BUILDINGENERGY NYC

Teamwork Makes the "Therm" Work!

Scaling District Geothermal through Coalitions

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Curated by Jeannine Altavilla (Bright Power) and Xavier Williams (SWA)

Northeast Sustainable Energy Association (NESEA)
October 12, 2023

Learning Objectives

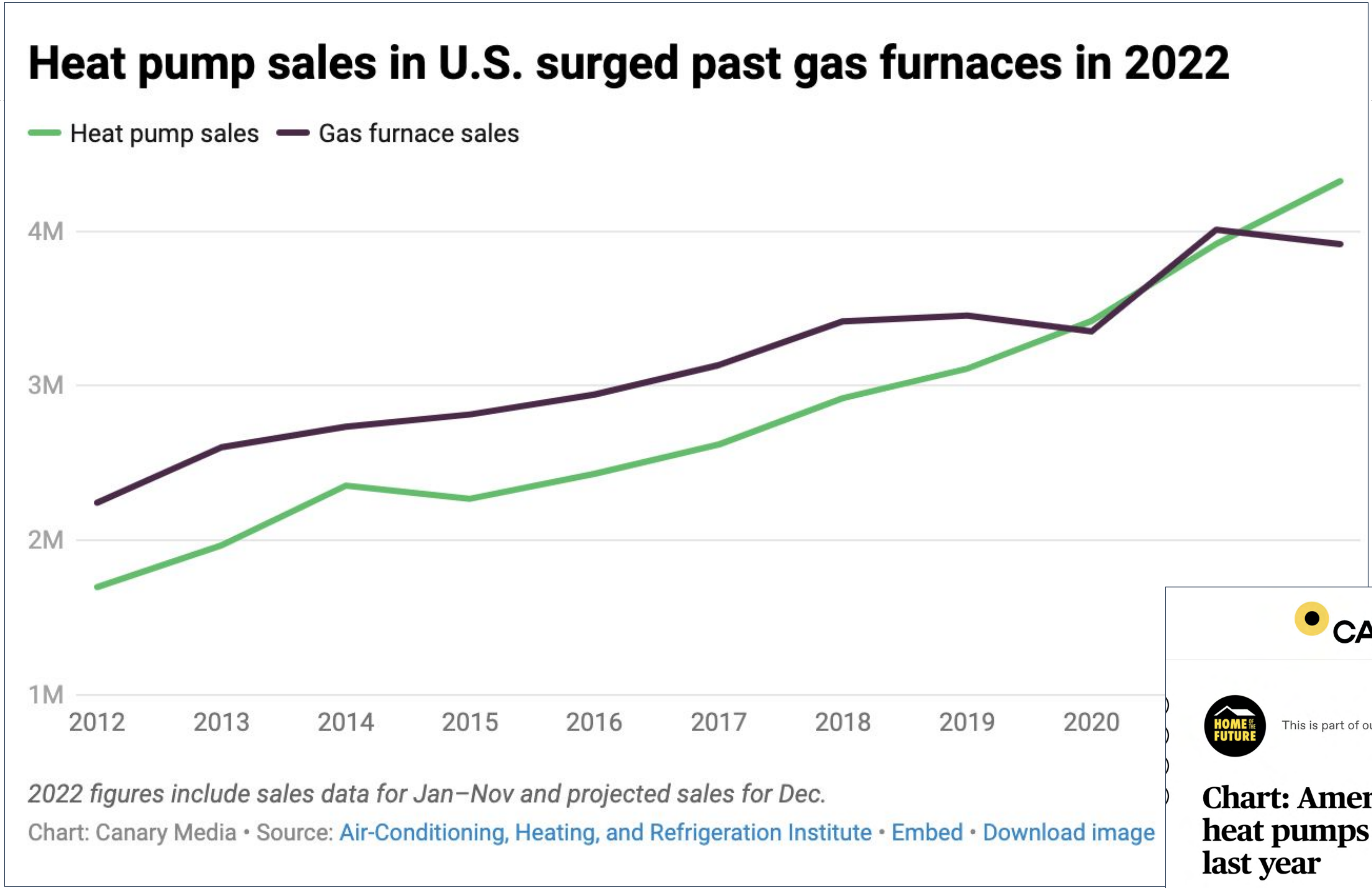
- Contrast ground source, geothermal, community heat pumps, networked geothermal, district geothermal, and Thermal Energy Networks
- Define the characteristics that make a building or neighborhood a promising fit for GSHP implementation
- Analyze the challenges of crossing industry boundaries in order to create effective coalitions, and utilize case studies to create coalitions to scale district geothermal
- Leverage funding opportunities to launch a pilot project

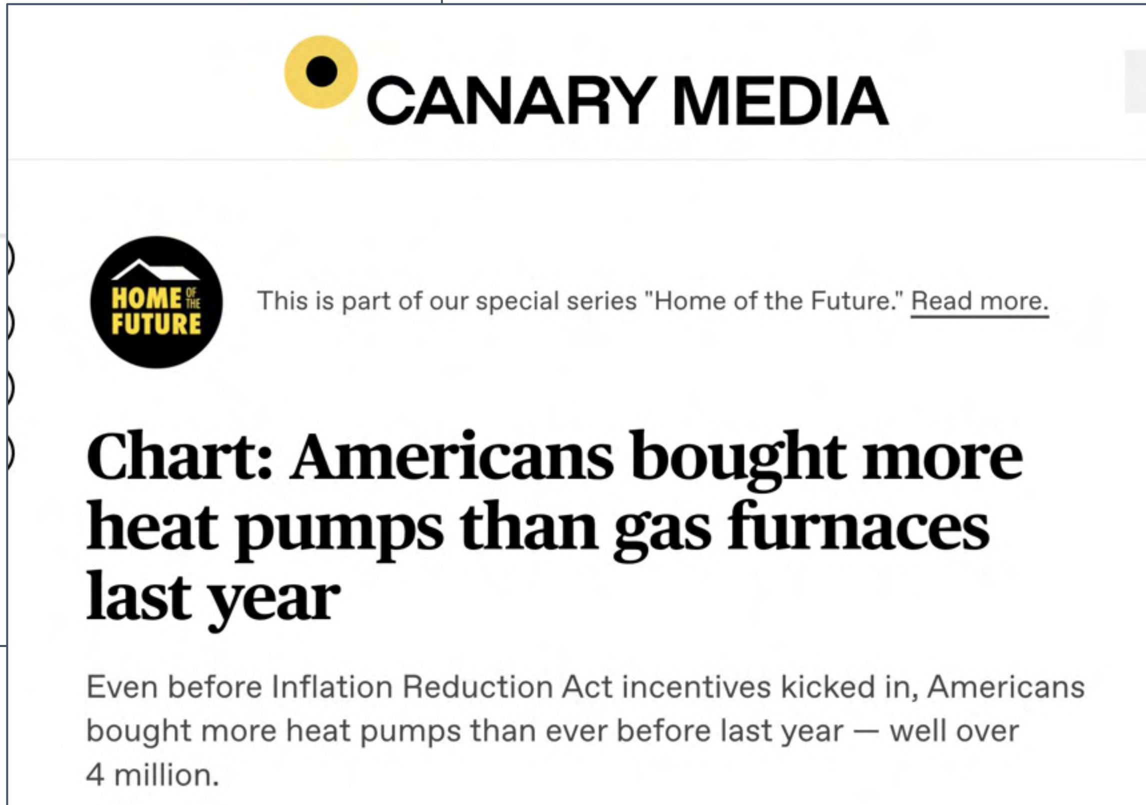
heet

A New Utility is Born

Barr Foundation
Putnam Foundation
E4THE FUTURE
PIVOT 2022 All Hands On Deck
Winslow Foundation
ENERGY FOUNDATION
MASSACHUSETTS CLEAN ENERGY CENTER


LOUISVILLE





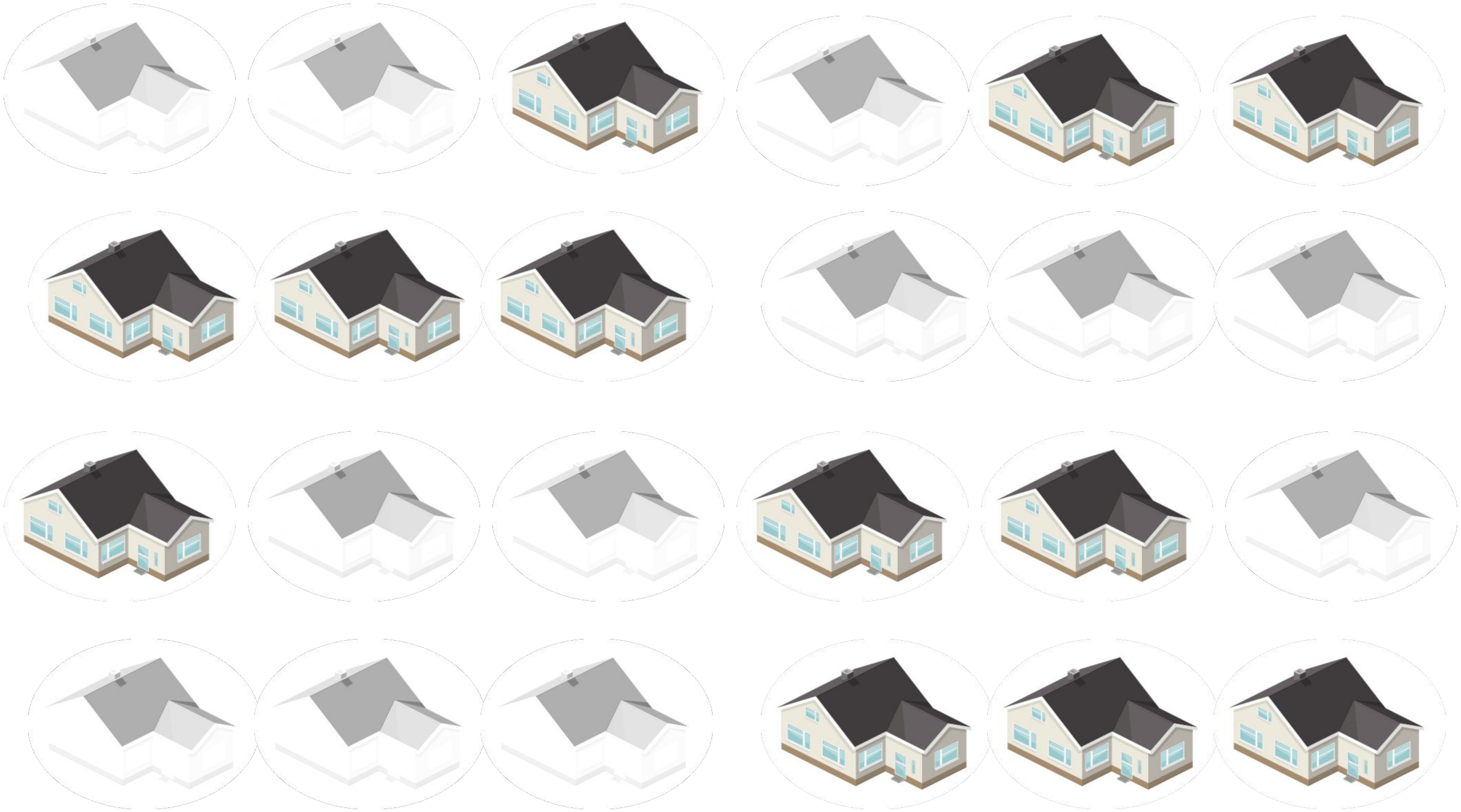
CANARY MEDIA

This is part of our special series "Home of the Future." Read more.

Chart: Americans bought more heat pumps than gas furnaces last year

Even before Inflation Reduction Act incentives kicked in, Americans bought more heat pumps than ever before last year — well over 4 million.

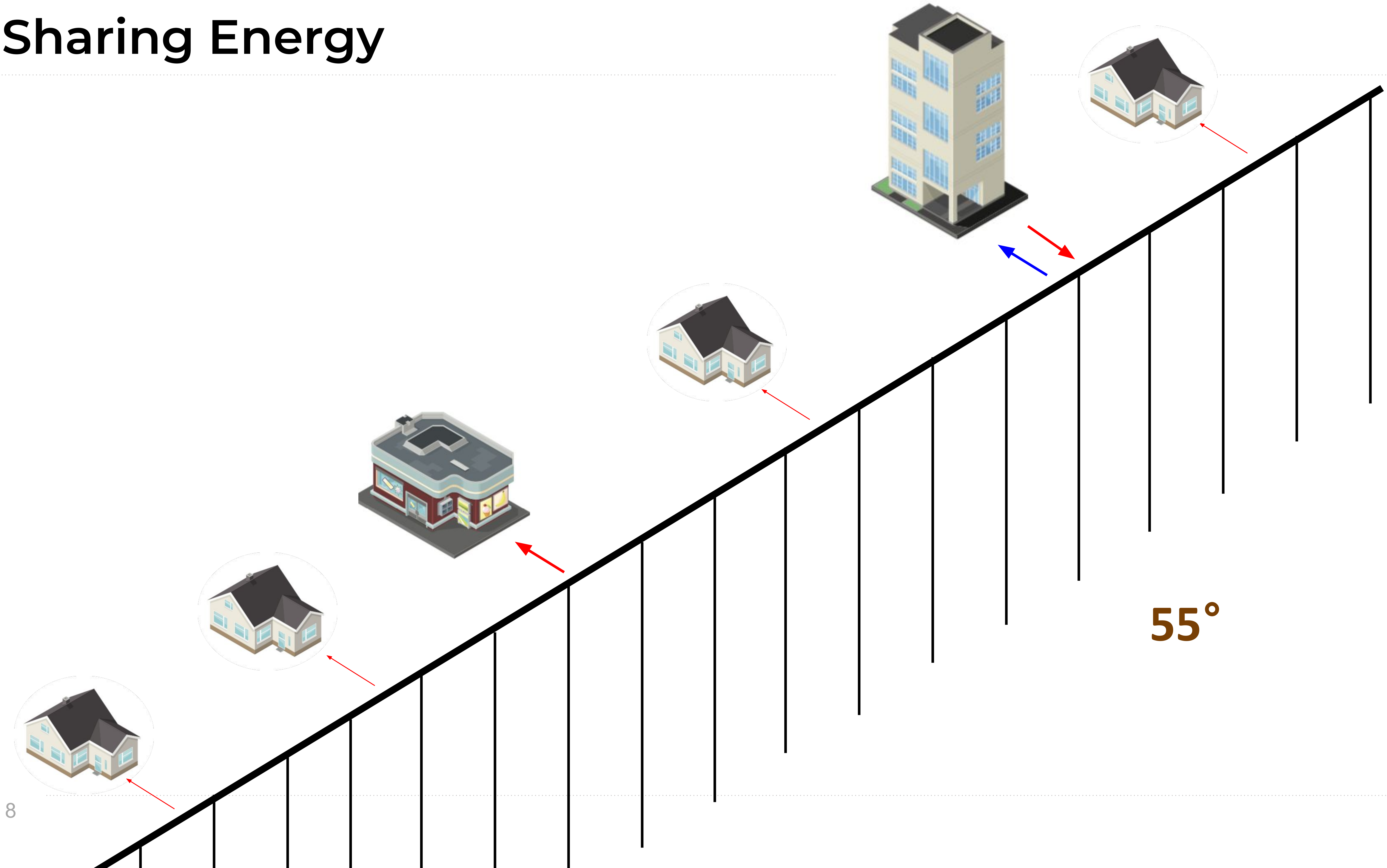
Fleeing Customers, Increasing Gas Bills



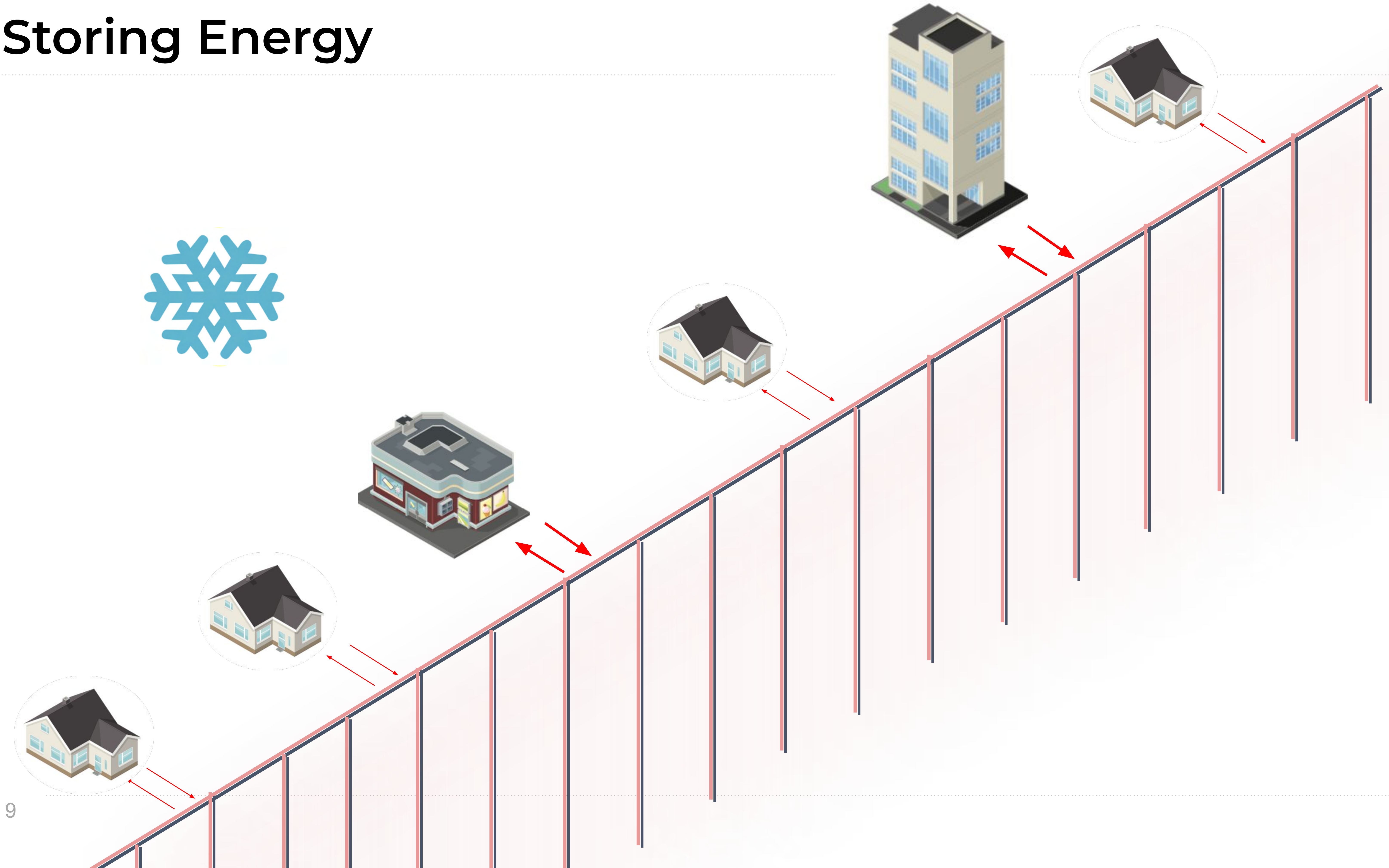
Networked Geothermal (AKA Thermal Energy Networks)

- Ground source heat pumps
- “Shallow” boreholes
- Ambient temperature
- Single pipe
- Thermal management

Sharing Energy



Storing Energy



Outcomes

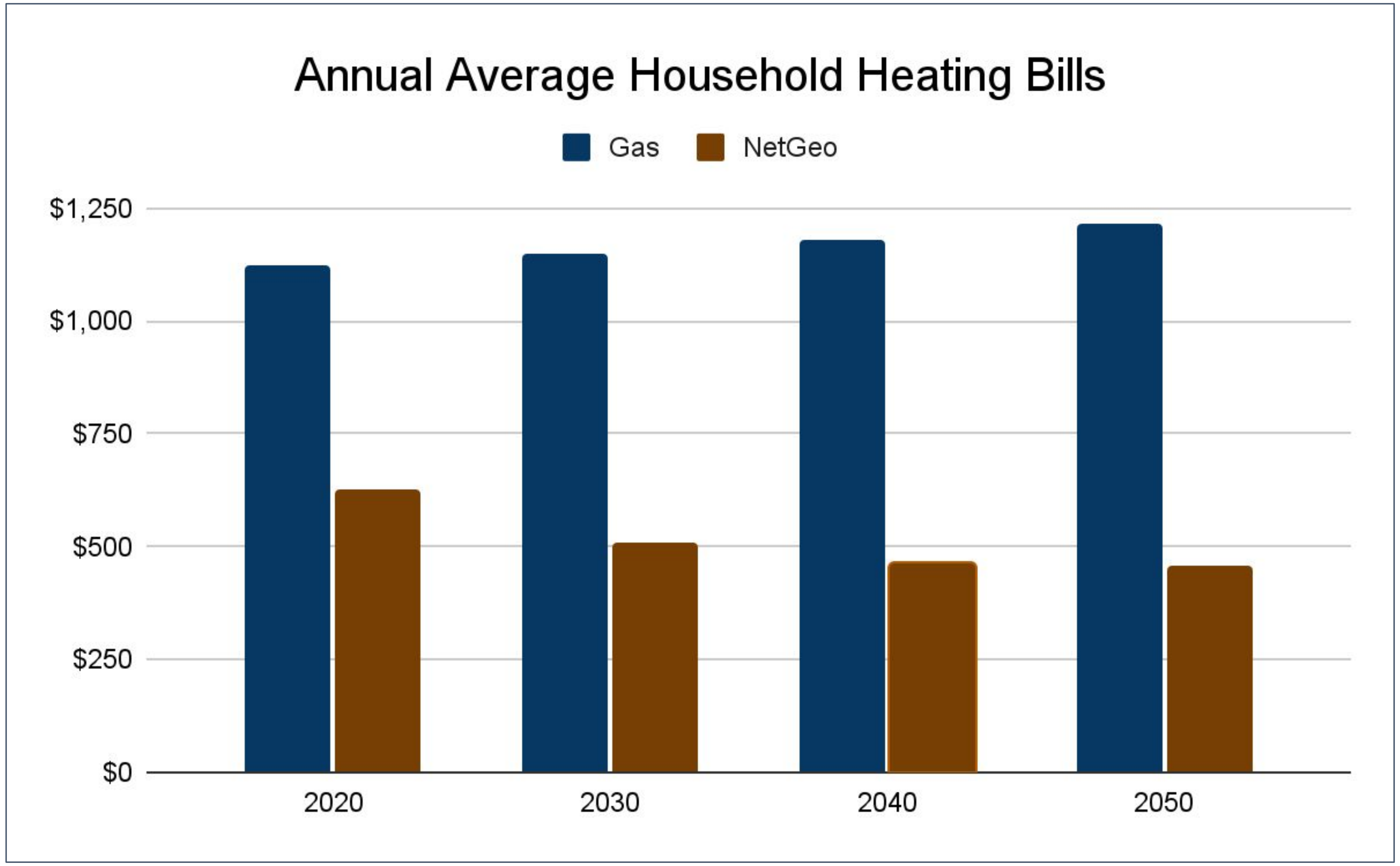
- Safety

East Harlem Gas Explosion 2014

Outcomes

- ➢ Safety
- ➢ Affordability
  - ○ Heating bills

MA Energy Bill Projection (gas vs networked geothermal)
(Applied Economics Clinic Brief)

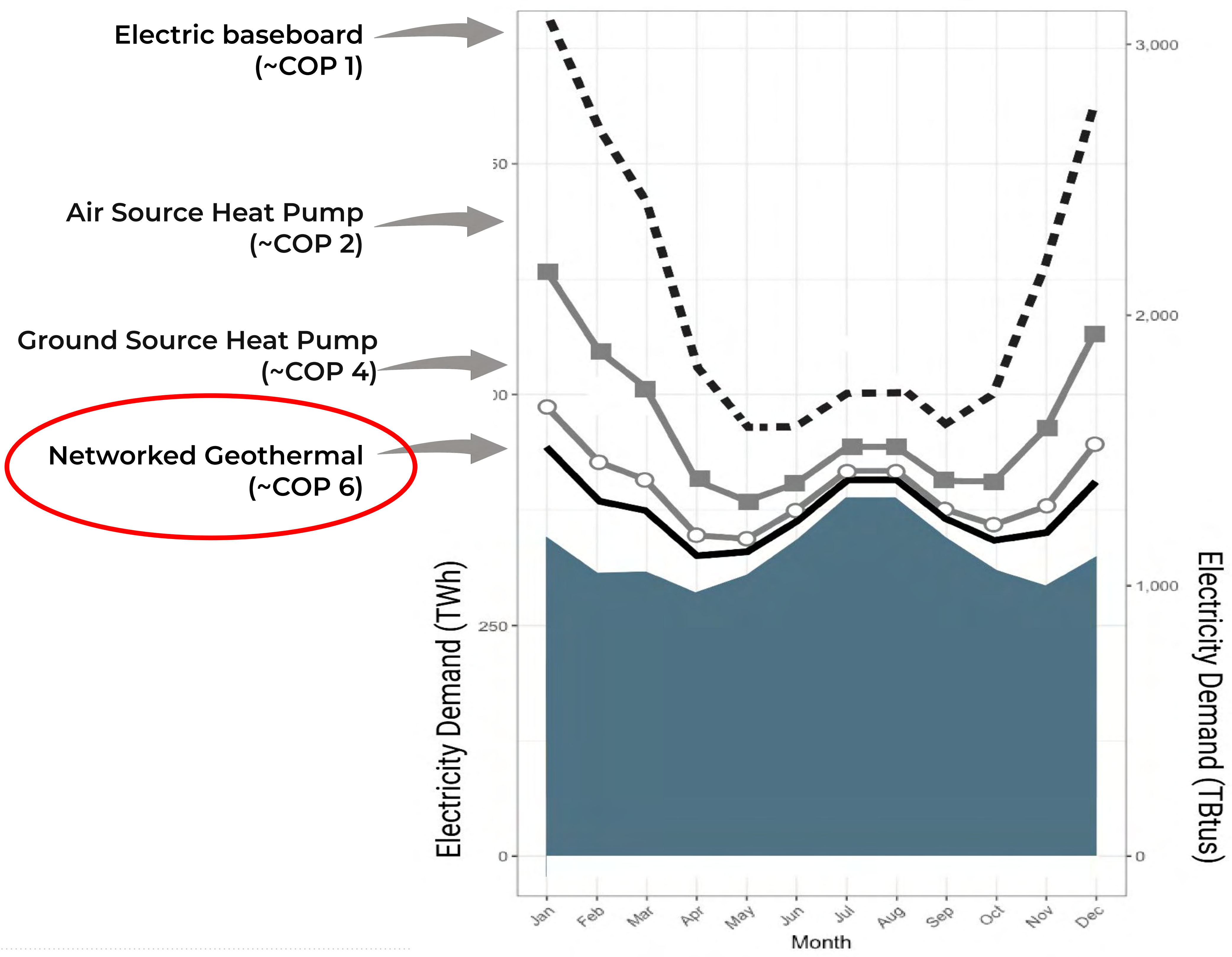


Inflection Point; When Heating with Gas Costs More; Applied Economic Clinic Jan 2021

Outcomes

- Safety
- Affordability
  - Heating bills
  - Electric bills

Future US Seasonal Electric Peaks
(as we electrify)



Buonocore, J., Salimifard, P., Magavi, Z., Allen, J., "The Falcon Curve: Implications of Seasonal Building Energy Use and Seasonal Energy Storage for Healthy Decarbonization" DOI: 10.21203/rs.3.rs-1054606/v1

Outcomes

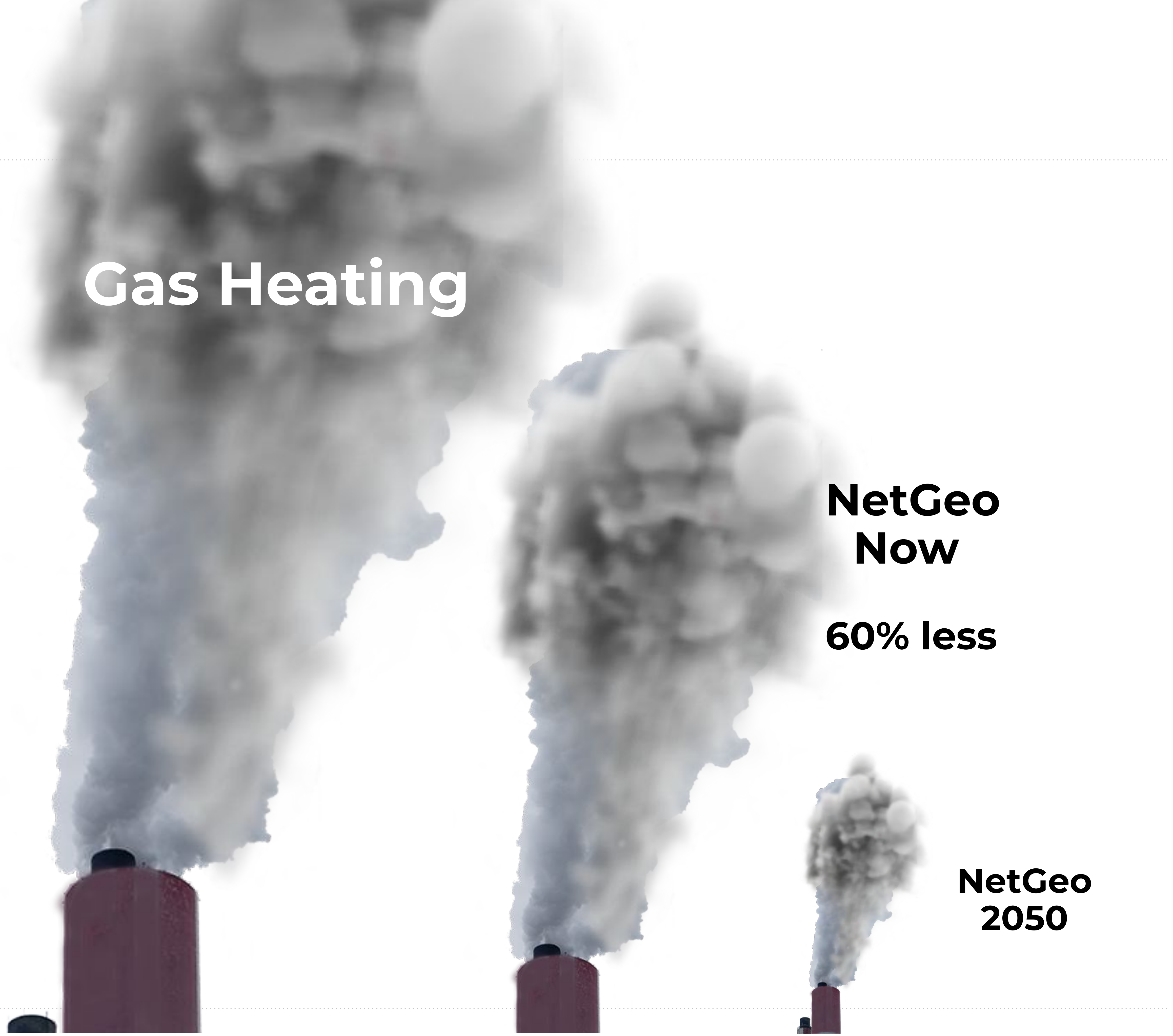
- Safety
- Affordability
  - Heating bills
  - Electric bills
- Workforce can transition

Gas Pipes

Water Pipes

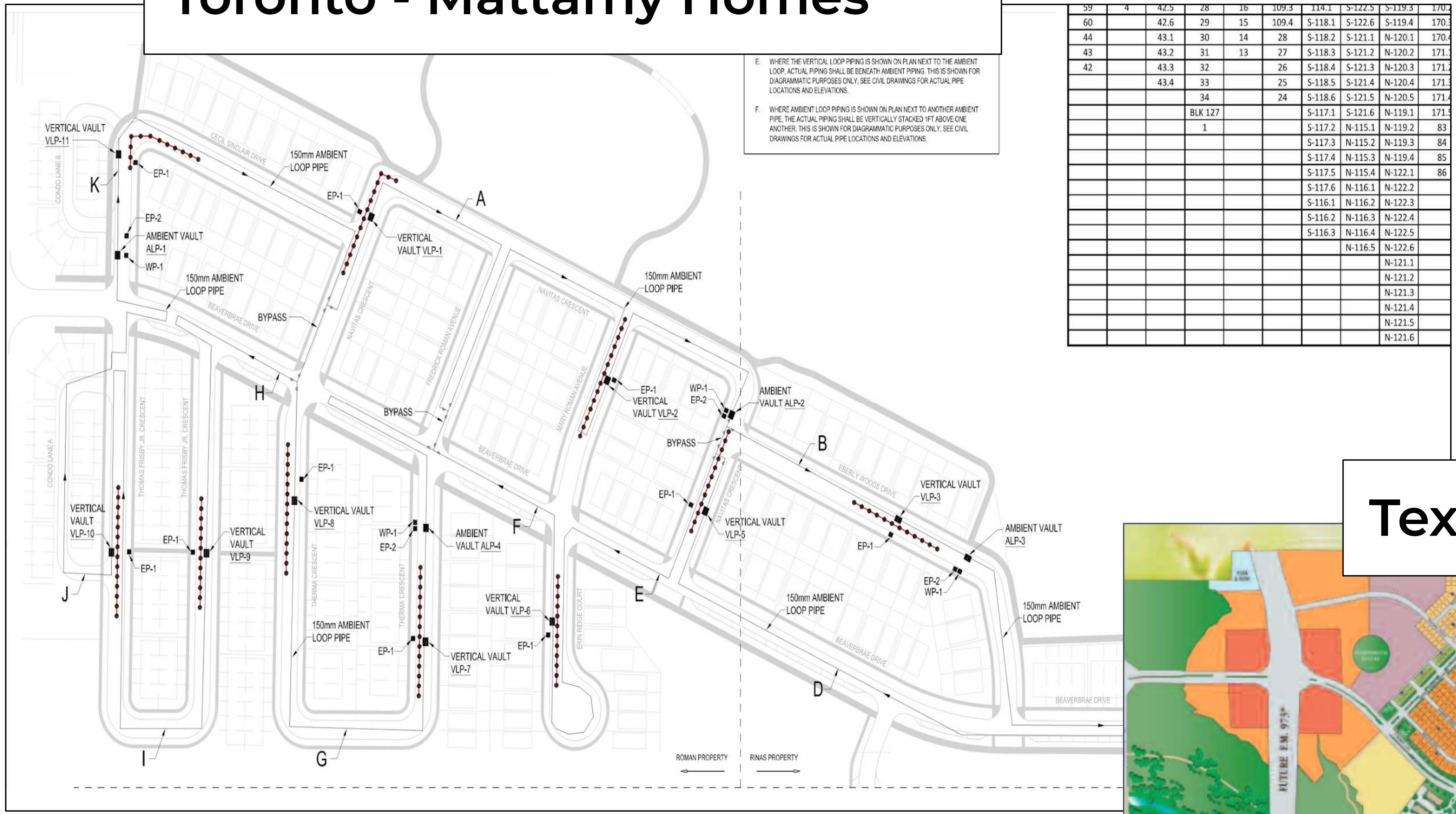
Outcomes

- ➢ Safety
- ➢ Affordability
  - ○ Heating bills
  - ○ Electric bills
- ➢ Workforce can transition
- ➢ Emissions

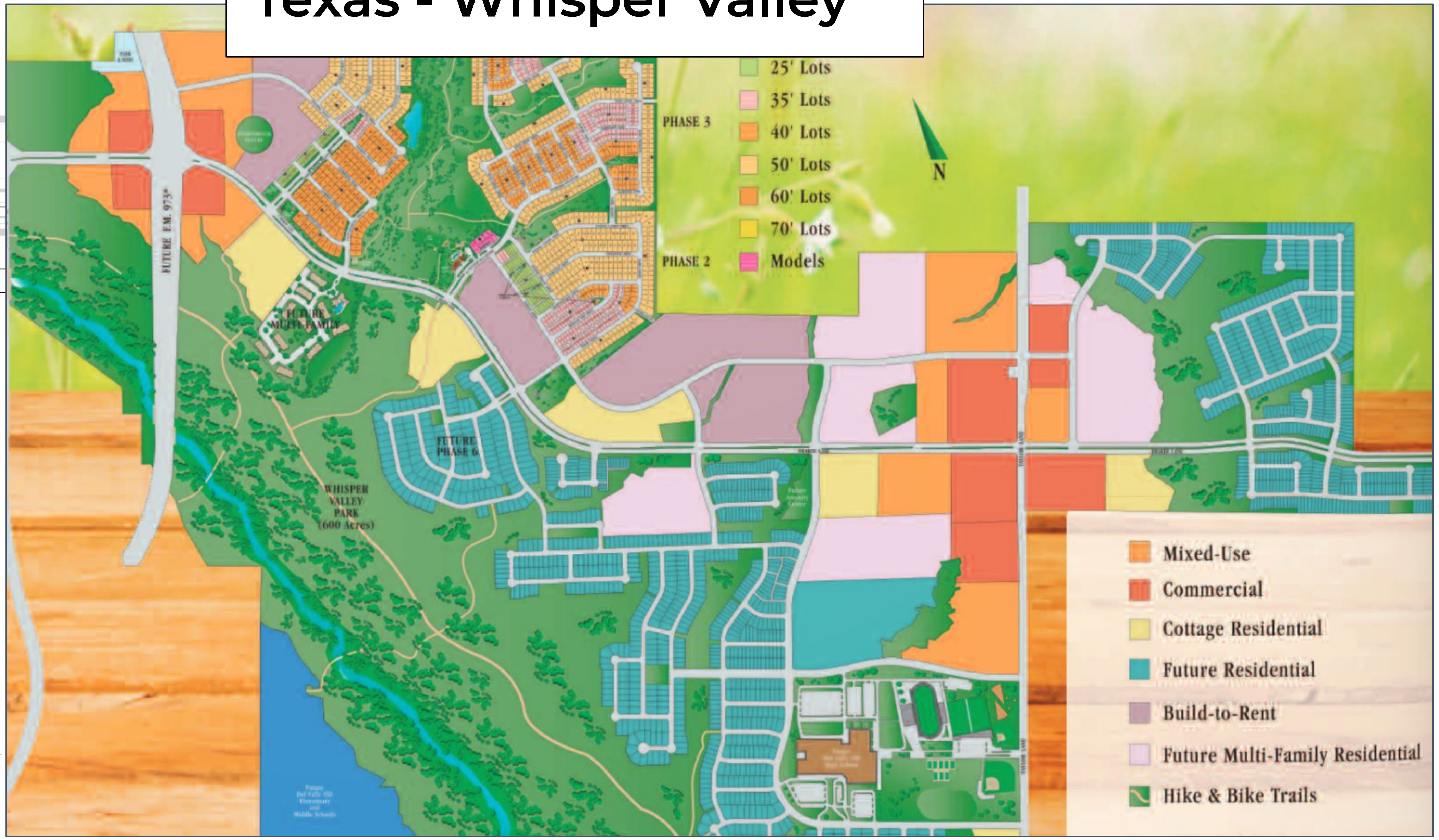


[GeoMicroDistrict Feasibility Study](), Buro Happold Engineering, 2019

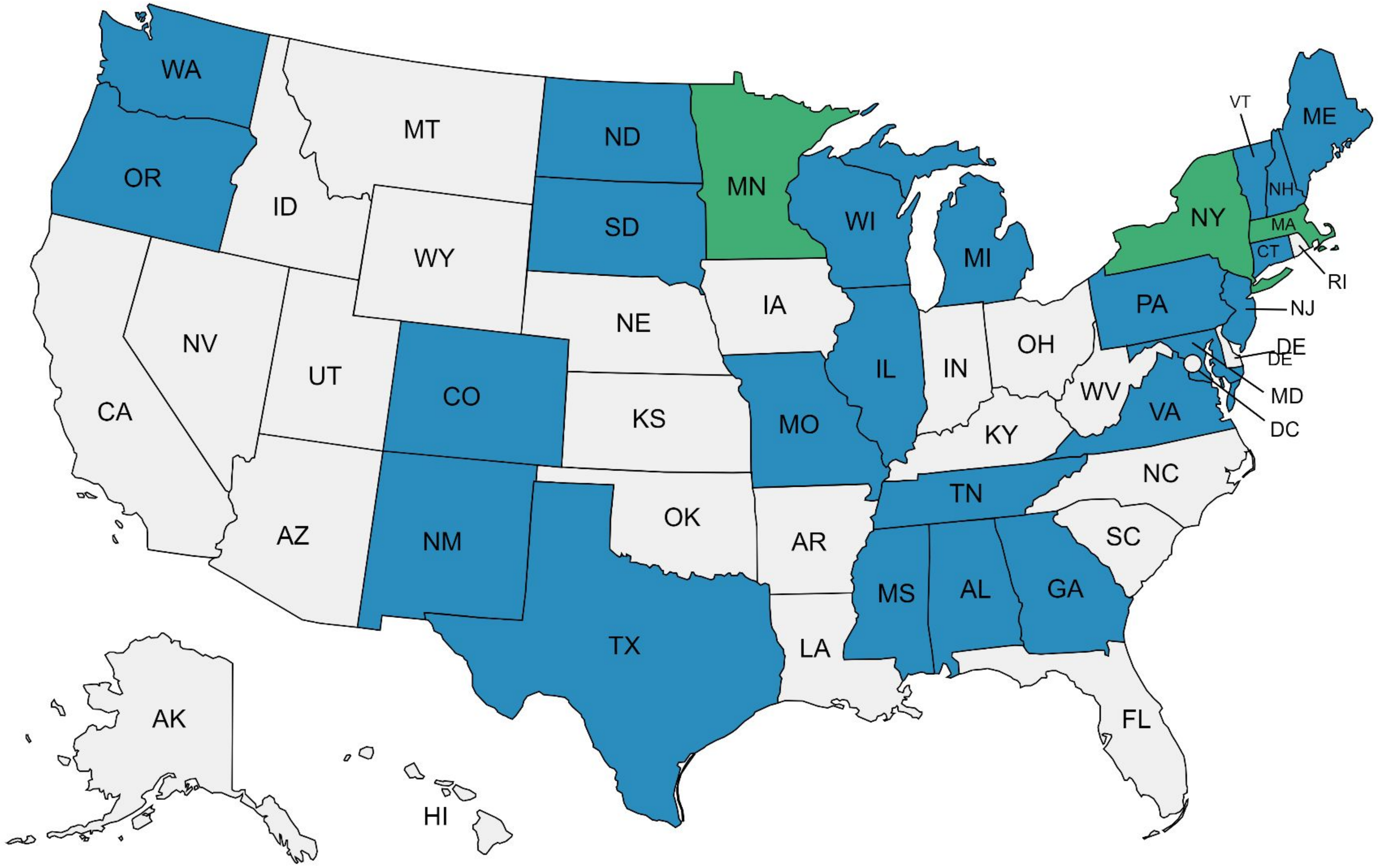
Toronto - Mattamy Homes



Texas - Whisper Valley



Utility Interest



As of Sept. 11, 2023

Gas Utility Pilots

Utility NetGeo Coalition

spire

nationalgrid

AVANGRID

National Fuel®

PGW

Xcel Energy®

VGS

conEdison

gti®

EVERSOURCE ENERGY

NW Natural

CASCADE NATURAL GAS CORPORATION® A Subsidiary of MDU Resources Group, Inc.

CMS ENERGY

Nicor Gas

Liberty™

BGE® An Exelon Company

Southern Company Gas

RICHMOND GAS WORKS

New Jersey Natural Gas

Washington Gas

EMERGENT
URBAN CONCEPTS

Jared Rodriguez, Principal

jared@emergentgroup.com

We NEED Scale to Solve the Climate Emergency

Developing Thermal Energy Networks (TENs) is rapidly emerging as a key approach to scaling building decarbonization, moving away from a "building-by-building" and toward a "community-by-community" or "neighborhood-by-neighborhood" approach.

We NEED to protect vulnerable communities.

A "community-by-community" or "neighborhood-by-neighborhood" approach includes careful strategic planning which emphasizes avoiding destabilizing already tenuous household economic stability in disadvantaged communities. Avoiding a gas utility death spiral and planning for transition is a critical step in our efforts to meet the Climate Leadership and Community Protection Act (CLCPA).

Decarbonization strategies.

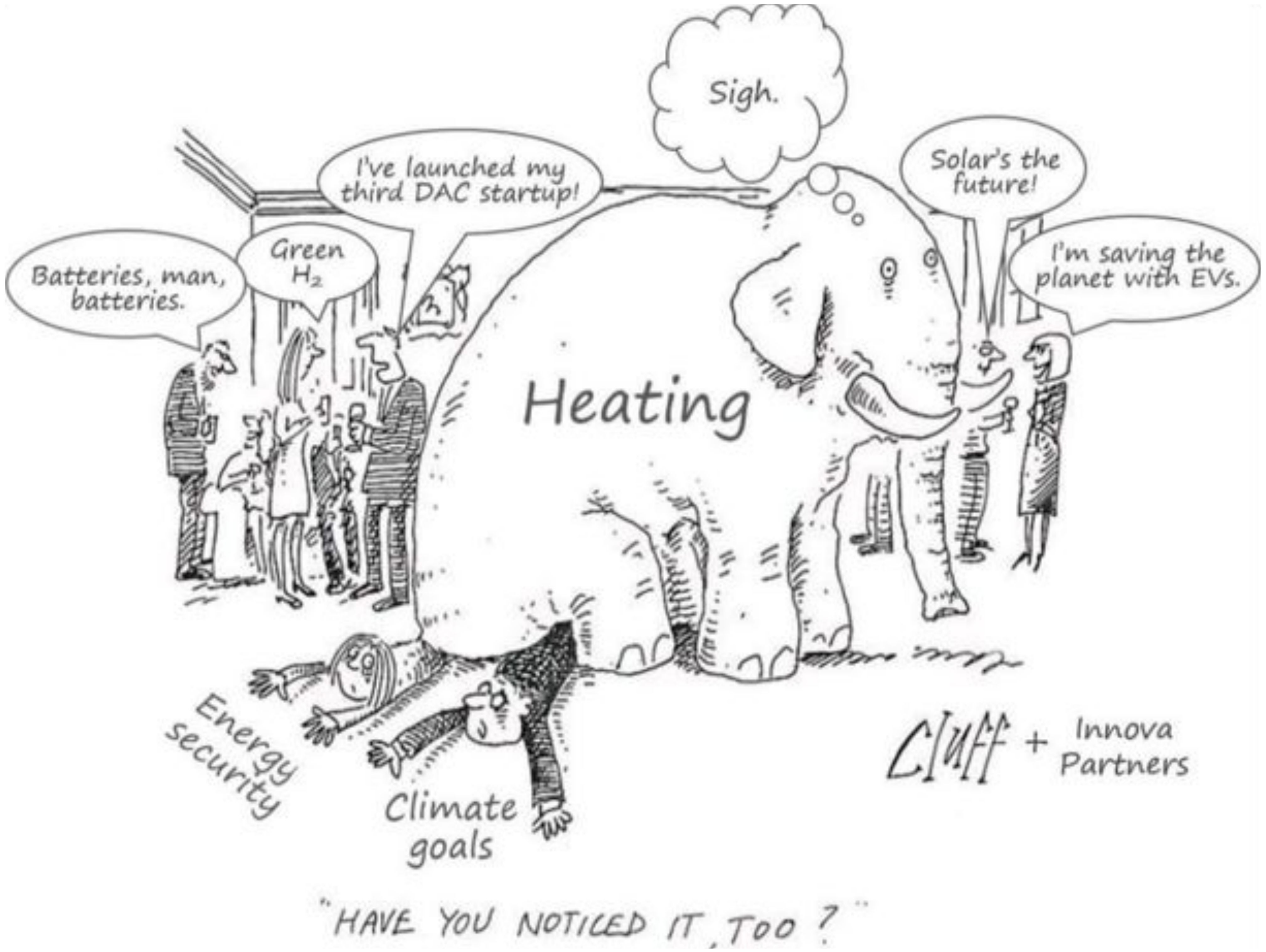
Address the elephant in the room and recycle wasted heat, share it across the building, and reduce peak loads.

REDUCE energy loads as much as possible.

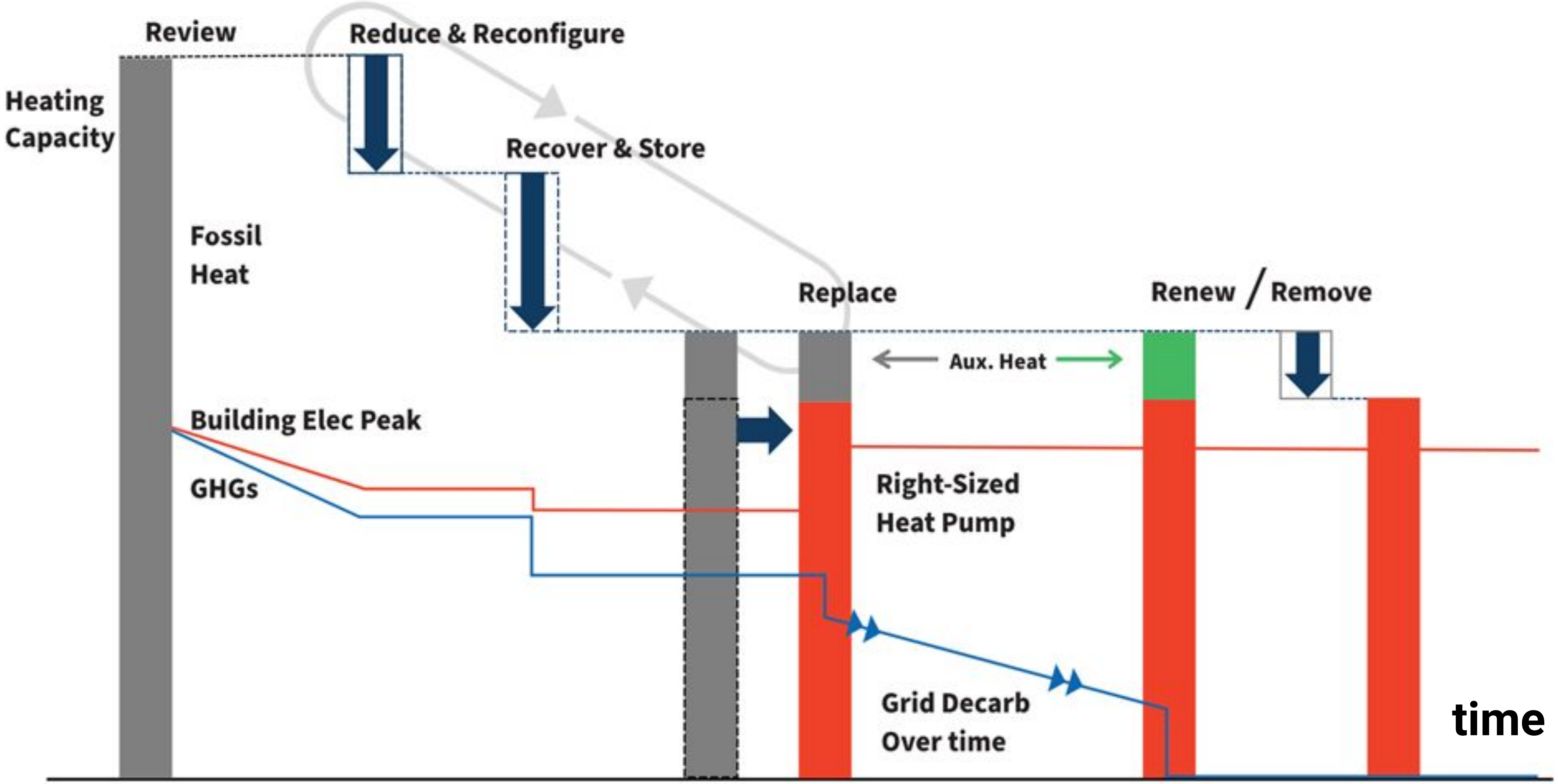
RECONFIGURE to create thermal networks and enable low temperature distribution.

RECOVER as much heat as possible from air, water, and wastewater sources.

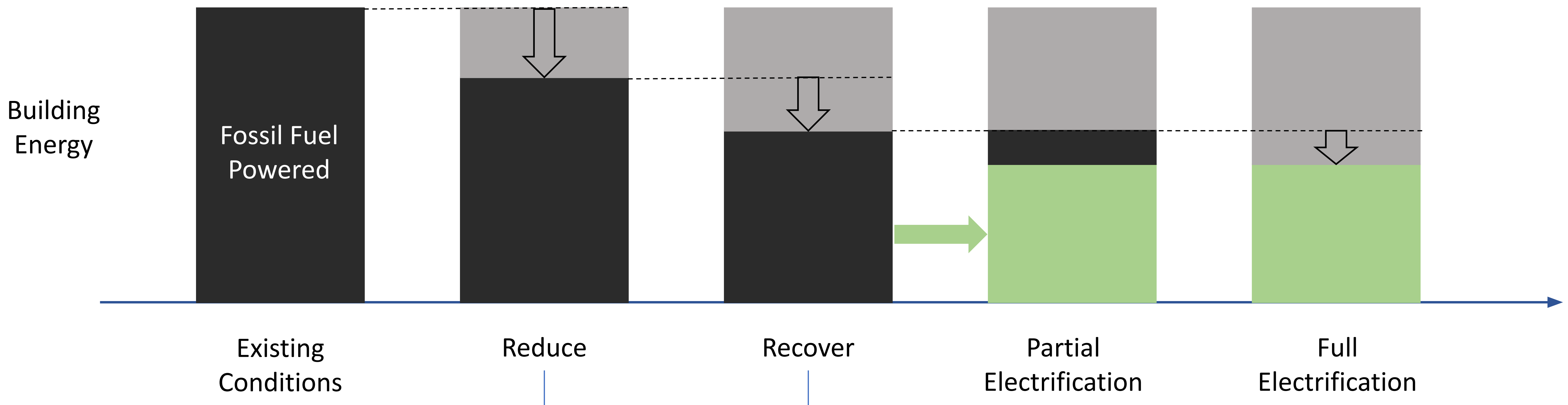
REPLACE equipment incrementally over time until full decarbonization is reached. Neither "all or nothing" nor "everything all at once."



Resource Efficient Decarbonization (RED): an incremental methodology and integrated design process combined with strategic capital planning creates a path towards carbon neutral buildings.



Resource Efficient Decarbonization



Reduce Energy Load

- Building Envelope Improvements
- Control Optimization
- Ventilation Improvements
- Dedicated Outside Air System
- Hydronic Distribution
- Lower Heating Supply Temp.
- Terminal Units

Recover Wasted Heat

- Waterside Heat Recovery
- Airside Heat Recovery
- Wastewater Heat Recovery

Partial Electrification

Replace fossil fuel inputs and prioritize the techno-economic portion of load

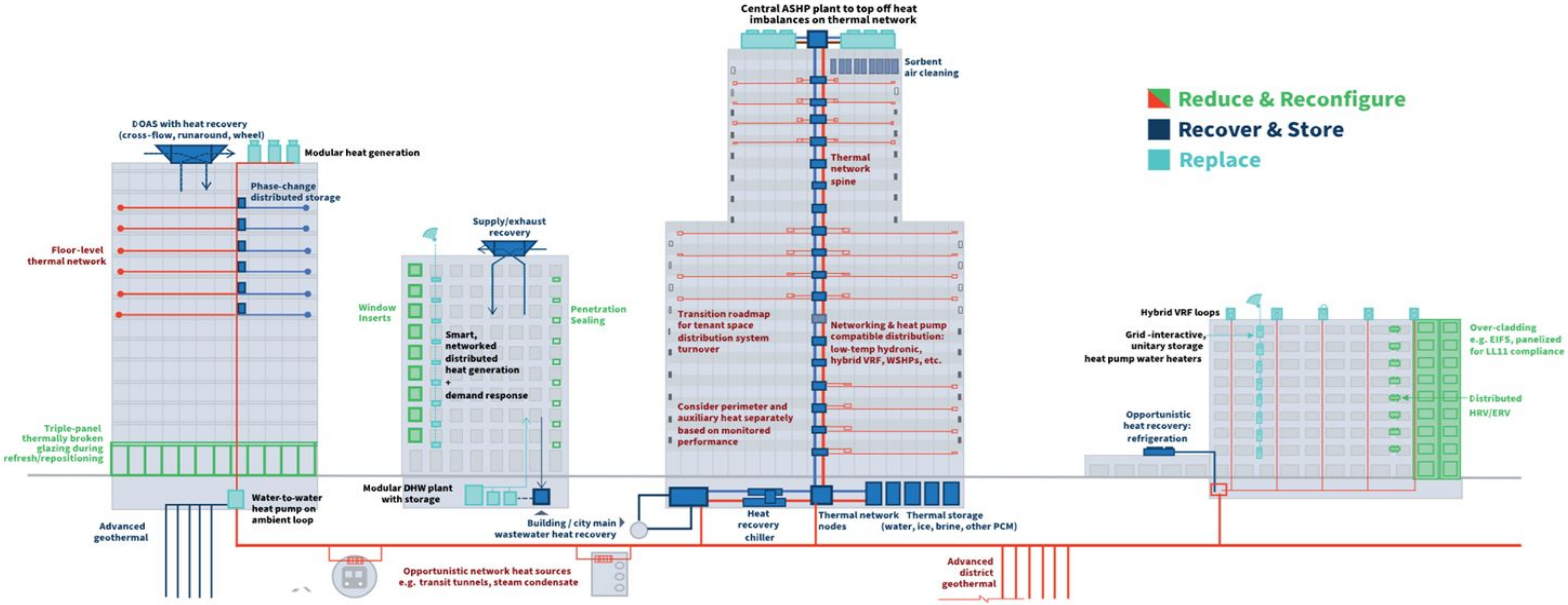
- Air Source Heat Pumps
- Water Source Heat Pumps
- Geothermal
- Thermal Layering

Full Electrification

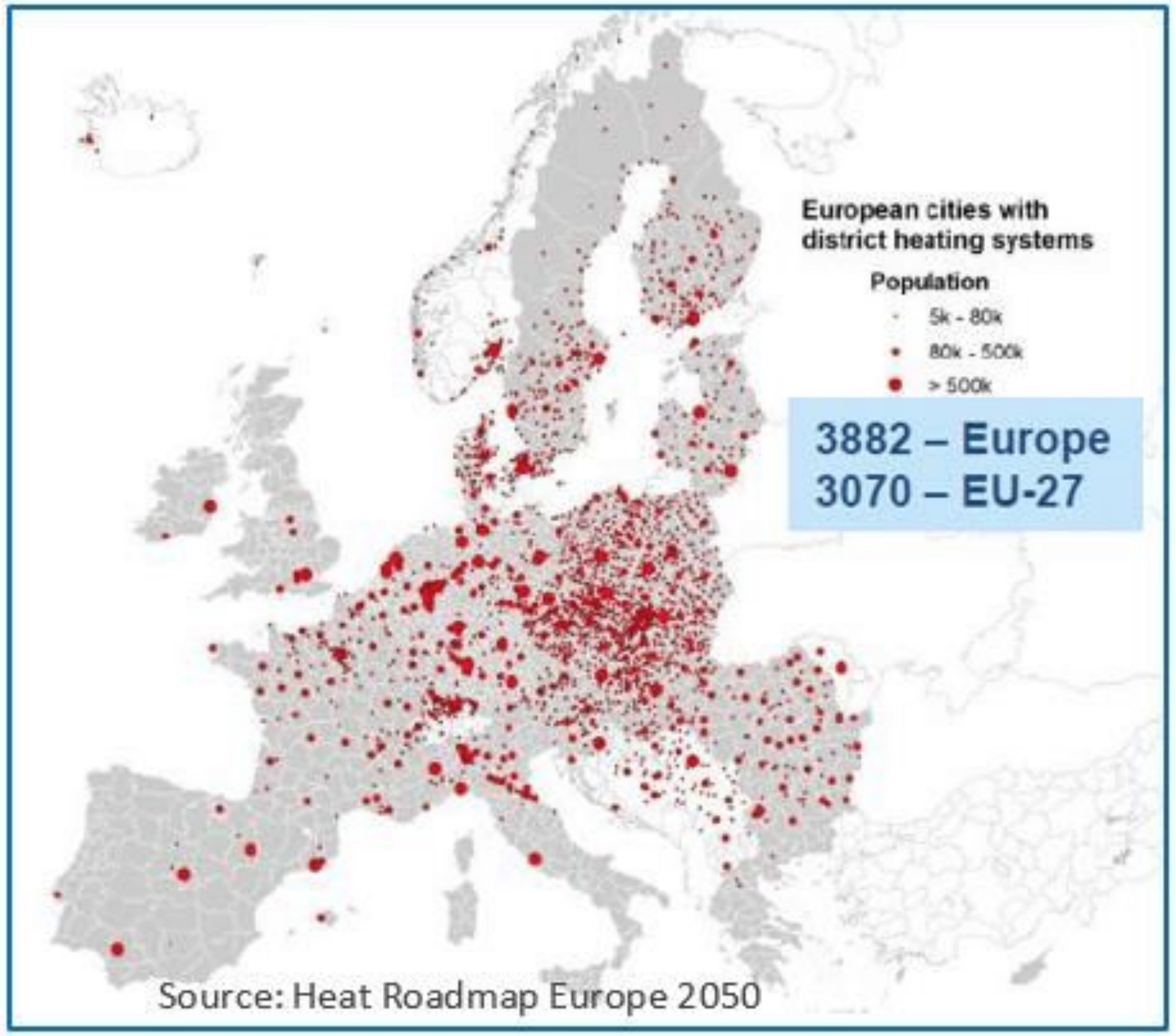
In-time, replace or remove the remaining peak load equipment

- Heat Pumps
- Thermal Storage
- District Thermal Network
- Grid-interactivity

Resource Efficient Decarbonization (RED): an incremental methodology and integrated design process combined with strategic capital planning creates a path towards carbon neutral buildings.

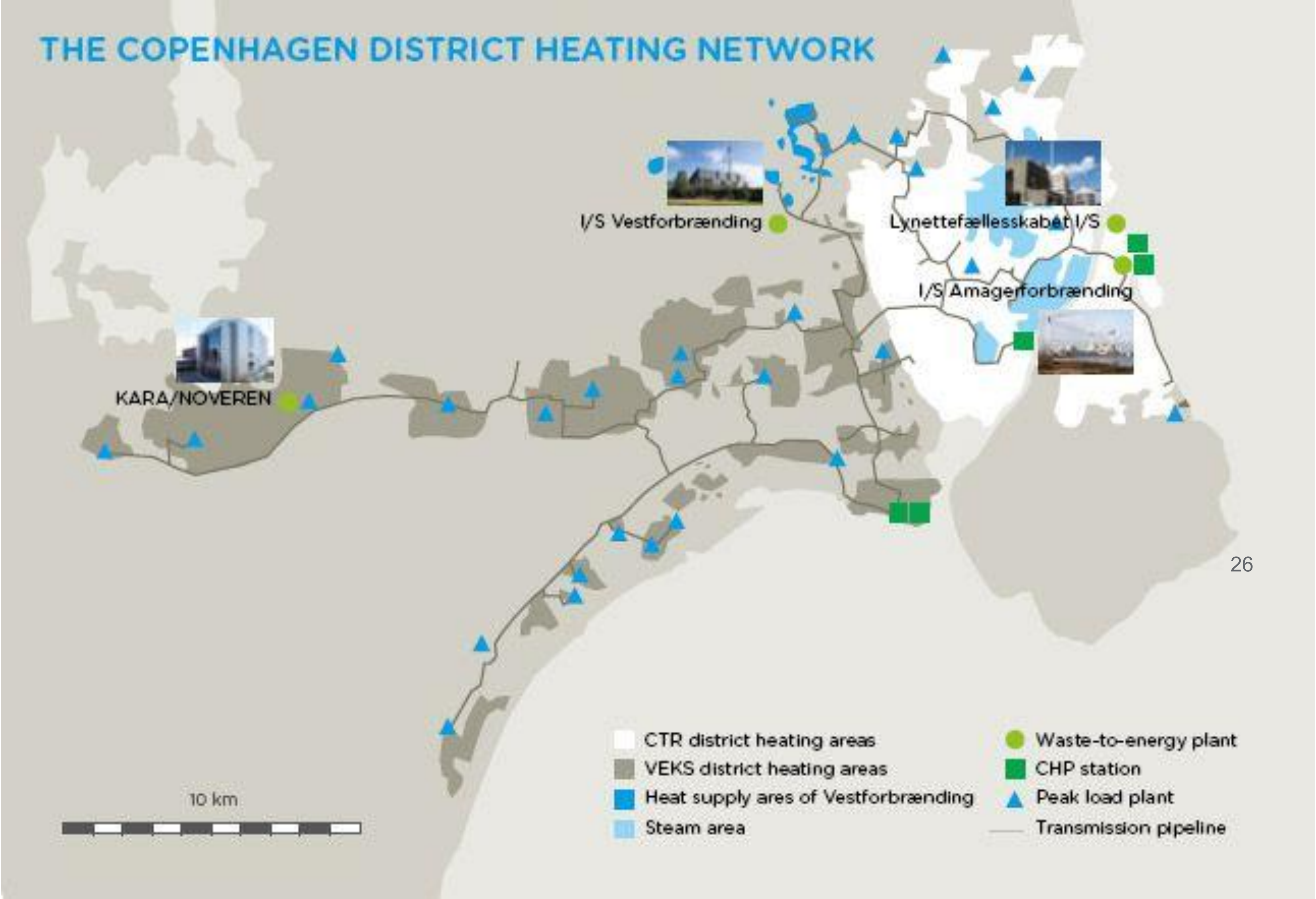


A proven model that is prevalent around the world.



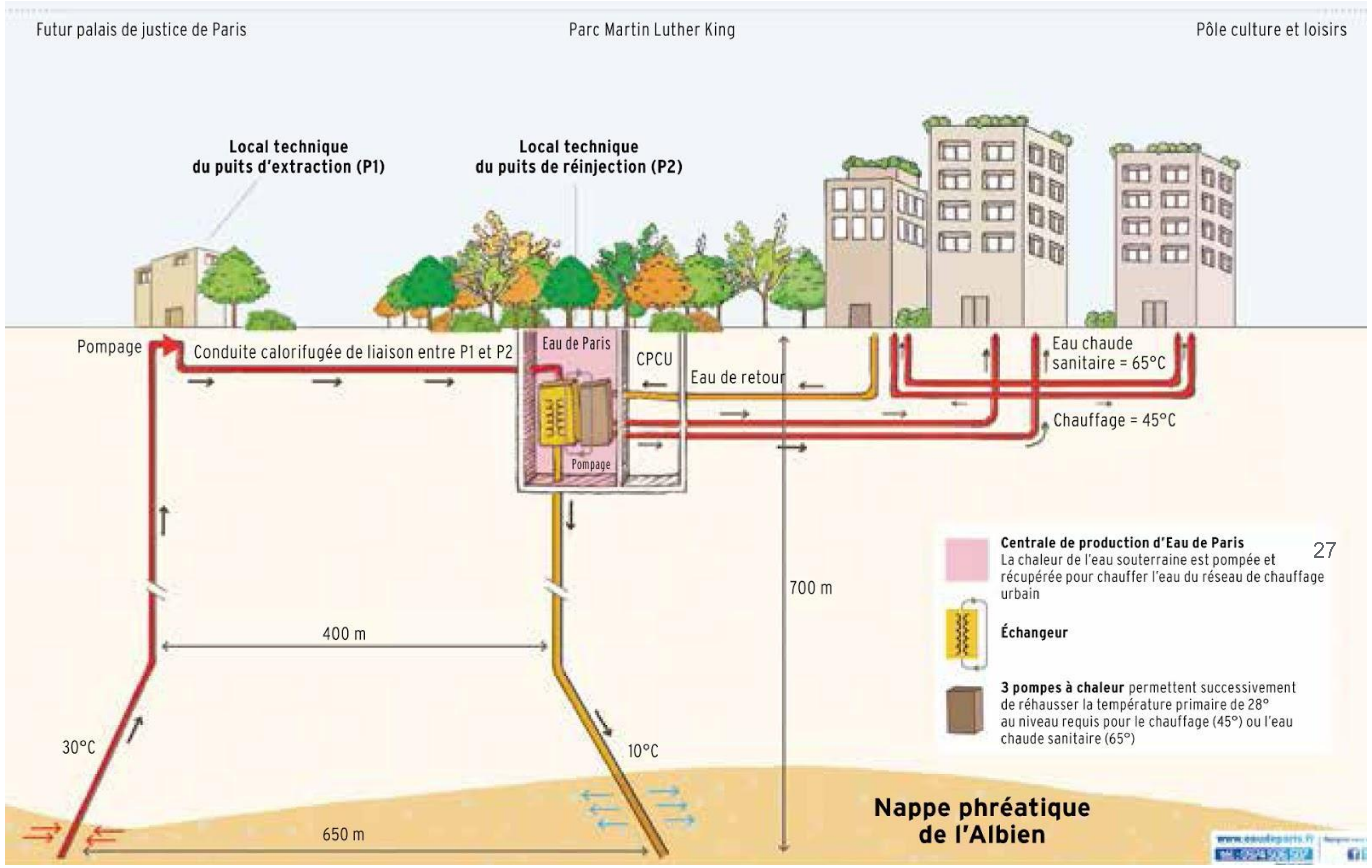
- "Shared infrastructure" model that has been implemented and refined over 150+ years
- Scalable model with further growth potential due to geopolitical considerations

Copenhagen



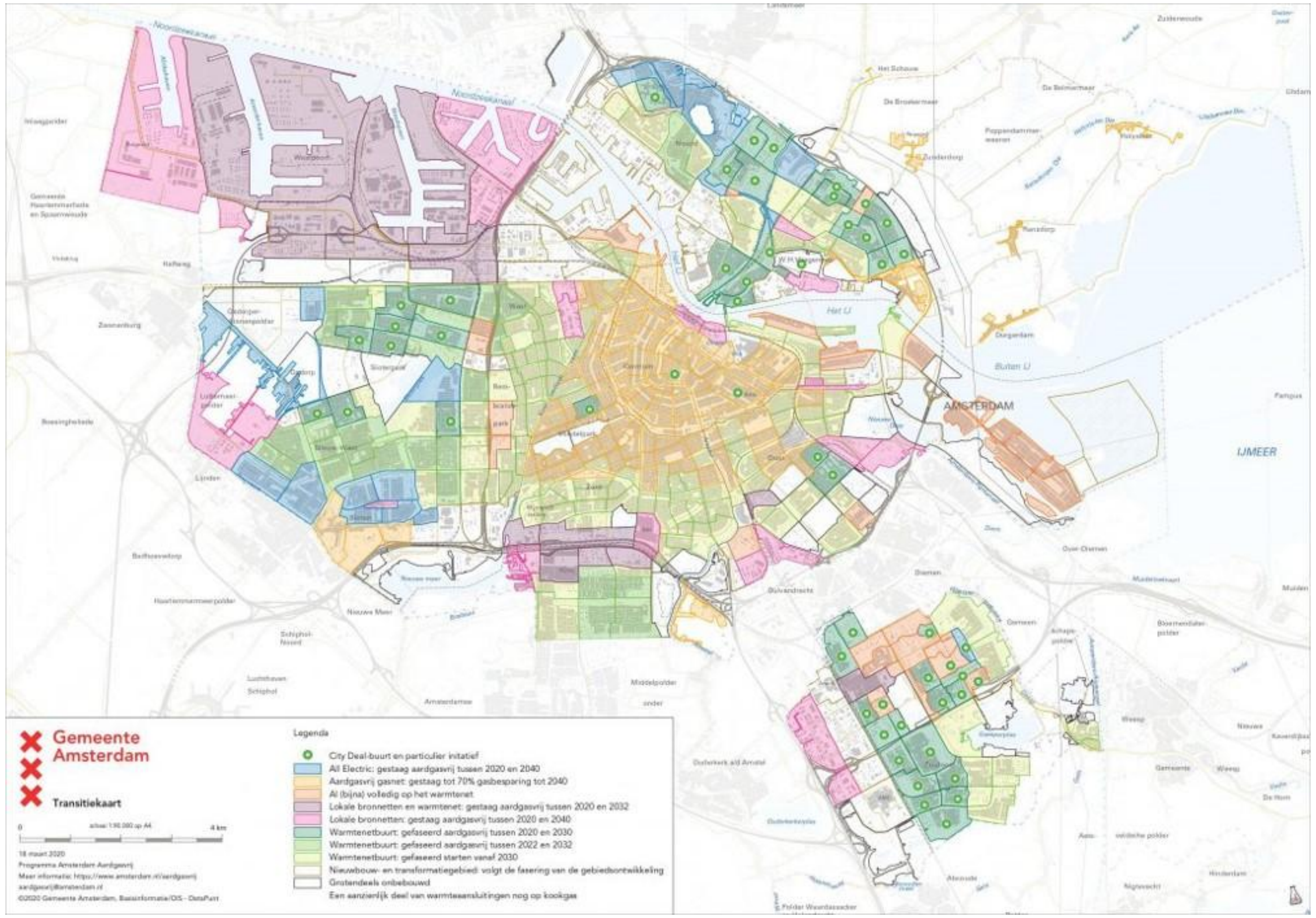
- Incorporates a diversity of heat sources and multiple interconnected networks across a large region
- Design experts on key European projects are also contracted in New York State projects

Paris



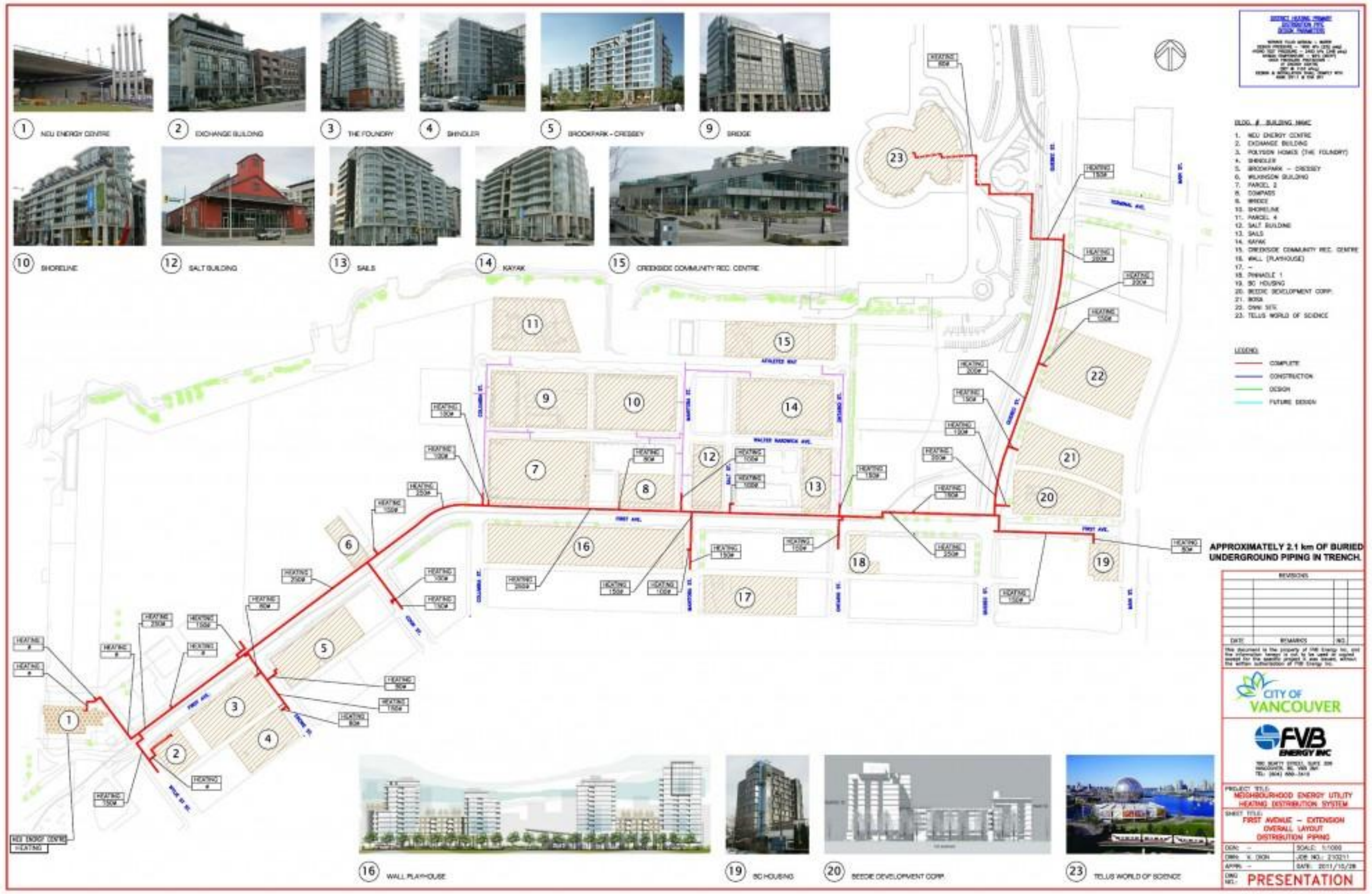
- Wastewater energy extraction and thermal distribution to buildings
- Connection points and scalability between different generations of networks

Amsterdam



- Regionally-planned network with interconnection and expansion potential
- Various interconnected systems; multiple heat sources including industrial waste heat

Vancouver



- False Creek, Vancouver
- First large, shared system in North America to draw from municipal wastewater
- District energy: "Neighborhood Energy Utility (NEU)“
- Serving 20M SF+ mixed-use buildings

Washington State

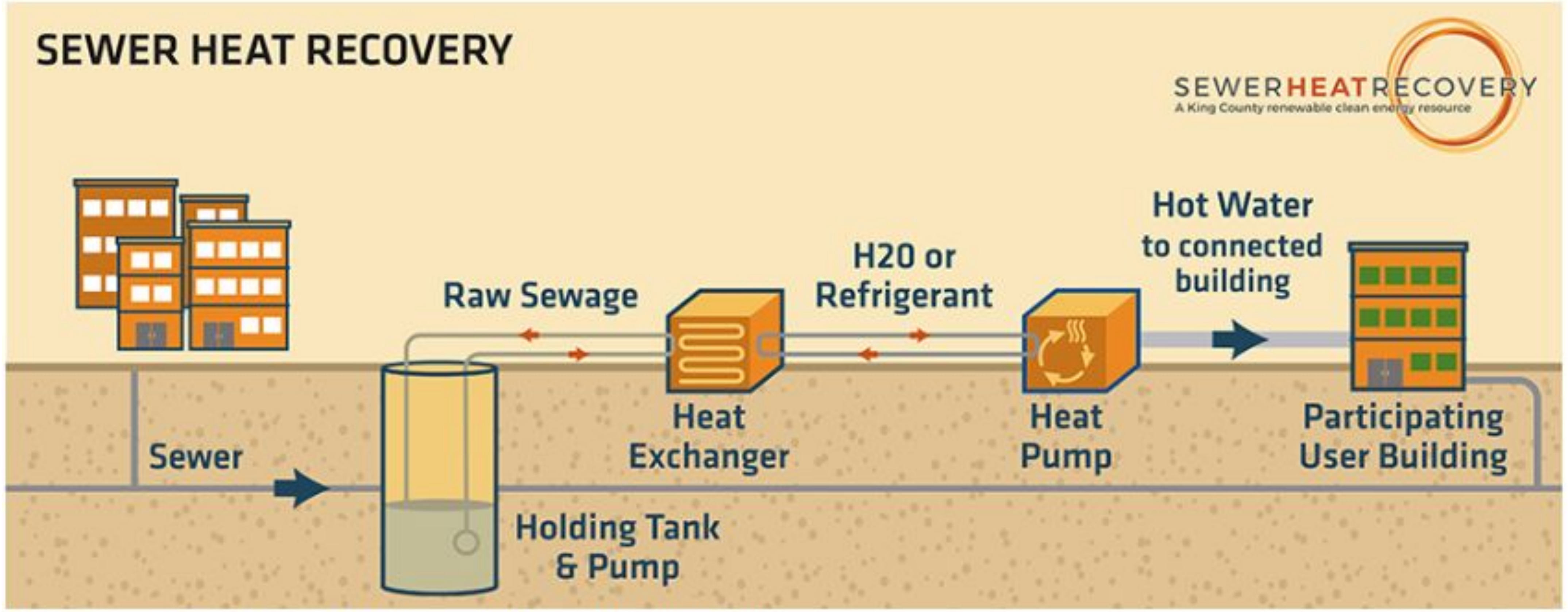


Illustration of process is an example. Technology requirements will vary.

King County Sewer District

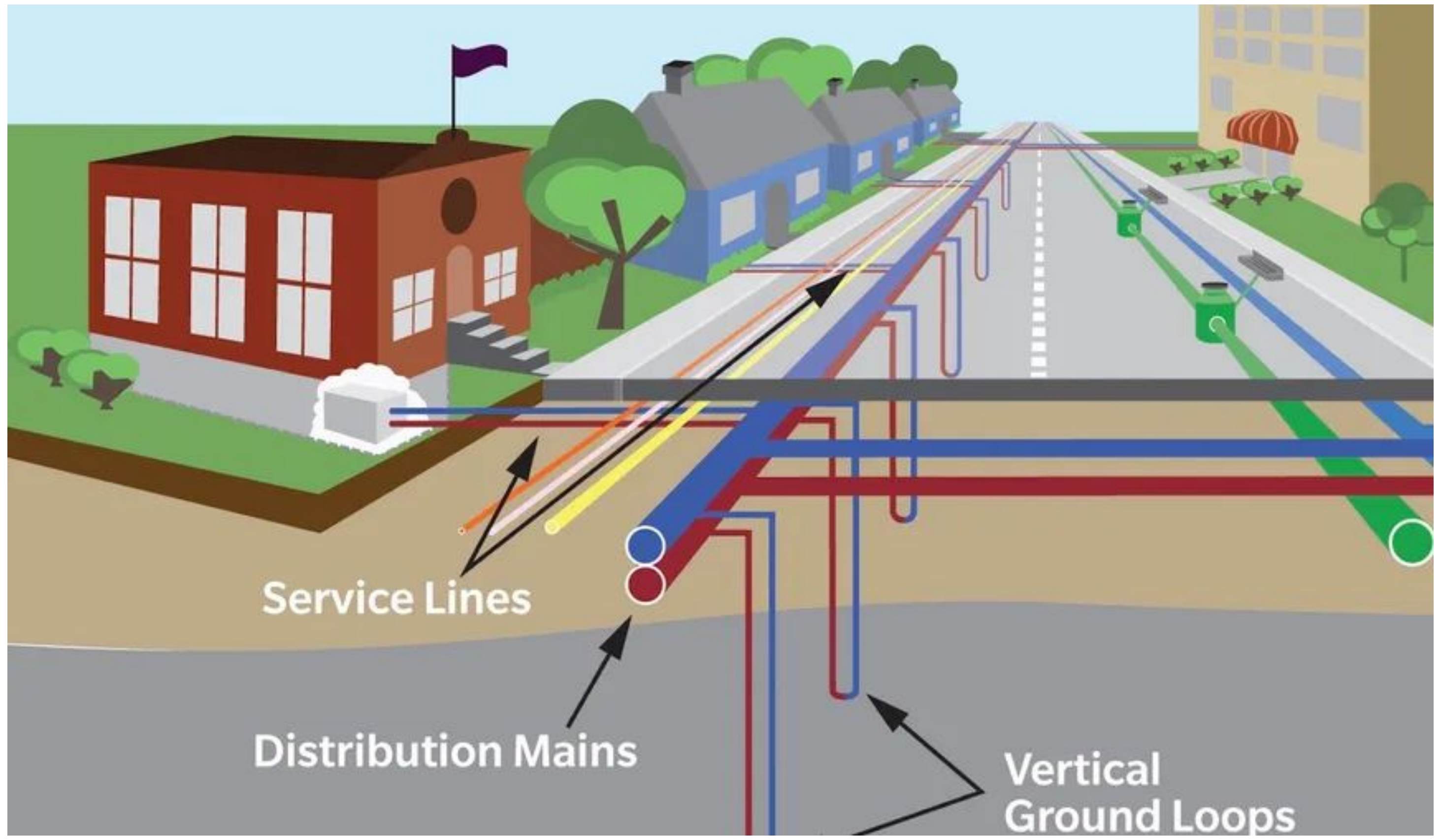
- Legislation allows private access to heat in sewer pipe through heat exchange

- Municipal tie-in with sewer infrastructure

- **Sewer heat treated as a commodity the municipality can sell; license fees paid to access sewer infrastructure**
- **New revenue source extracted from existing infrastructure; increases "utilization" of existing fixed assets**

King County Council legislation link
Agreement for Sale and Use of Thermal Energy from King County Wastewater – template

Massachusetts



- "Geogrid": shared bore fields and lateral pipe in public ROWs
- All systems + heat production owned by the utility
- Block-by-block network approach
- Eversource, National Grid, Muni Gas Utilities, HEET, etc.
- Organic or planned growth/expansion dictated by gas infrastructure retirement and leak prone pipe

NEW YORK!

Press Releases

Unions and Climate Advocates Applaud the New York State Senate and Assembly for passing the pioneering Thermal Energy Network and Jobs Bill

by AGREE – June 3, 2022

Neighborhood-Scale Building Decarbonization and Quality Union Jobs

FOR IMMEDIATE RELEASE

Albany, NY — The New York State Legislature today passed the Utility Thermal Energy Network and Jobs Act (S9422, A10493). The landmark bill, passed unanimously in the state Senate and 138-5 in the Assembly, represents a victory for labor unions and

Joint Utilities file UTEN Pilot Projects Across NYS. Rulemaking is ongoing at NYSDPS.

What this could mean for Cold Climate Regions

Opportunity to develop a clean energy delivery pathway “from the ground up,” while emulating an established, scalable utility model and existing institutions for community-scale implementation

Thermal Generation

>Emphasis on technology-neutral clean thermal energy

>Heating / cooling media is the commodity (like electricity or natural gas)

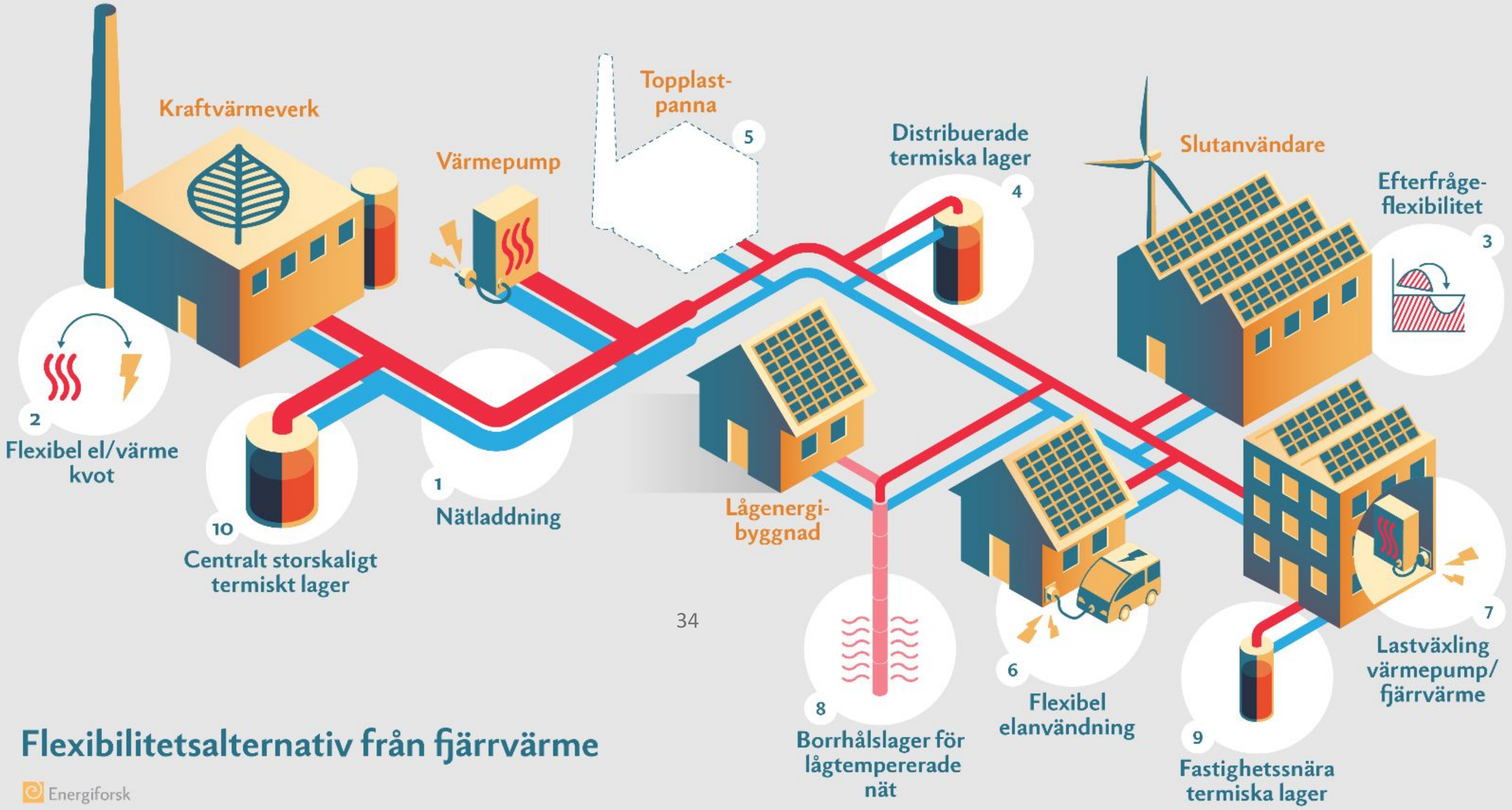
>Short-term: utilities can play a larger role to fulfill the generation gap when the market is still nascent

>Long-term: market for thermal energy can emulate the NYS electricity market (NYISO model, open market via bids / RFPs)

Thermal Distribution

>Utilities receive the commodity (hot water) and are responsible for distributing the thermal energy to their customers

>Obligation to receive and pay for the commodity at market rates



Flexibilitetsalternativ från fjärrvärme

Energiforsk

image credit: U.S. Dept. of Energy, Geothermal Technology Office

Coalition Members May Include

- State and Local Regulators
- Policymakers and Other Officials
- Other Governmental Bodies (City, County, State)
- Economic and Industrial Development Agencies and Organizations
- Public and Private Regulated Utilities
- Activist or Community Based Organizations
- Housing Organizations
- Commercial Developers
- Solution Providers and Manufacturers
- Trade Unions
- Trade Organizations

Next Steps in Your Community

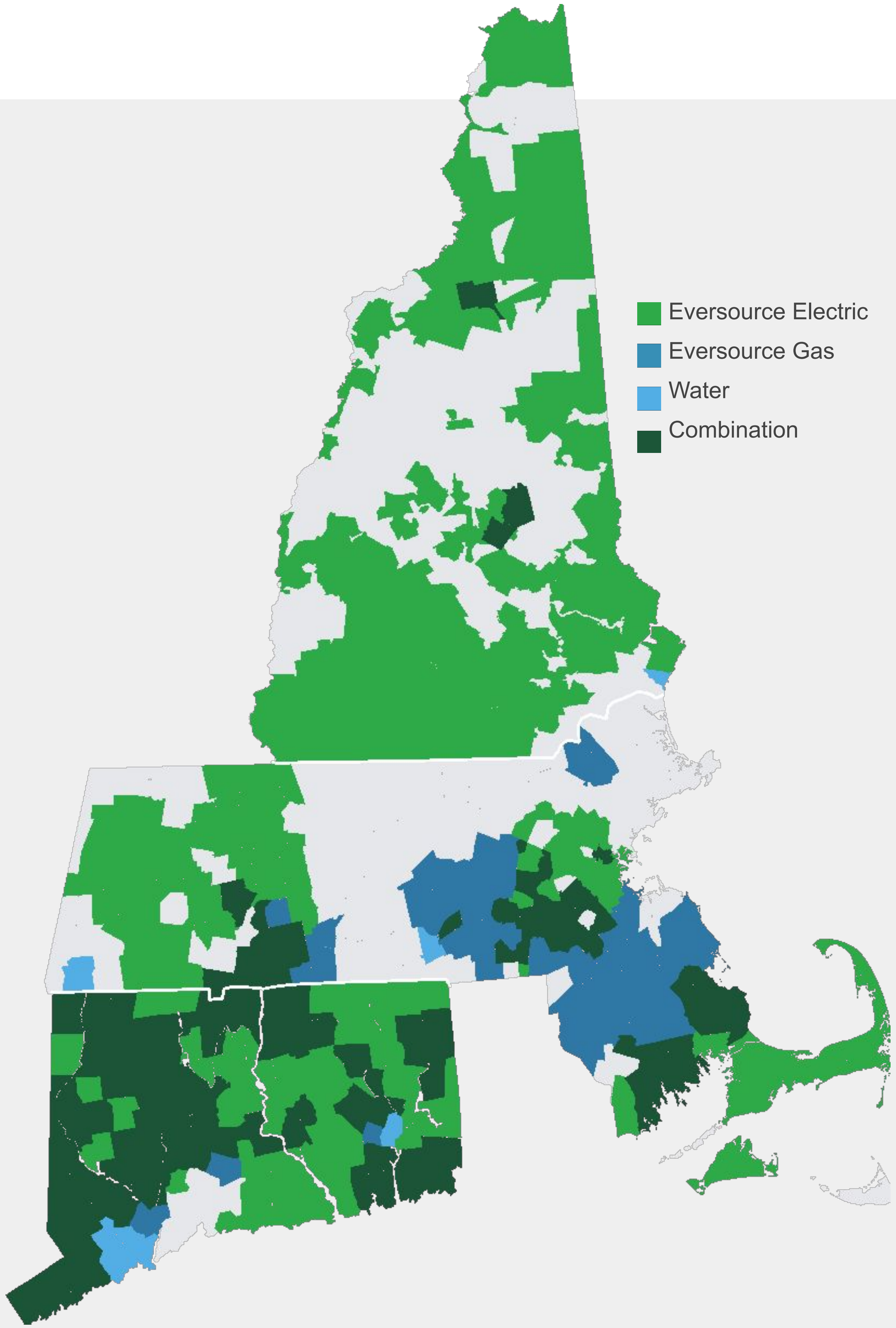
1. **Engage a Thermal Development Team**
2. **Identify Coalition Members, Structure and Form the Coalition**
3. **Develop a Thermal Access Agreement and Authorize the Coalition to Perform**
4. Identify thermal supply sources and thermal supply deals
5. Identify and Secure a Project Pipeline through Customer Acquisition
6. Identify and Procure EPC, Maintenance and Billing Partners
7. Finance and Construct Thermal Nodes and Connections
8. Identify and Secure Partners for conveyance if applicable

Networked Geothermal Pilot

Eversource Overview

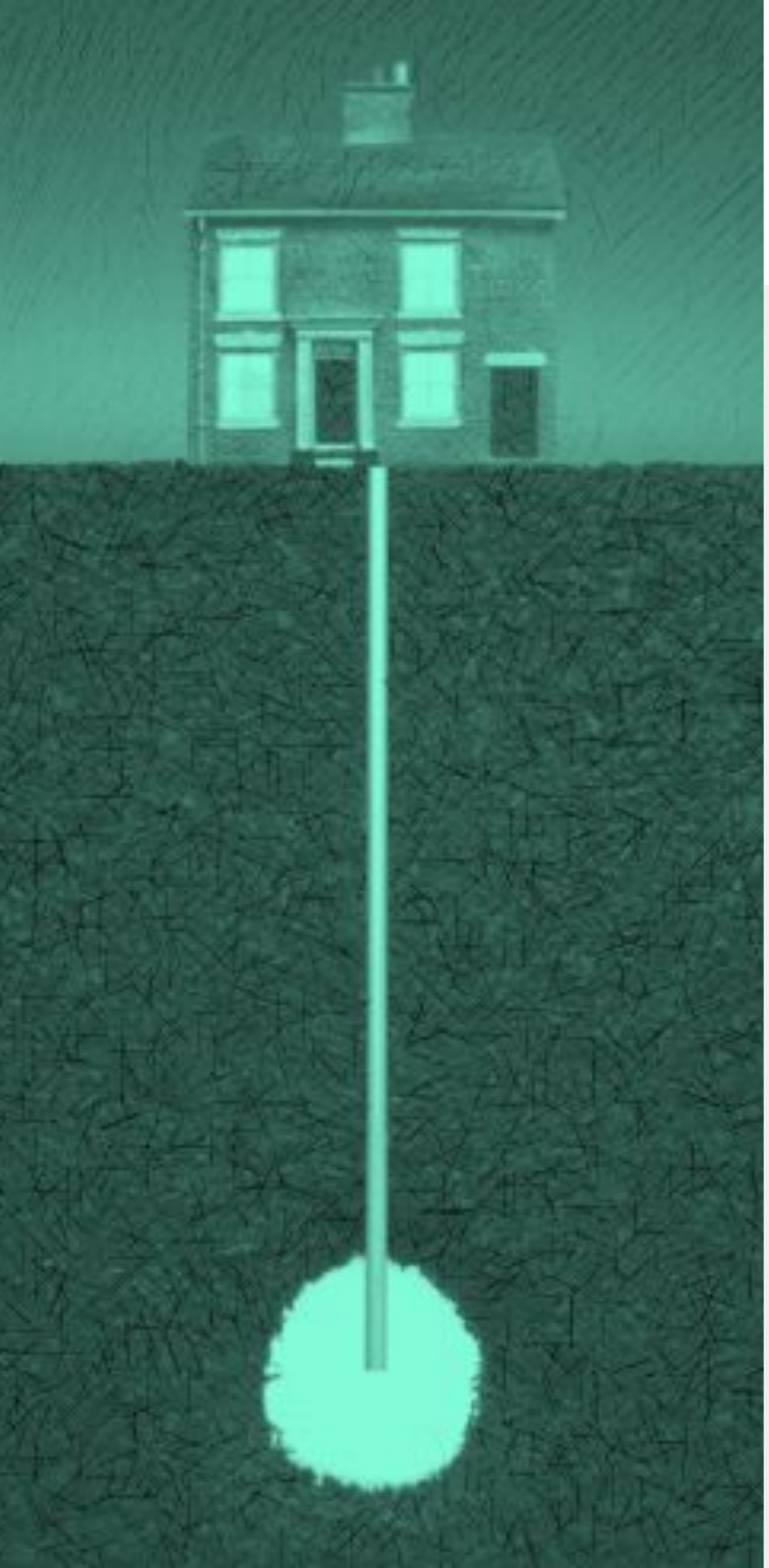
Eversource operates across three states and has been recognized by Barron's as the most sustainable energy company in the nation.

- Approximately 4.4 million total energy customers across the three states (Gas, Electric, and Water)
- Internally set a net zero by 2030 goal
- Working towards broader climate goals in each of the operating states



Project Overview

- Loop is currently being installed in Framingham, MA
- Single pipe design with approximately 1 mile of main
- ~375 ton system
- 24 Residential Homes, 5 Commercial Buildings, 10 FHA Apartment Buildings
- Main borefield with smaller satellite fields
- Combination of all heating types

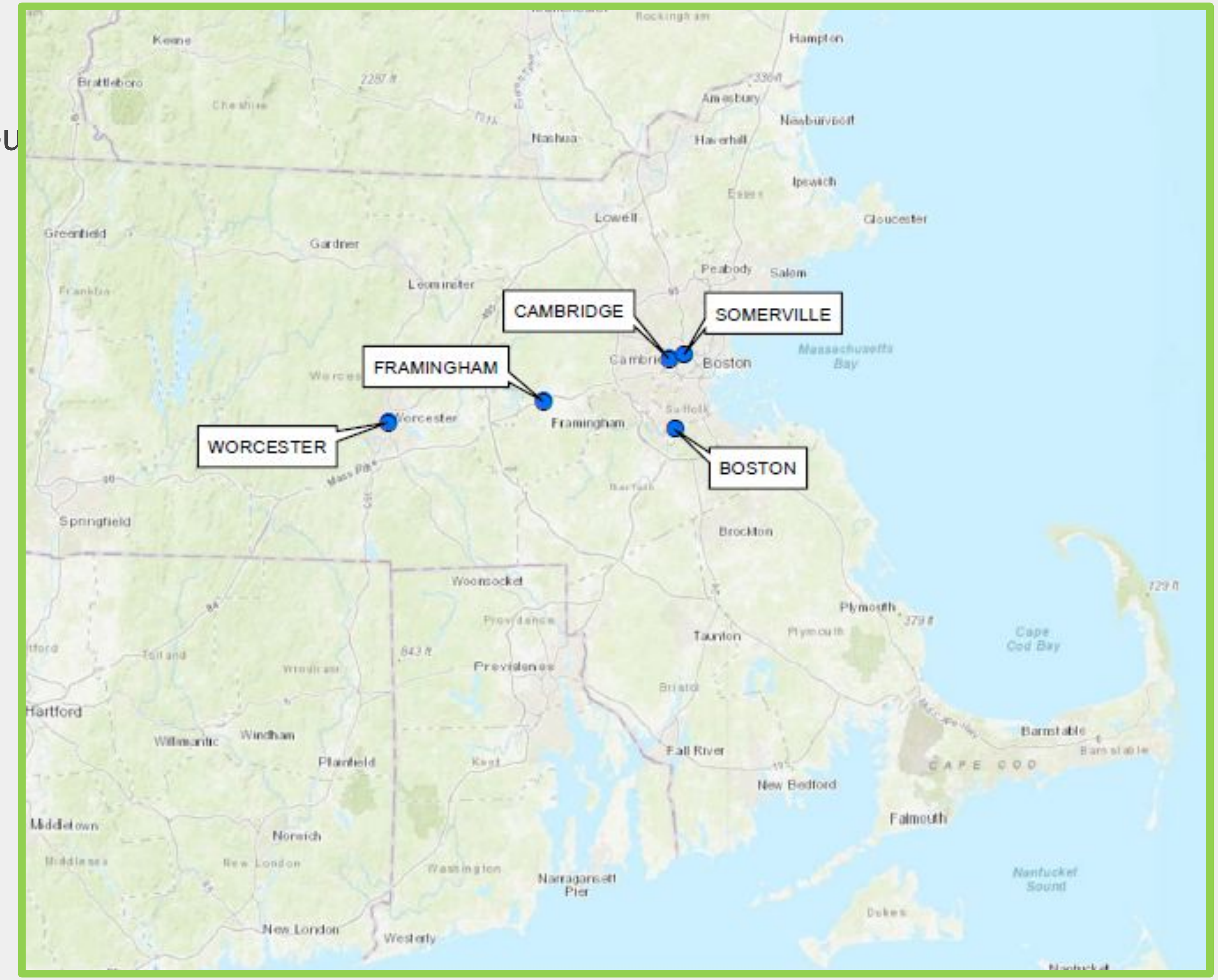


Big Picture Questions

- Is it feasible to provide geothermal wells/loops and GSHPs as an **alternative/complement to delivered fossil fuels and gas service**?
- What is the **appropriate financial and business model**?
- What are the **customer energy and cost savings**?
- What is **required to maintain a GSHP** system of wells?
- What are the **efficiencies that can be gained from shared loop system?**

Site Selection Process

- 17 originally screened sites across 5 cities
- Three phase screening used.
  Two quantitative with the third being detailed rou
  selection (qualitative)
- Initial criteria were go/no go with critical site attributes as per the D.P.U order
- Screening 2 was quantitative with scoring assigned to a set of 24 criteria
- Some of the factors analyzed:
  - – *Load Diversity*
  - – *Customer Fuel Diversity*
  - – *Area Geology (Depth to Bedrock)*
  - – *ROW Accessibility*
  - – *Potential MEP sites*

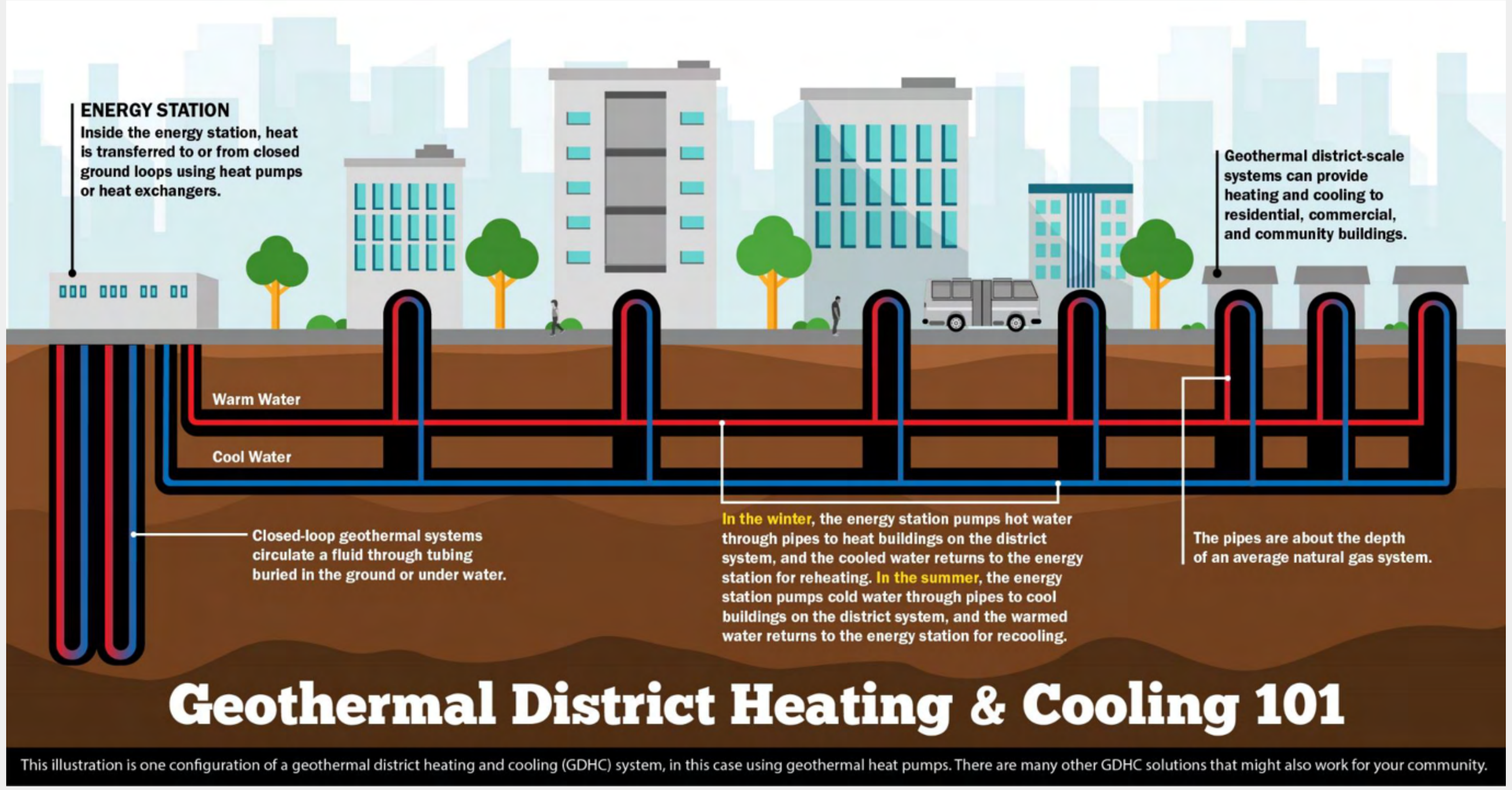


Building Conversions

- Building conversions are a critical part of connecting customers to a networked geothermal loop
- Depending on the existing systems, it can be challenging
- Dual systems could be installed for reliability or cost savings
- Electric baseboard systems generally have the highest ROI for customers
- Energy efficiency work is also being completed with HVAC installations

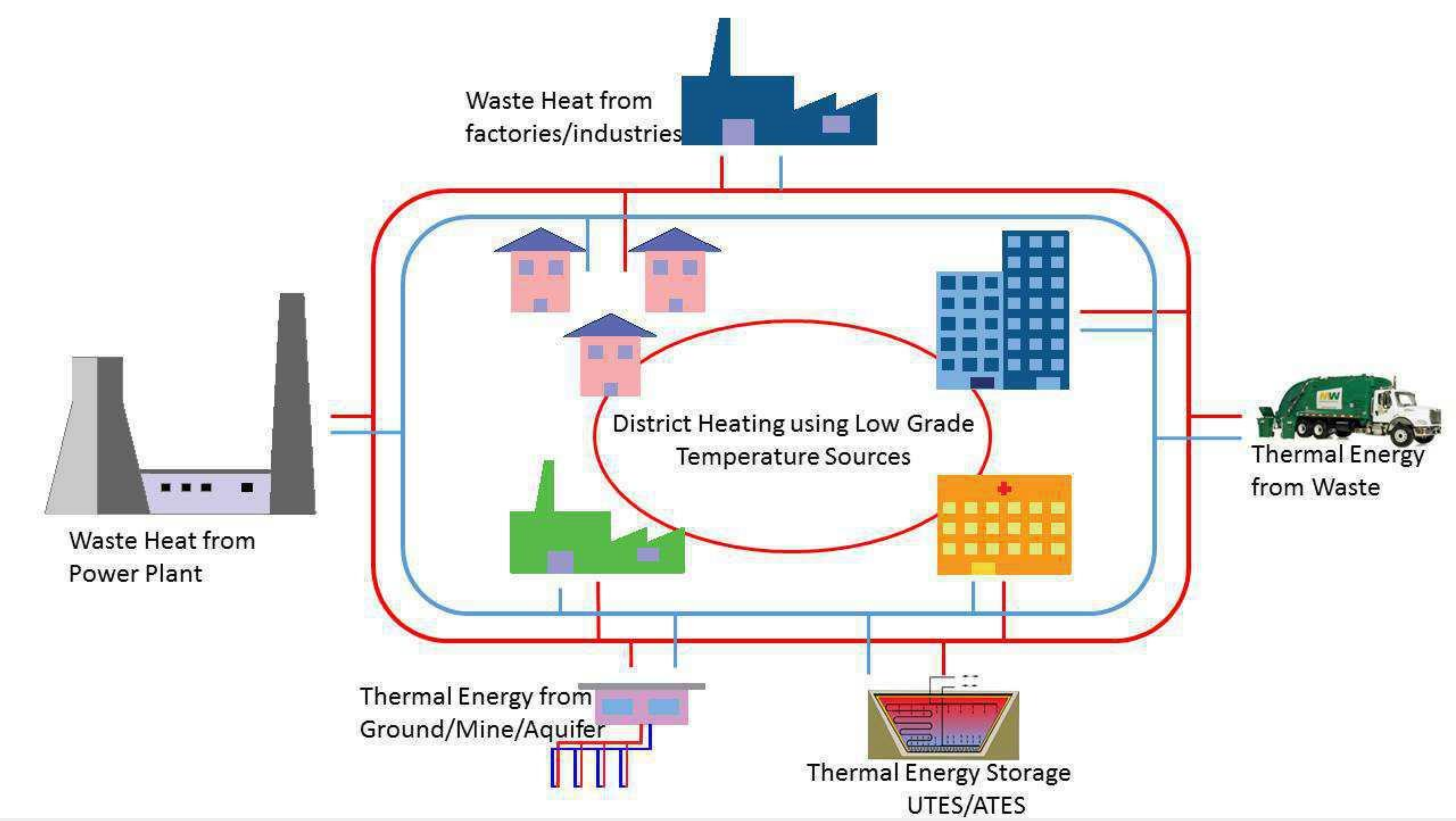
Opportunities for NY Sites

- Lots of dense, diverse load in urban centers
- EJ communities make strong loop anchors
- Green space can be used to site borefields
- Strong state-level push for thermal networks
  - Thermal Energy Network and Jobs Act
- Multiple announced demonstration projects
- New building projects already taking advantage of GSHP



Integration With Alternative Sources

- NYC especially has diverse heating and cooling sources that can be tied into a thermal network
  - Waste Heat Recovery
  - Power Plants
  - Data Centers
  - Rivers, Oceans, etc.
  - Refrigeration, labs, universities



Project Success Metrics

Success Factors	Data Points to Collect
Validated installation and operating costs	• System installation costs • Ongoing O&M costs
Customer acceptance of technology	• Customer Satisfaction surveys • Customer comfort
Environmental Benefits	• Emission reductions • System efficiency
Technology performance	• System performance • Changes in customer energy consumption
Cost savings	• Changes in customer heating and cooling costs

ABOUT
BRIGHTCORE

WE LEAD WITH OUR INTELLECTUAL CAPITAL AND TECHNICAL EXPERTISE

WE INVEST OUR FINANCIAL CAPITAL TO TRANSITION YOUR BUILDINGS TO CLEAN ENERGY

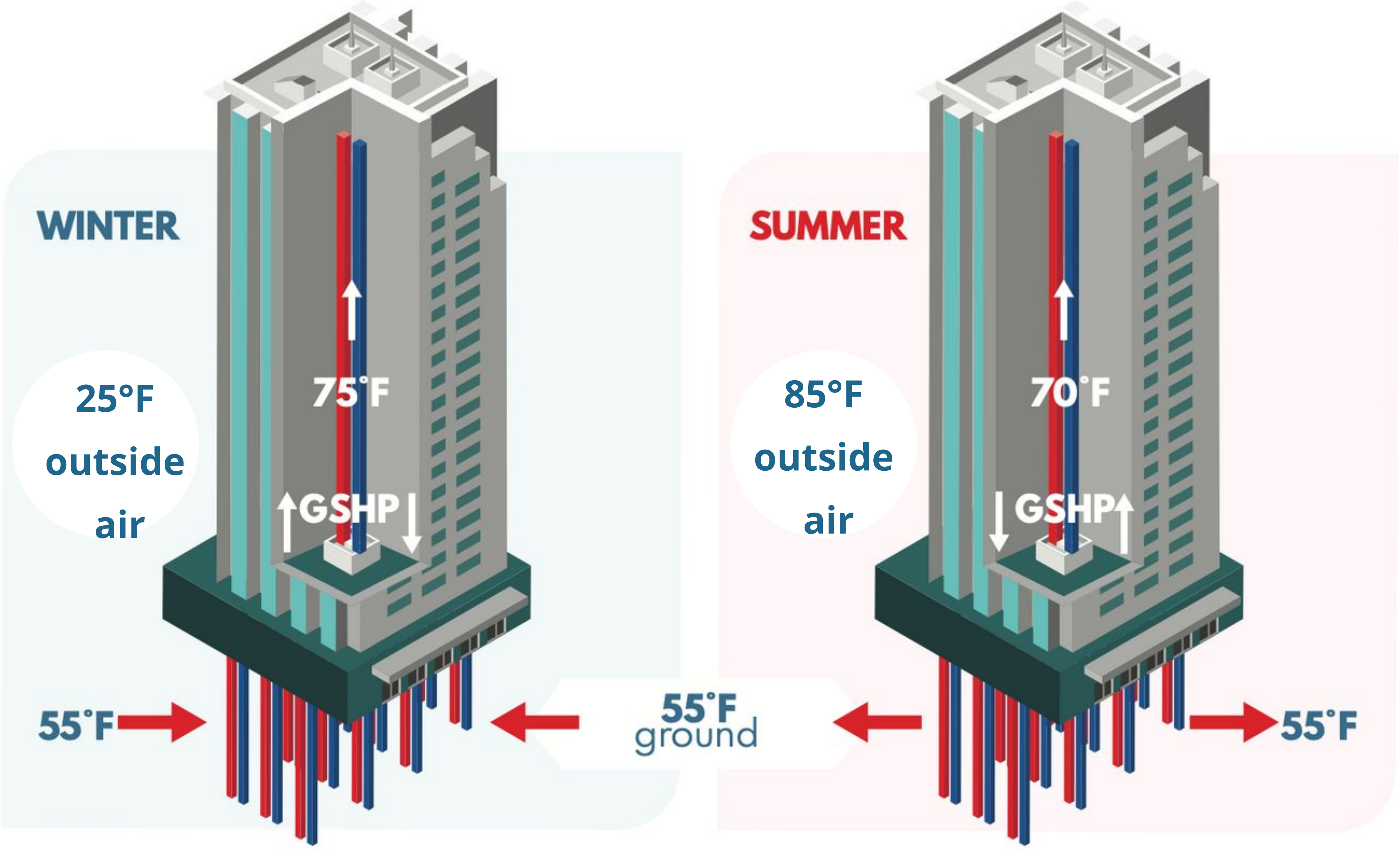
We provide building owners with immediate cost savings and revenue potential without the need for any capital investment.

The ability to "pre-heat" or "pre-cool" the system from the earth's 55-degree ambient temperature dramatically reduces system demand compared to conditioning peak outside air temperatures.

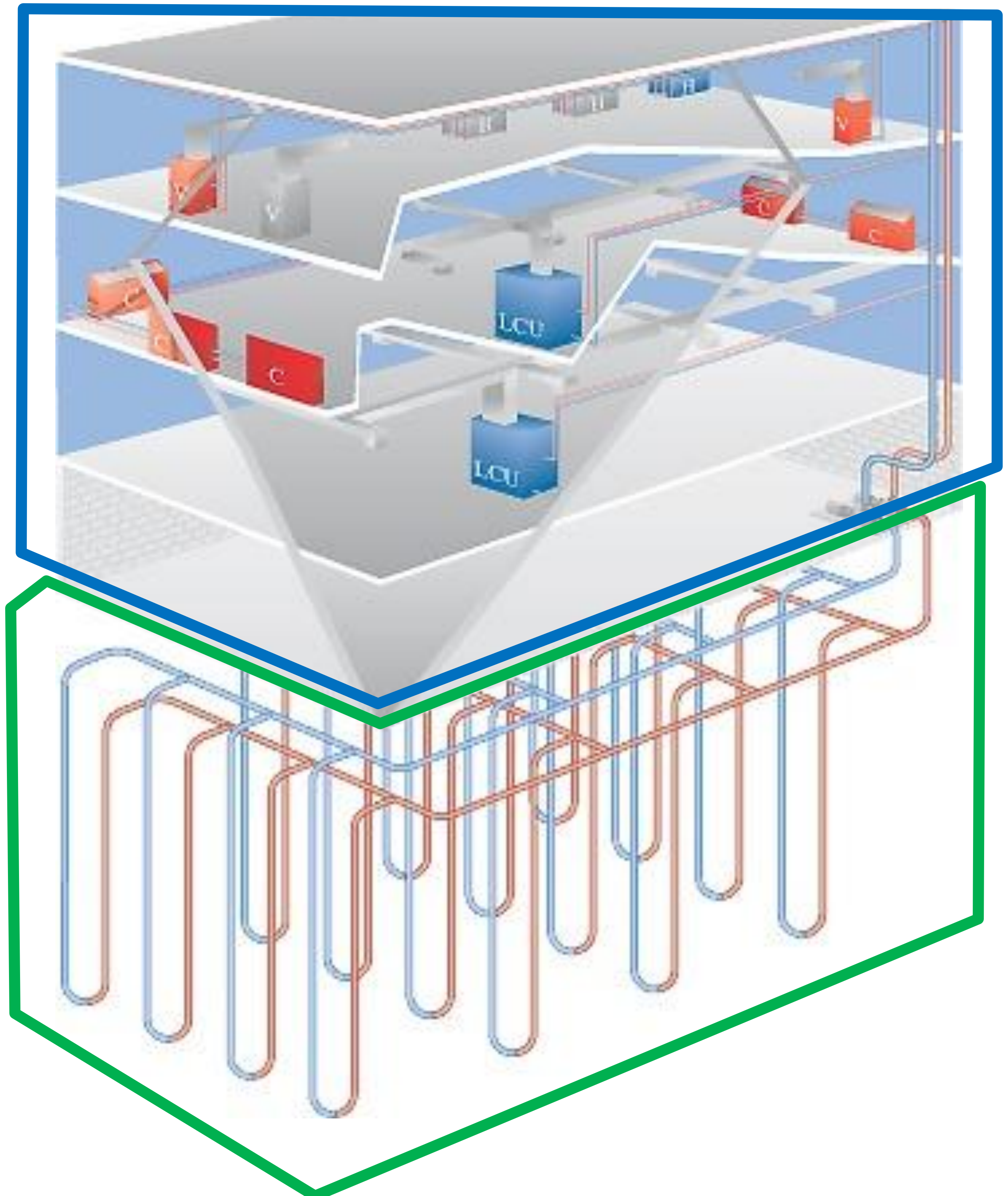
5 units of heating or cooling delivered into the building

Geothermal solutions provide efficiencies more than 400%, while traditional fossil fuel systems are limited to 78-90%.

BASICS OF MODERN CLOSED-LOOP
GEOTHERMAL SYSTEMS



GEOTHERMAL SYSTEM DESIGN ELEMENTS



Building System (HVAC):
Water Source Heat Pumps, Interior Piping, Circulating Pumps, DHW Heating Equipment, etc.

Ground Connection (GLHE): Ground heat exchanger (sub-surface lateral piping, and the manifold / header)

GSHP CONNECTION
INTERNAL HVAC SYSTEM

Coordination with MEP to best understand building loads

Evaluate temperature requirements for air or water heat distribution

Figure 4.1
Centralized Water-to-Air GHP System

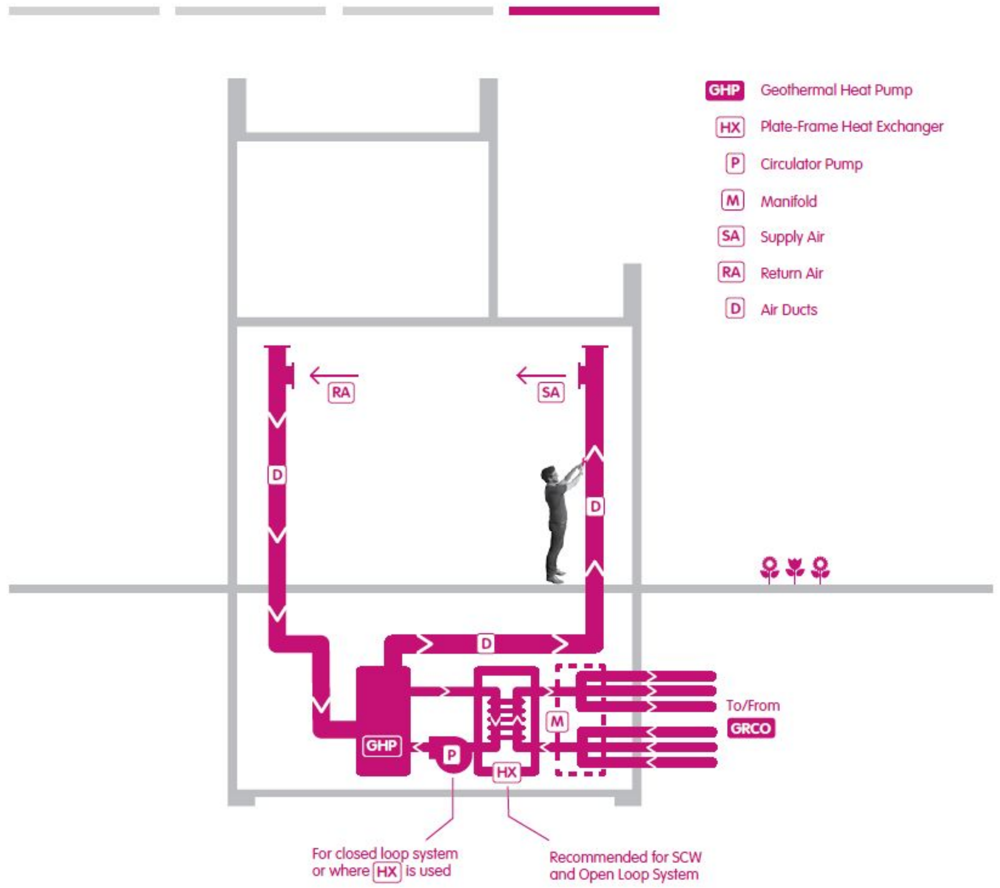


Figure 4.2
Distributed Water-to-Air GHP System

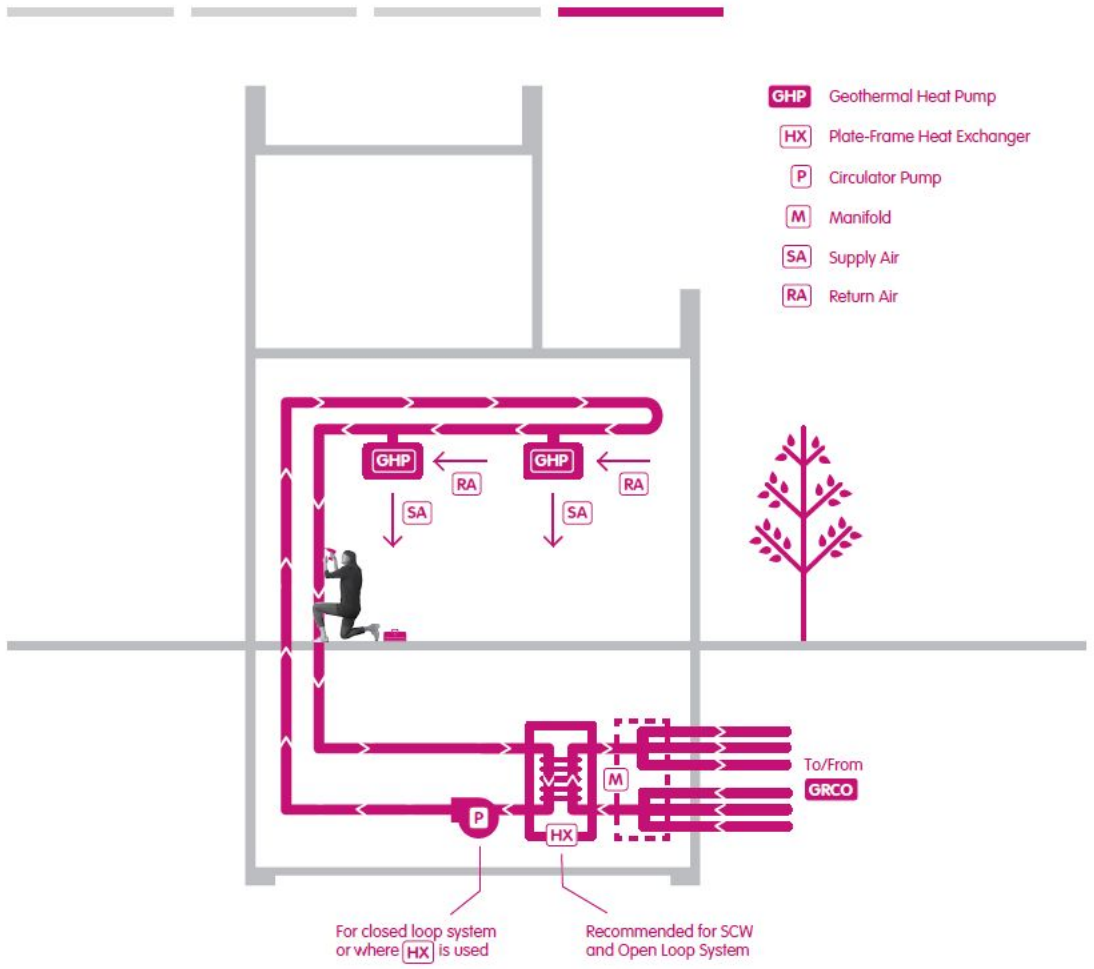
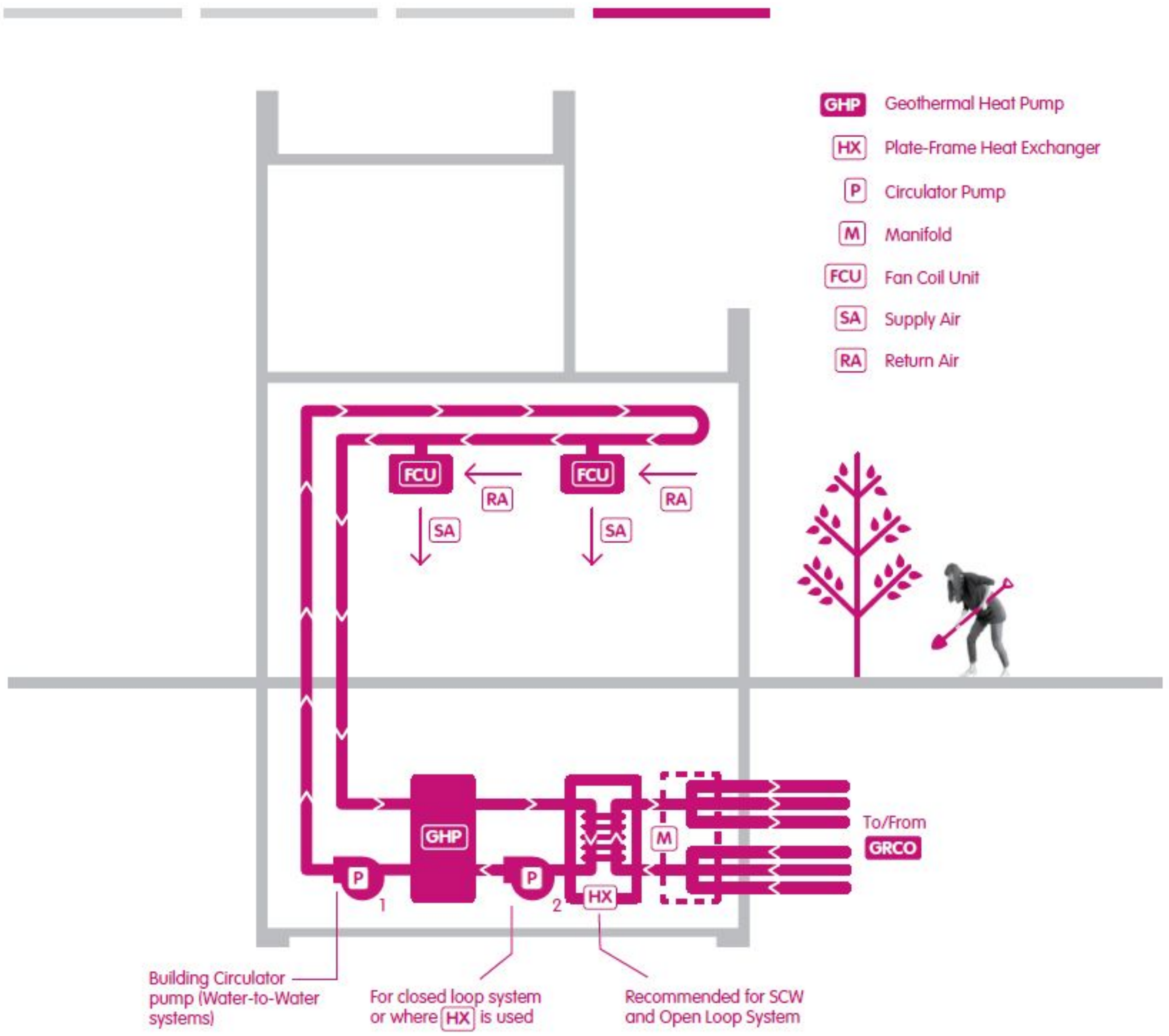


Figure 4.3
Centralized Water-to-Water GHP System



BASICS OF MODERN CLOSED-LOOP

WATER SOURCE HEAT PUMPS & AMBIENT TEMPERATURE NETWORKS

- Water-to-water and water-to-air heat pumps leverage the ambient temperature loop to provide the most efficient heating and cooling.

- Buildings with opposing loads can benefit from each other's energy use when connected to an ambient temperature network.

- Ambient temperature loops can also source energy from closed-loop geothermal, waste-water heat recovery, CSO, and surface water.

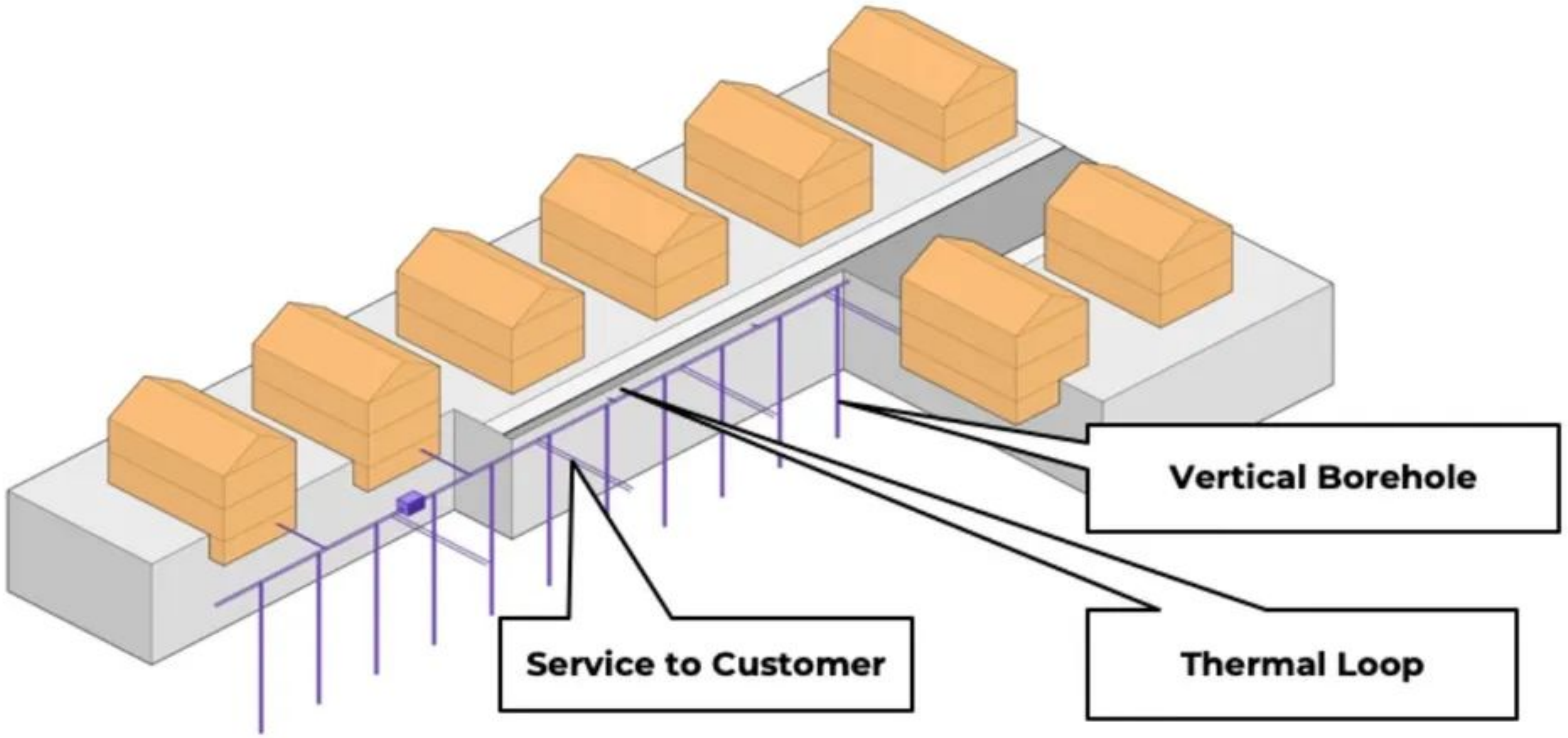
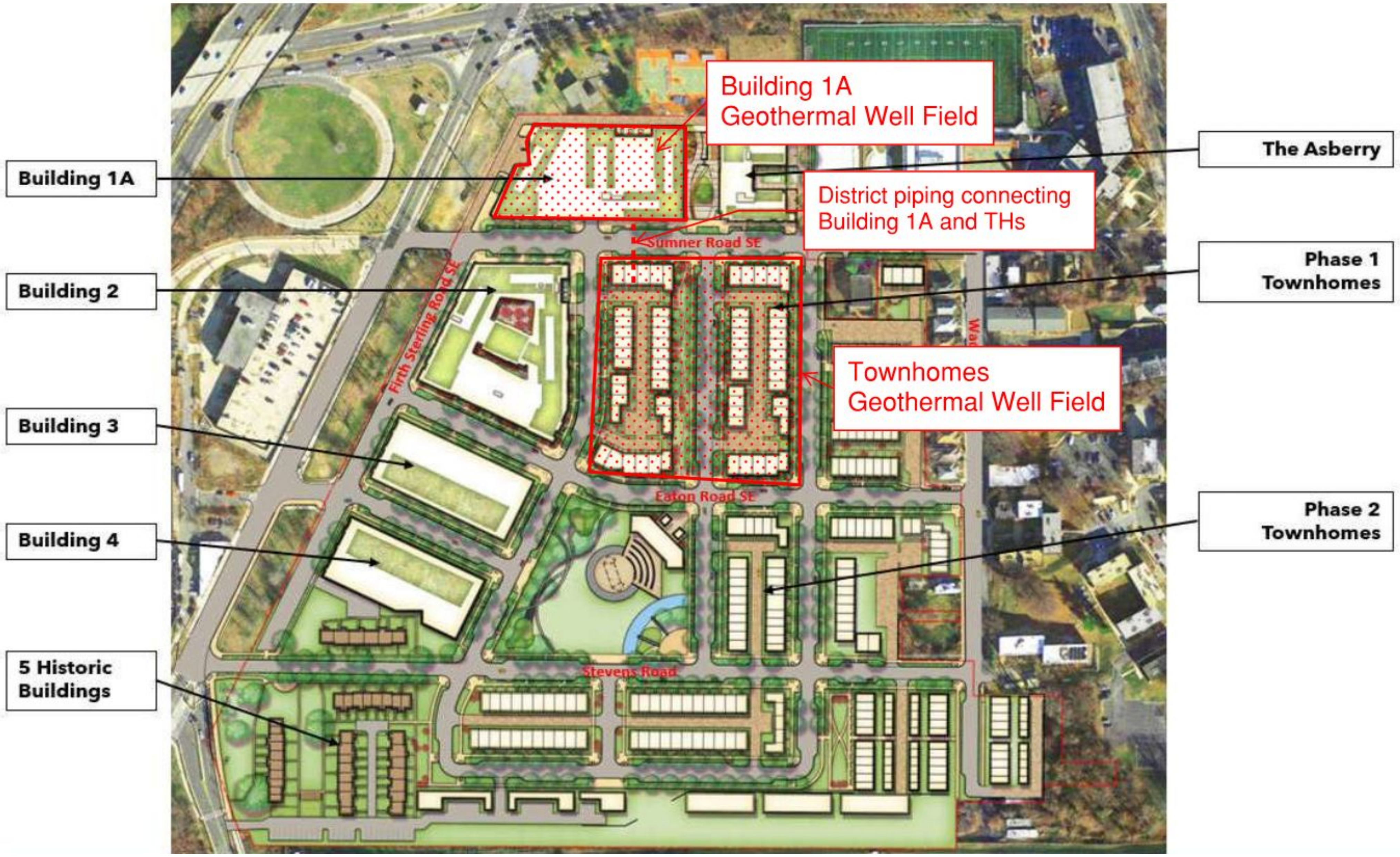


Image Source: HEET and Burro Happold

AMBIENT LOOP CASE STUDY

BARRY FARMS COMMUNITY HEAT PUMP PILOT

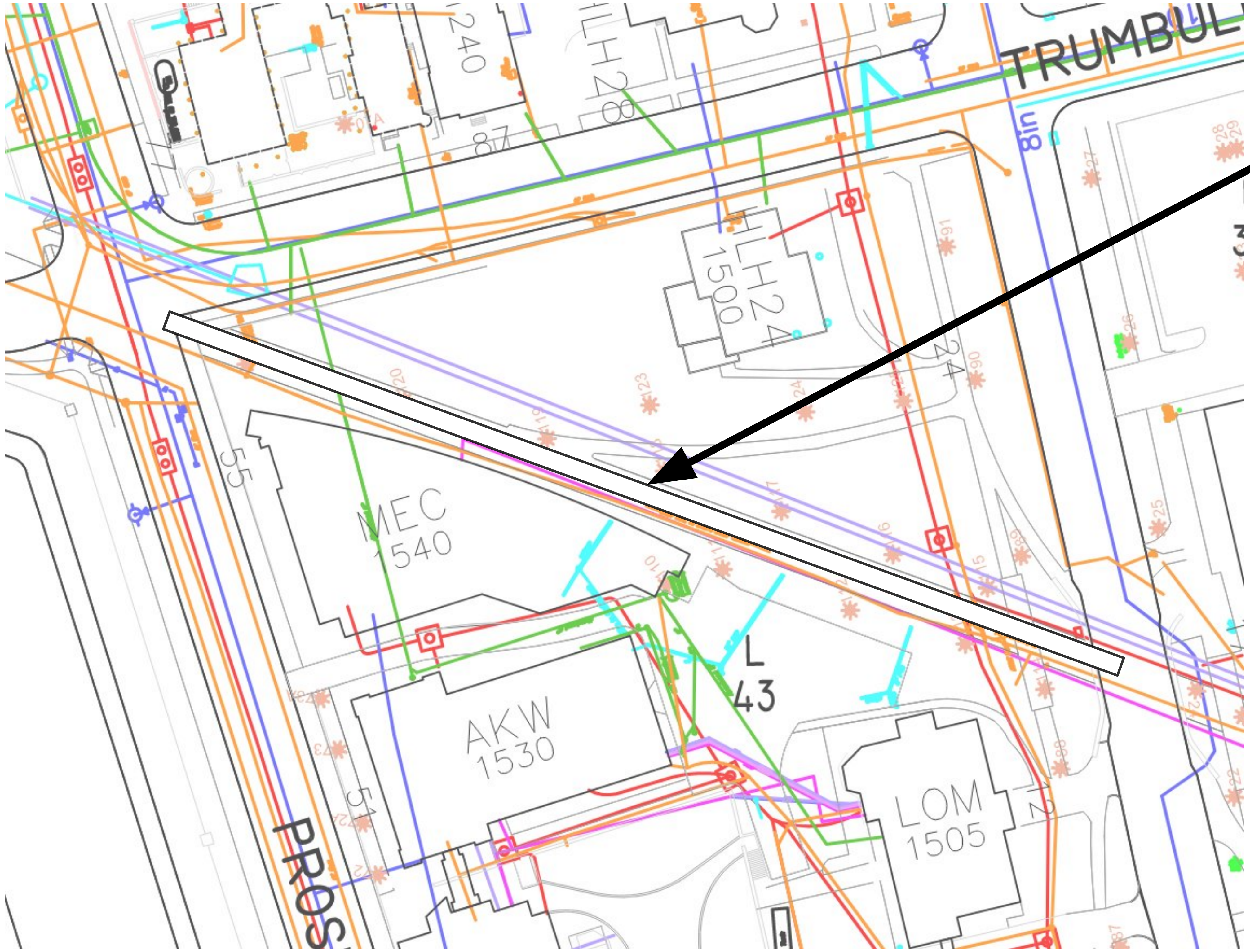
- An affordable housing re-development project in Southeast Washington.
- Awarded $2.5 Million from the Washington D.C. Public Service Commission to support the pilot project.
- The community heat pump will connect a multi-use, multifamily building to townhomes.
- First phase of geothermal system will be serving 200 apartments and commercial areas.
- Project brings clean heat in a historic and environmental justice neighborhood.



CONVENTIONAL V. SPECIALIZED DRILLING RIG SIZE

DESIGN CHALLENGES

CONSTRAINED DRILLING AREA



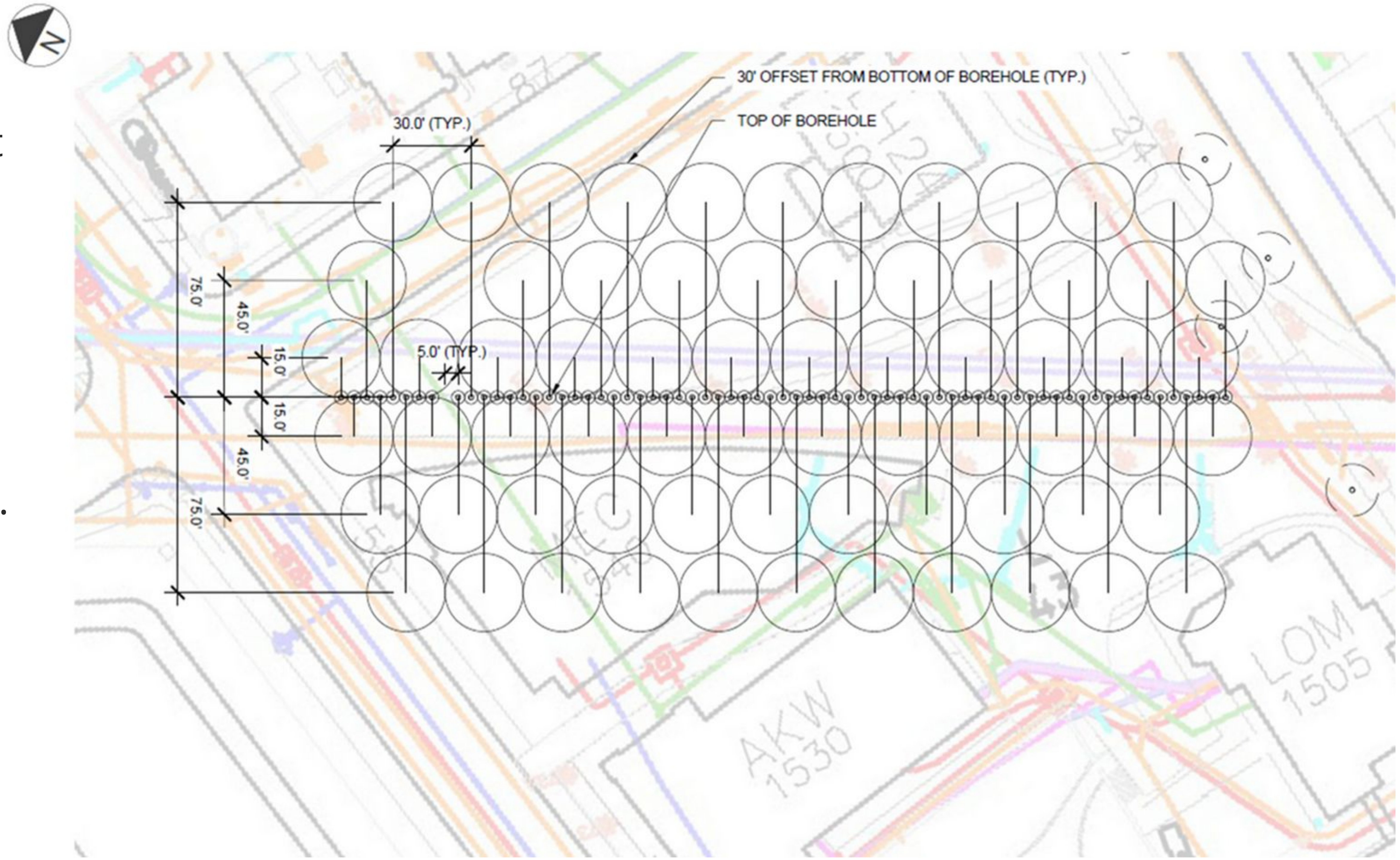
This area has many obstacles that would prevent conventional geothermal drilling methods from being installed:

- Trees
- Narrow Street
- Underground utilities
- Sensitive research buildings nearby

TECHNOLOGICAL INNOVATION

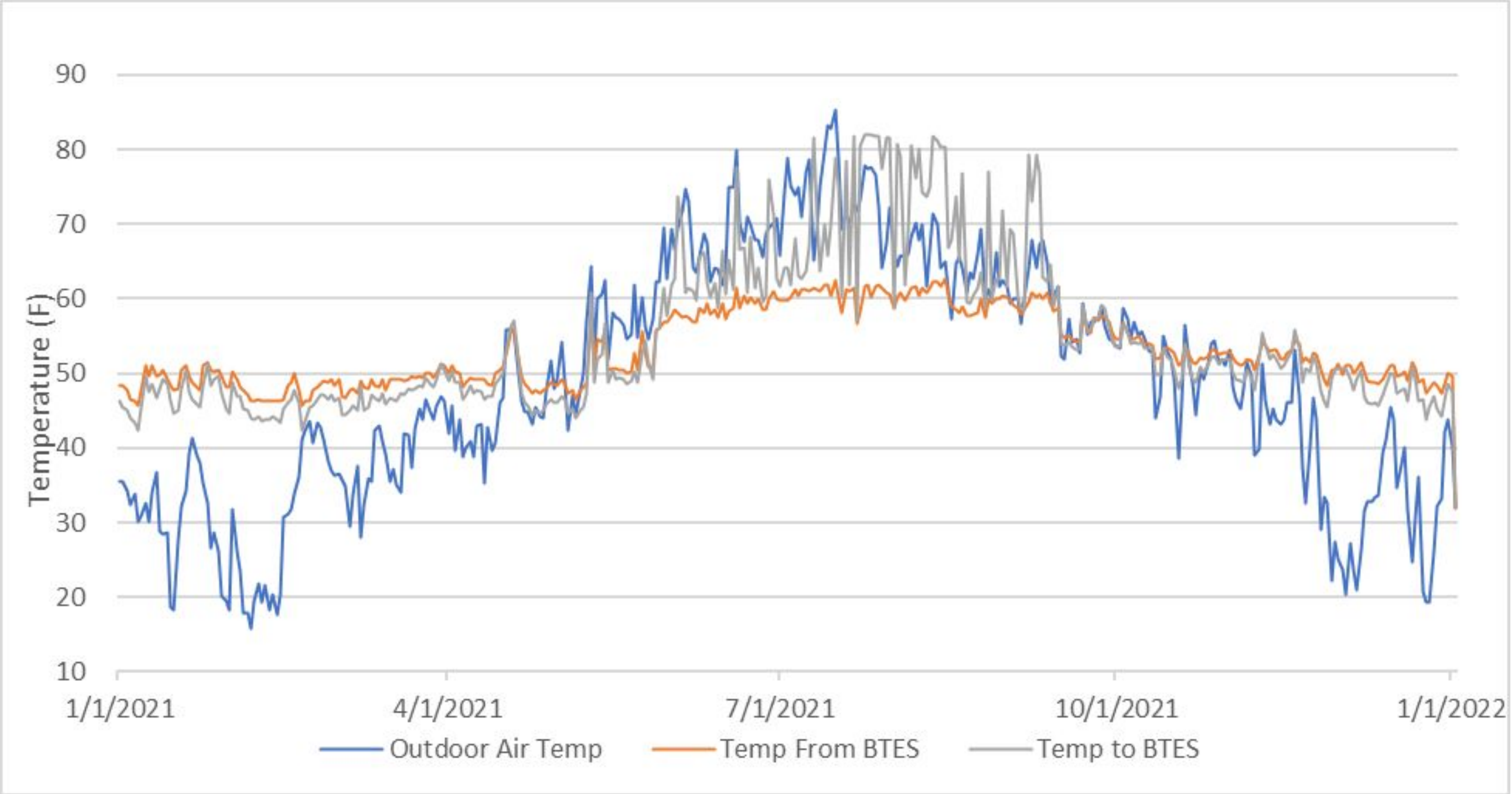
INCLINED BOREHOLES

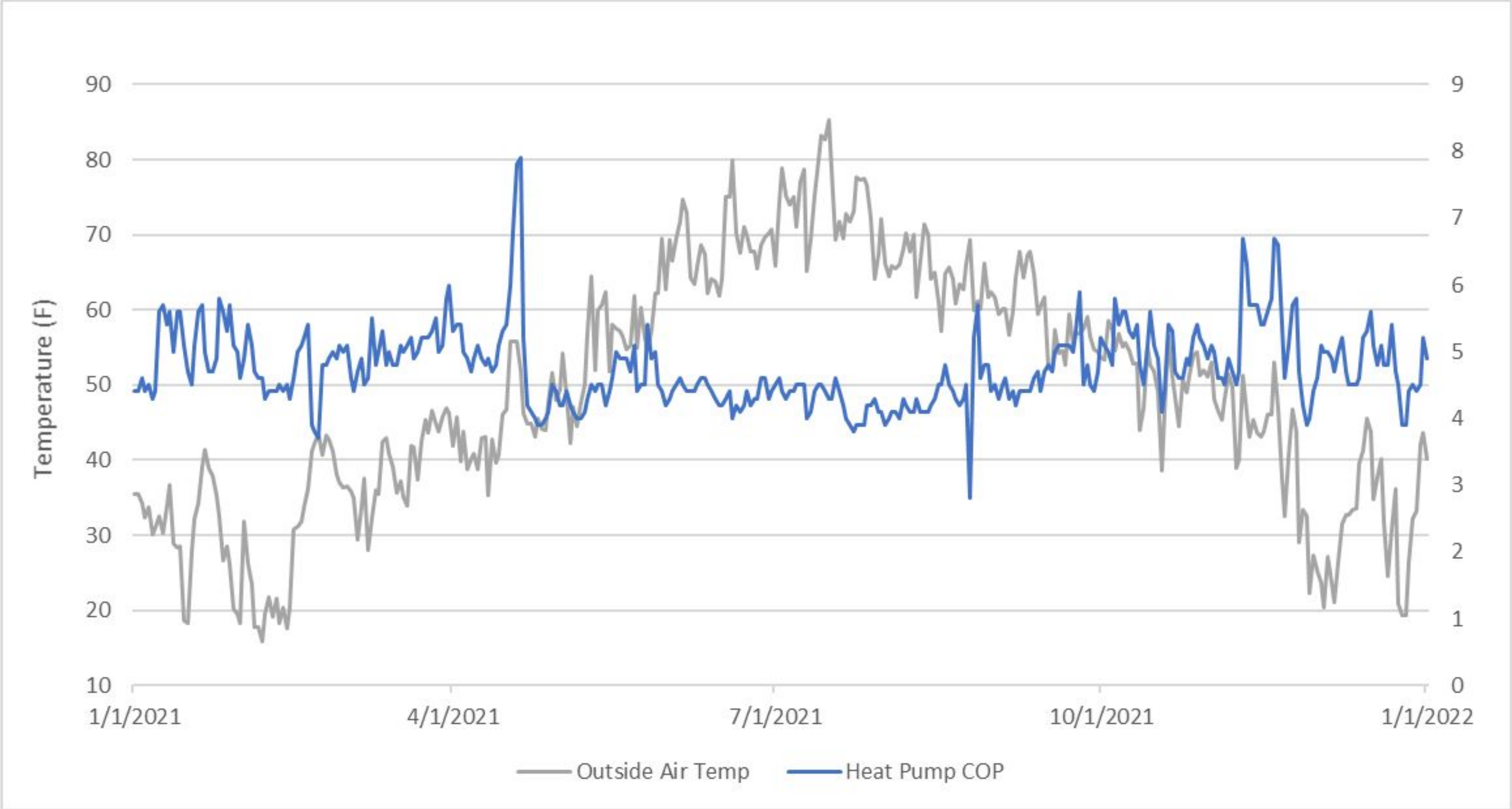
- There's available drilling technology that is capable of drilling at very precise, straight inclined angles.
- These inclined boreholes can be drilled in a small surface area and extend to contact an overall greater thermal mass.
- Boreholes can extend from the drilling area to the building or property footprint boundaries.



ENERGY RESULTS

SYSTEM PERFORMANCE





» Outdoor air temperature and temperature to and from BTES over one year for Frölundatorg.

» Daily COP and outside air temperature for Frölundatorg with a yearly average COP 4.7.

COST FEASIBILITY WITH

INCENTIVES & FINANCING

INCENTIVES: LOWERING COSTS AND FUTURE PENALTIES

- The federal investment tax credit applies to both the ground technology and building mechanical equipment
- State and local district heating and cooling opportunities
- Avoided cost of local govt penalties

FINANCING: SUPPORTING UPFRONT OR LONG-TERM PAYMENT

- State or city financing tools and loans
- Private and utility “As a Service” funding models

Questions? Reach Out!

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