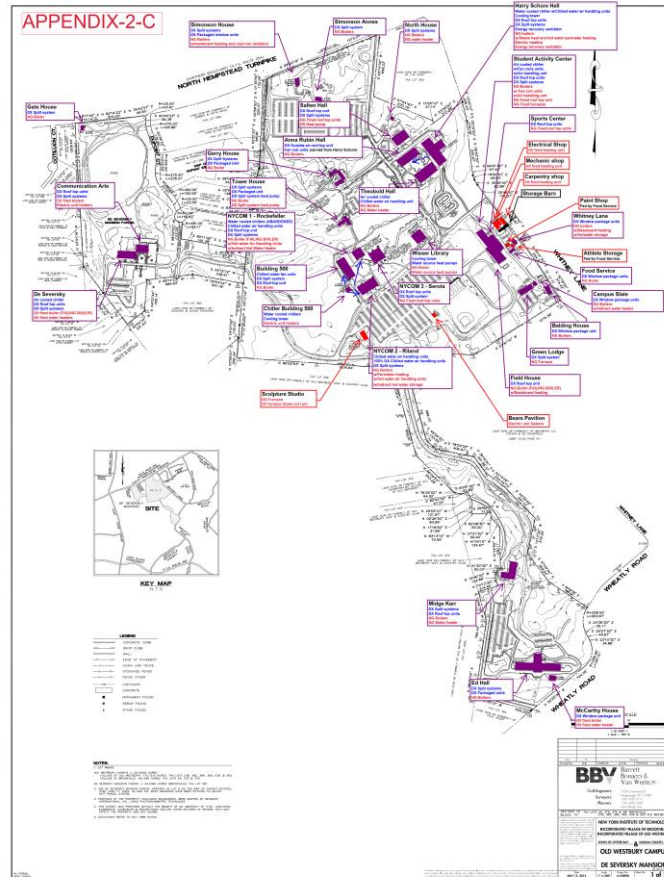
FUTURE DORM - 275 TONS



MIDGE KARR AND ED HALL - 340 TONS LOCATED APPROXIMATELY 3,000 FEET FROM OTHER BUILDINGS



# Modeling and Inventory of Data for Heating and Cooling a Campus



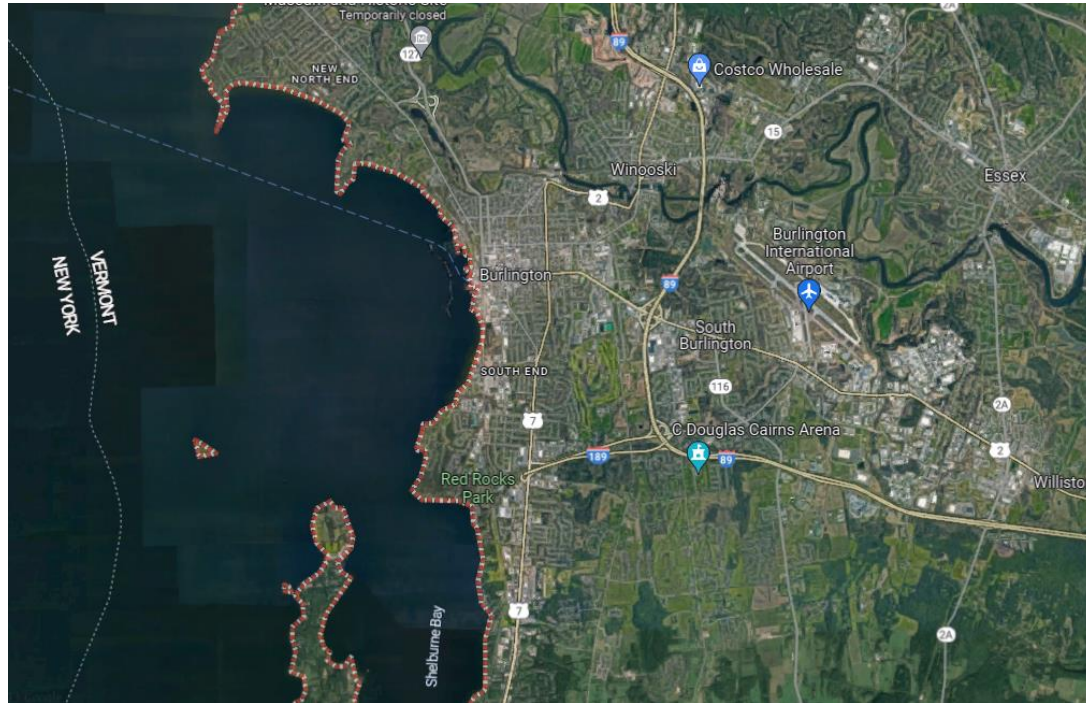


# Geothermal Infrastructure Belongs to Our Union Pipefitters



# Many communities [will] utilize surface water energy transfer

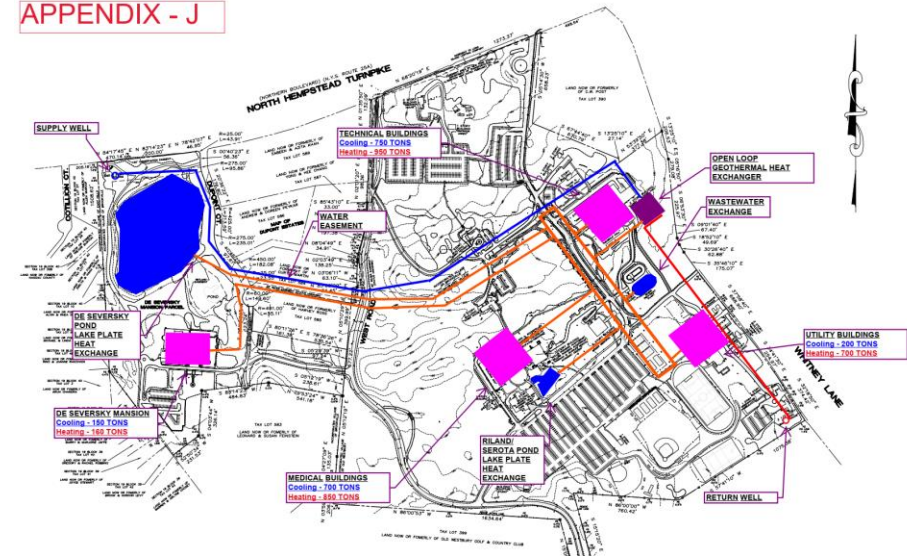
## Surface Water Energy Exchange



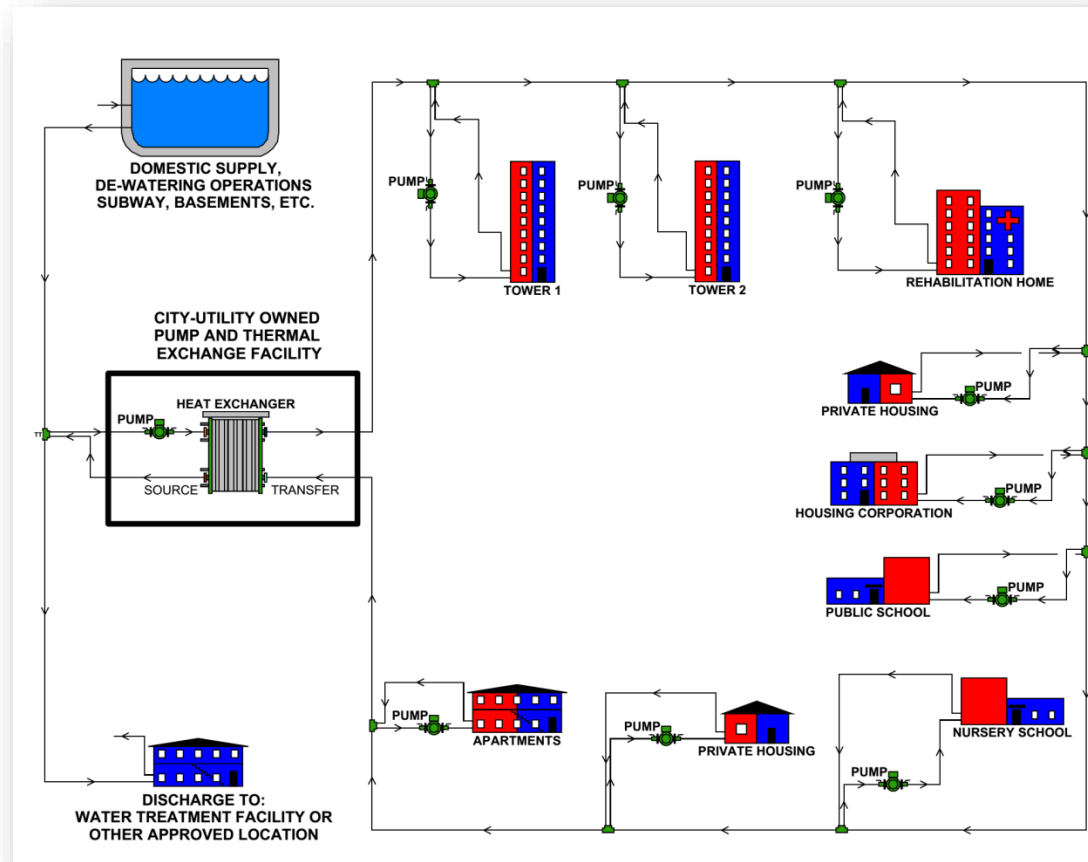
Lake Champlain & Burlington



### APPENDIX - J



# City Thermal Energy Networks in the Bronx



# SUNY has been working for years to understand decarbonization with TENS



Office for Capital Facilities  
H. Carl McCall SUNY Building  
Albany, New York 12246

Events  
SUNY HEAT PUMP TRAINING SERIES 



Jay,

As you know the Heat Pump training series so far has been wildly popular, I know we are only on the 3rd module, but I want to explore the possibility of having a second iteration of the training series in the future that is open to more state agencies. Is there anyway you could send me the curriculum so I can share it with the GreenNY committee?


Thanks,  
Alex

**Alexander Lykins, MBA**  
*Clean Energy Specialist*  
*SUNY Office for Capital Facilities*  
*The State University of New York*

Based on these experiences, and our cooperative efforts with Egg Geo, we are pleased to recognize and recommend their services to agencies seeking to decarbonize buildings.

Sincerely,

Alexander Lykins, MBA  
Clean Energy Specialist  
SUNY Office for Capital Facilities  
The State University of New York

*Kristy Egg, RN, BSPH*  
 egg geo, llc

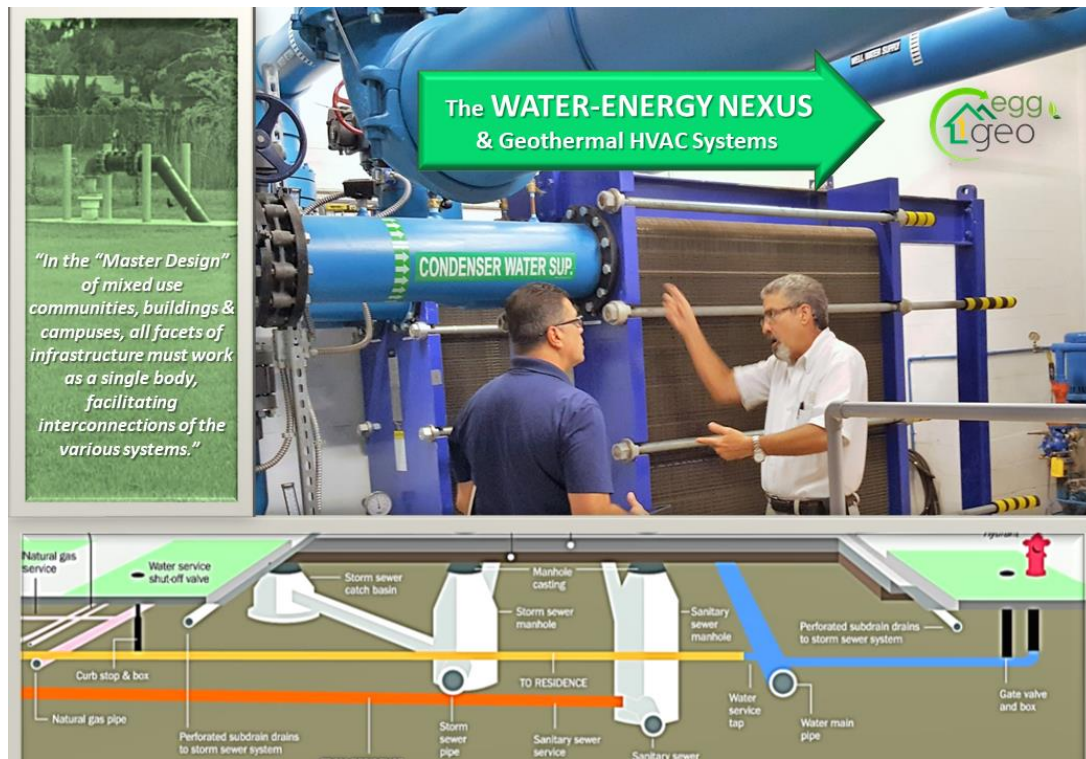
learn more and register:  
<https://www.eventbrite.com/e/module-1-introduction-to-clean-heating-and-cooling-tickets-153843789917>



- Ground Source Heat Pumps & Ground Source Heat Pumps**
- **The Nuts and Bolts of Heat Pumps**
  - **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 and Cooling?**

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

# The Water-Energy Nexus – Existing Infrastructure



- When we're talking about water energy, there's another type of hydropower; it has to do with using the movement of water to transfer energy in the form of BTUs. It is one of the most basic and simple uses of water in every form. It has been safely done for generations, and has been legislated as a recommended form of heating and cooling energy transfer. As a case in point:

# 6 Ways to use Existing Water for Energy

## Subway Dewatering >>

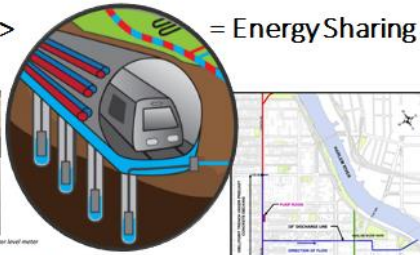
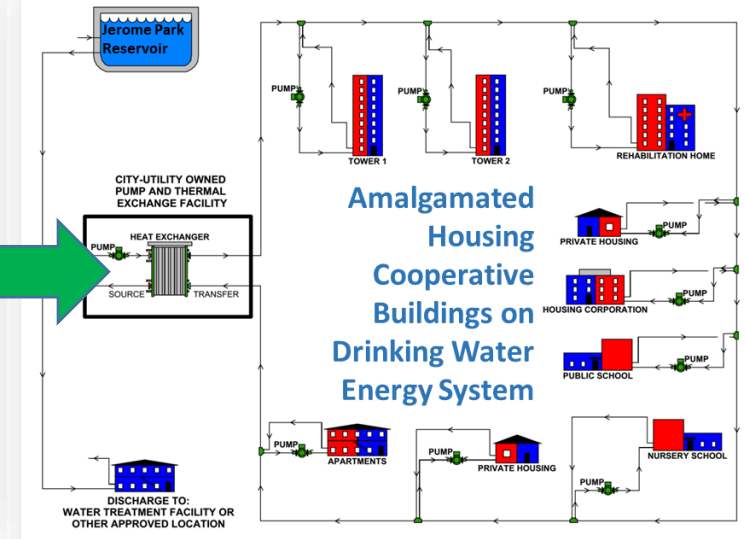
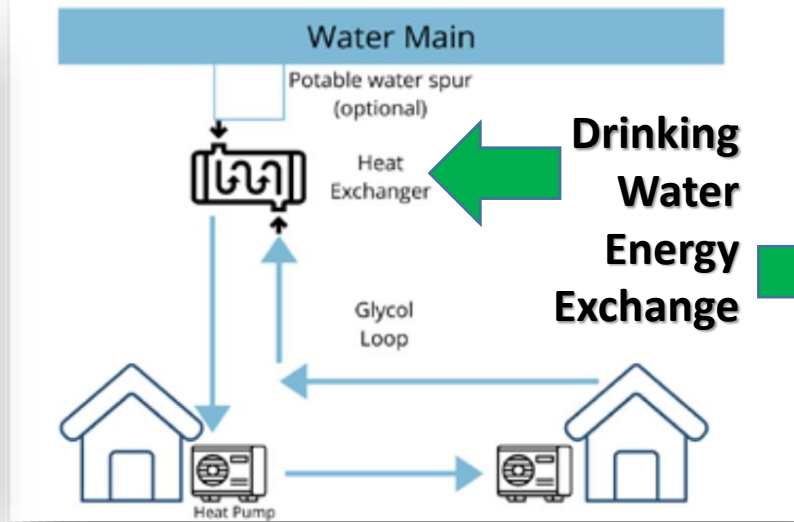


Figure 28. Checkmate from top left - of typical dewatering. 1) flow meter installed, 2) water level meter installed and 3) pressure gauge installed to water line.



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## Conduit Hydropower: Sources of energy recovery

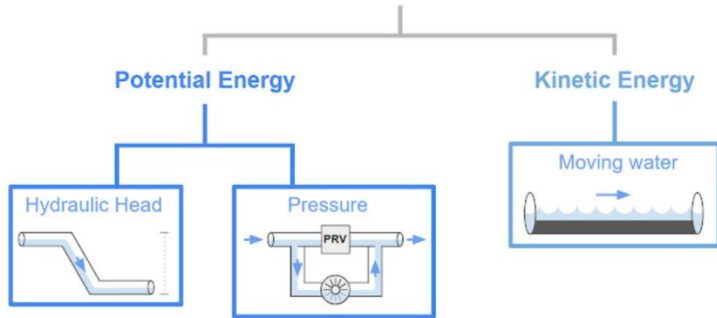
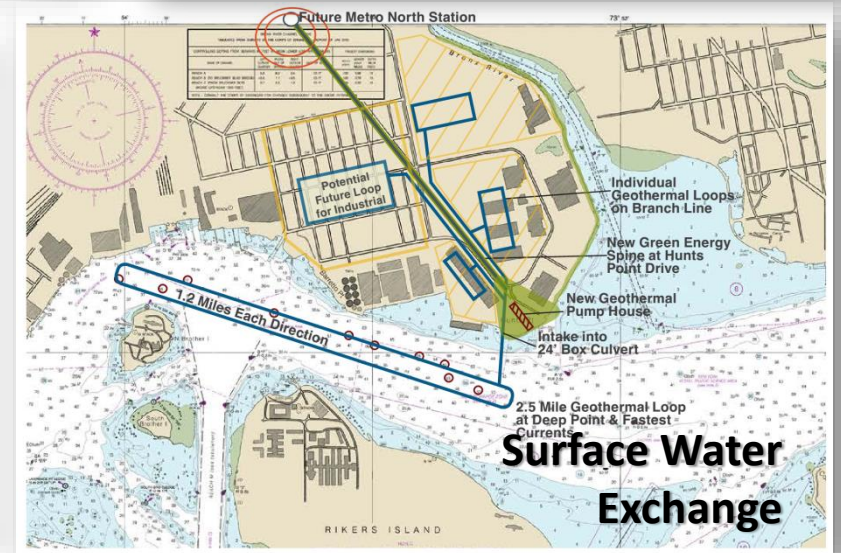
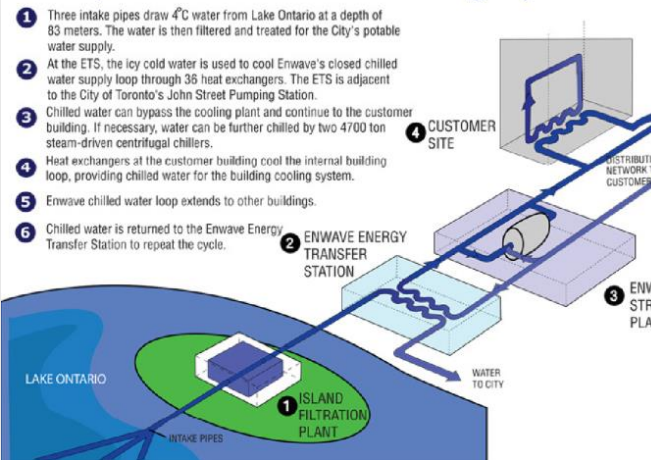


Figure 3. Sources of energy recover in water management infrastructure which can be harnessed by CH technologies (Source: Sebastian Grimm).

## Deep Lake Water Cooling System



# Governmental Task Force

- A qualified task force can operate with the purpose to implement simple, yet essential changes and cooperation between infrastructure authorities would accelerate decarbonization and energy efficiency efforts throughout the City.





# Historical Effort for Geothermal:

## Data Gathering Efforts

### Trip to Tampa

During the trip to Tampa, 2 project sites have been visited. These systems were all residential applications, where open loop GSHP systems were used for HVAC needs. Mr. Egg, who is the owner of Egg Geothermal is continuing to provide us with additional data about GSHP systems they've installed.





DURO PUMPS AND WATER SOFTENERS

**THERON EGG PLUMBING & APPLIANCES**  
PHONE 100  
SODA SPRINGS, IDAHO

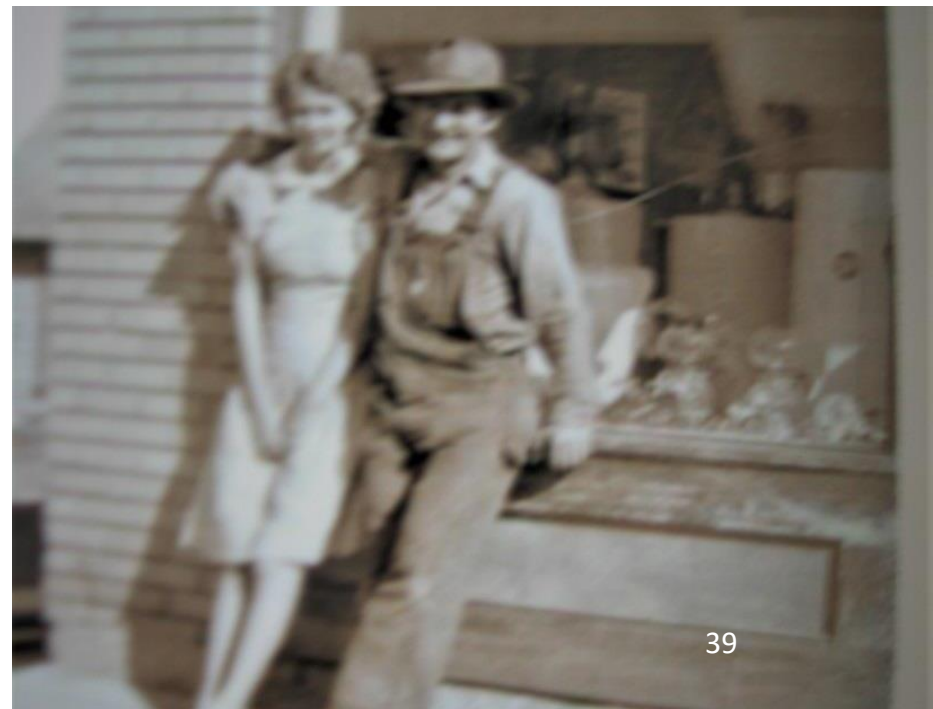
Customer's Order No. \_\_\_\_\_ Date Jan. 23 1948

M. Jay Reno

Address \_\_\_\_\_

SOLD BY	CASH	C.O.D.	CHARGE	ON ACCT.	MOSE. RETD.	PAID OUT
	<input checked="" type="checkbox"/>					

QUANTITY	DESCRIPTION	PRICE	AMOUNT
	<u>Plumbing Water &amp; Hooking</u>		
	<u>4/8 oil heater</u>		
	<u>15 ft 3/4" Tubing @ 12.00</u>		<u>1.80</u>



Theron Egg Plumbing, Circa 1948

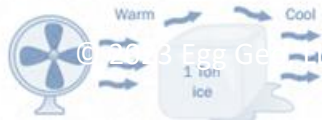
Theron "Jay" Egg      Theron John Egg

# Geothermal technologies: Growing with the Renewable Energy Industry



FIGURE 2-9 A geothermal air-conditioning system requires these main parts: (a) an earth-coupled portion, (b) a heat pump, (c) the building or object to be heated and cooled. (Sarah Cheney/Egg Systems)

Heat Transfer and HVAC Basics 41



New release:  
"Our Hidden Powers"

**OUR HIDDEN POWERS**

working together for a planet in balance

Kristina Hagström Ilievska Gabriella Skog

Johanna Arpiainen



# Present Day Geothermal Efforts



## Geothermal Activity Book

- Crossword
- Science Experiment
- Coloring
- Word Scramble
- Maze
- ...and more!



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

SAVE 20%

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 Orio** 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.

**Modern Geothermal HVAC**  
Engineering and Control Applications

