Thermal Energy Network Tools & Resources

Speakers: Ania Camargo Cortés / *Building Decarbonization Coalition*
Angie Alberto Escobar / *HEET*
Jared Rodriguez / *Emergent Urban Concepts*
Debbie New / *Vermont Community Thermal Networks*

BUILDING DECARBONIZATION COALITION

Thermal Energy Networks

Tools and Resources

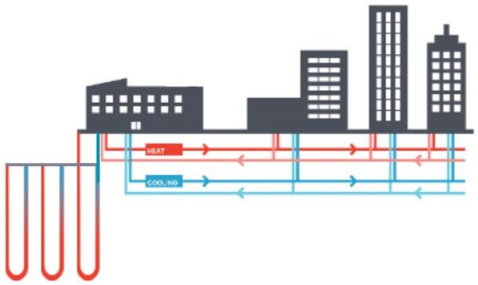
Ania Camargo Cortés
Associate Director, Thermal Networks
March 13th, 2025

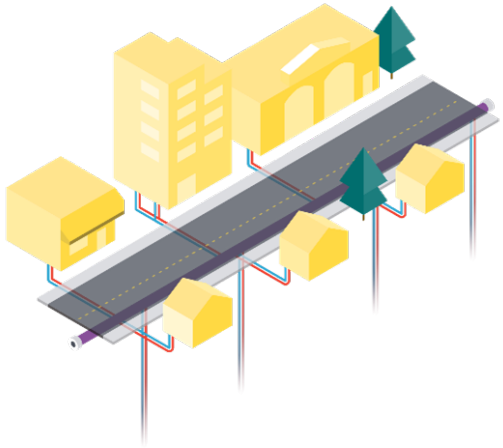
Thermal Energy Networks

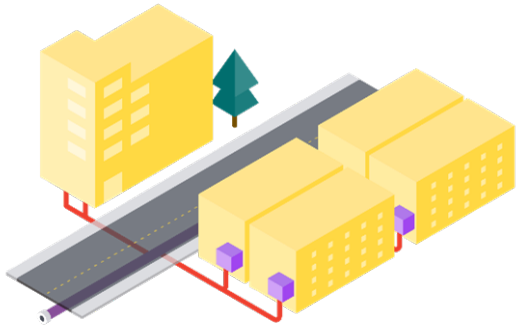
(Connected buildings that share clean non-combusting thermal energy)

Thermal Energy Networks

Central Plant	Distributed: Geothermal Heat Pump in Every Building	
Geo District Energy 4G	**Geothermal Networks (GENs)**	**Systems Without Boreholes**







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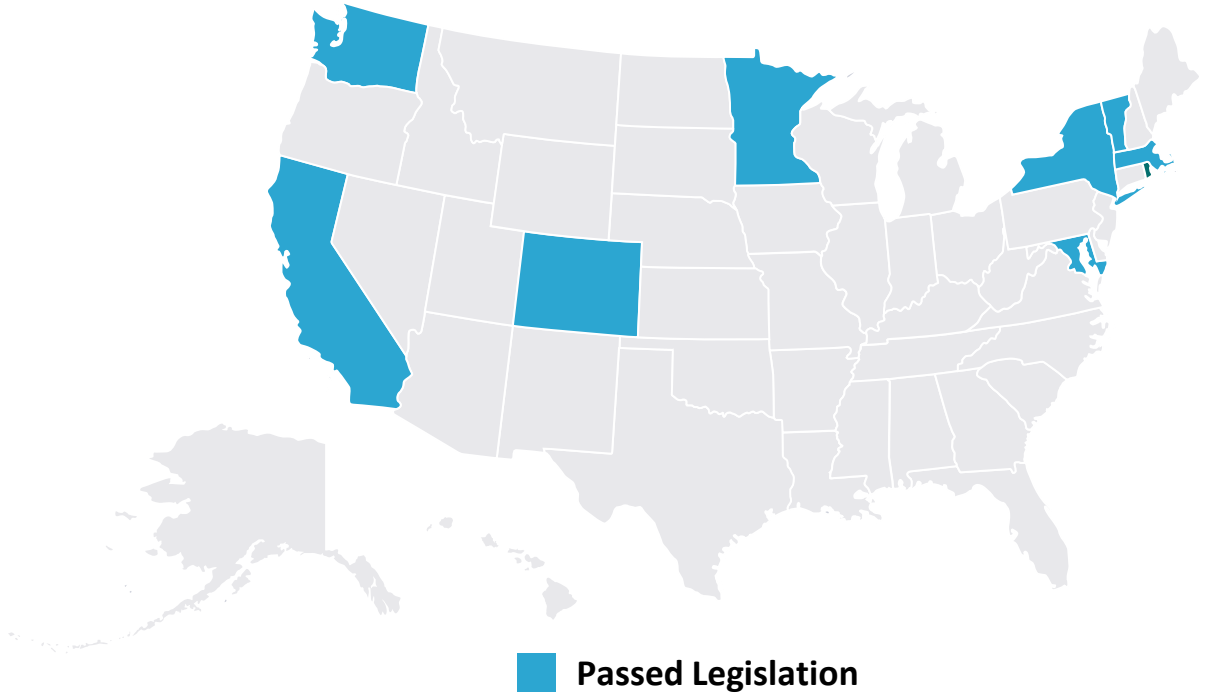
Thermal Energy Network Legislation



Passed Legislation

MA - 2021, 2022, 2024
MN - 2021, 2024
NY - 2022
CO - 2023, 2024
WA - 2024
MD - 2024
VT - 2024
CA - 2024

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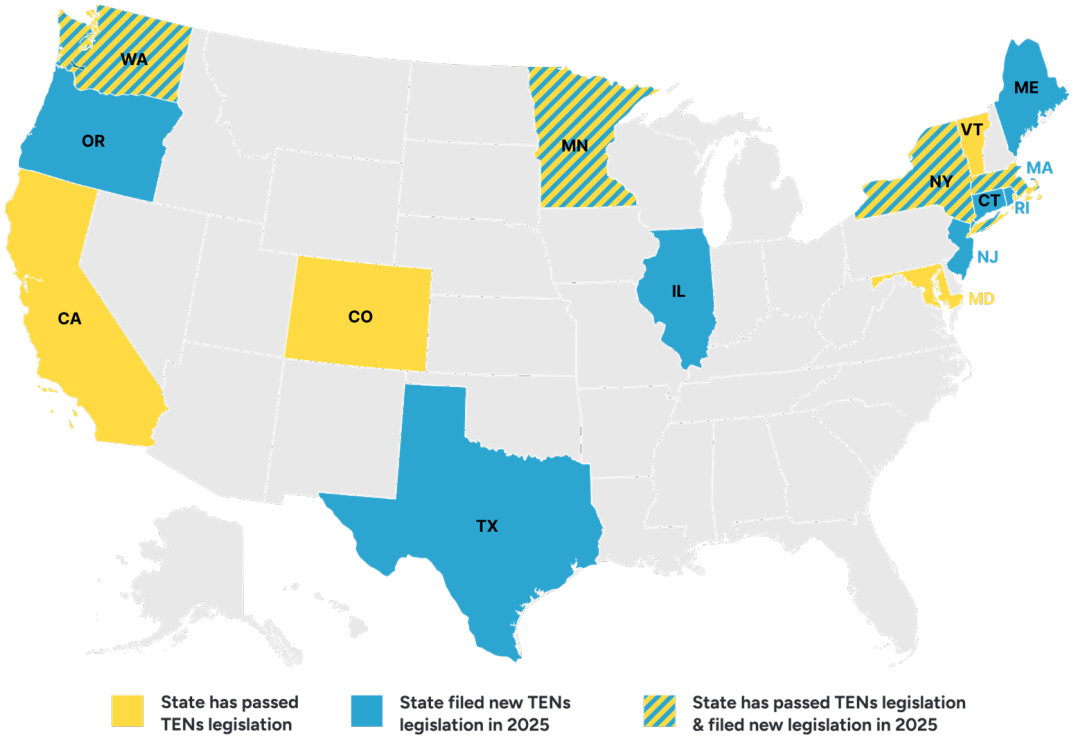
Updated 3/25/2025

Thermal Energy Network Legislation



MA - 2021, 2022, 2024, **2025**

MN - 2021, 2024, **2025**

NY - 2022, **2025**

CO - 2023, 2024

WA - 2024, **2025**

MD - 2024

VT - 2024

CA - 2024

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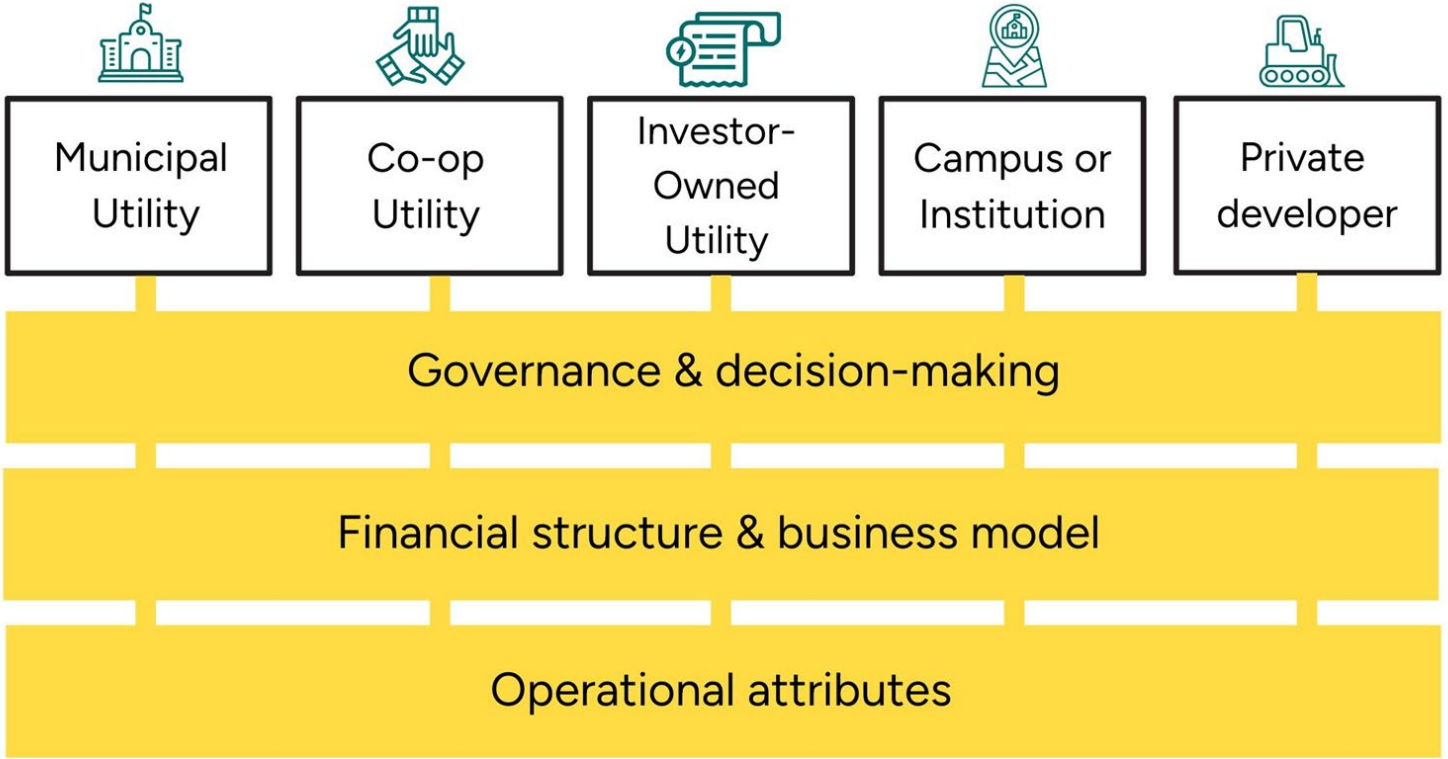
Updated 3/25/2025

Ownership Models: Pathways



Ownership Models : Analysis & Case Studies

West Union, Iowa

A city -owned, LLC-leased geothermal network

Edmonton, Alberta

A municipal utility in a new development

Ann Arbor, Michigan

Voters approved a clean energy utility to own a future geothermal network

(Geo)Thermal Energy Networks: Connecting more than buildings

Stakeholders

State decision makers
TENs owners and developers
Workers
TENs industry
Trade Orgs
EJ & rate payer Advocates
Communities
Environmentalists

Communication, Education, & Data

What are TENs?
Benefits
Costs
Ownership
Case Studies
Locations
Data
FAQ

Legislation & Regulation

Ownership
Protections
Definitions
Standards
Thermal market

Deployment Readiness

Feasibility
Financing
Workforce readiness & availability
Supply chain
Community Outreach

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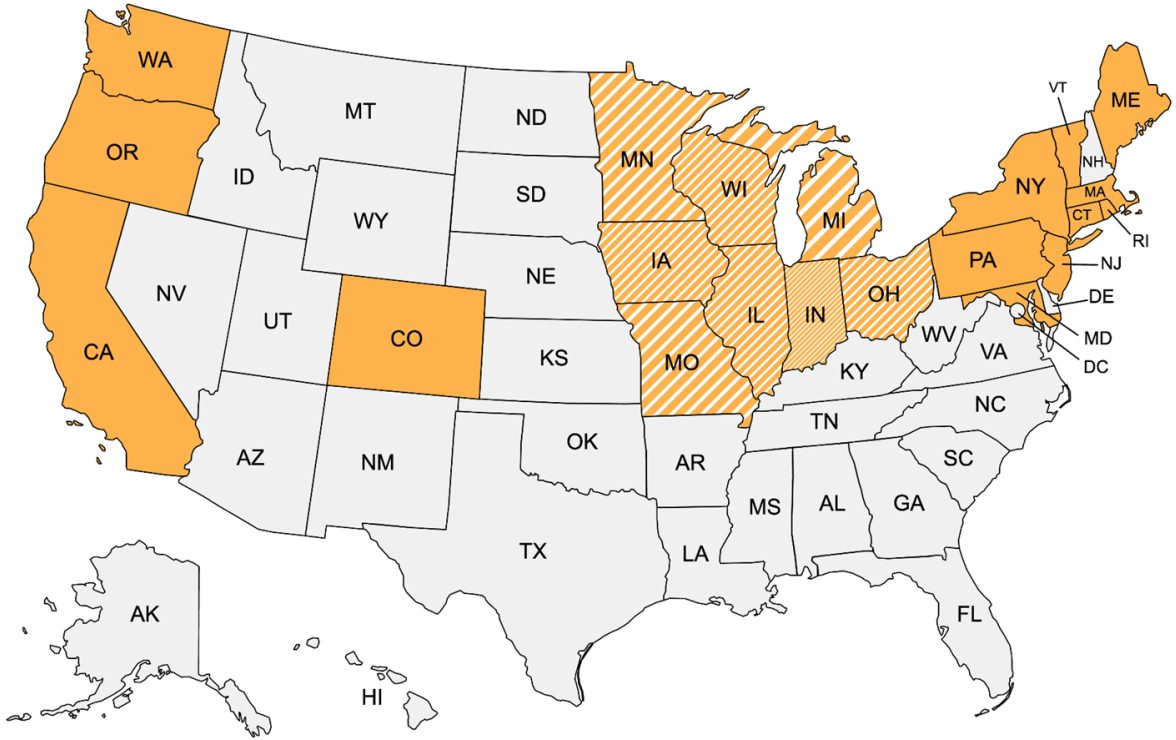
UPGRADE NY

www.upgradeny.org

National Thermal Energy Network Coalition



Coalition Members

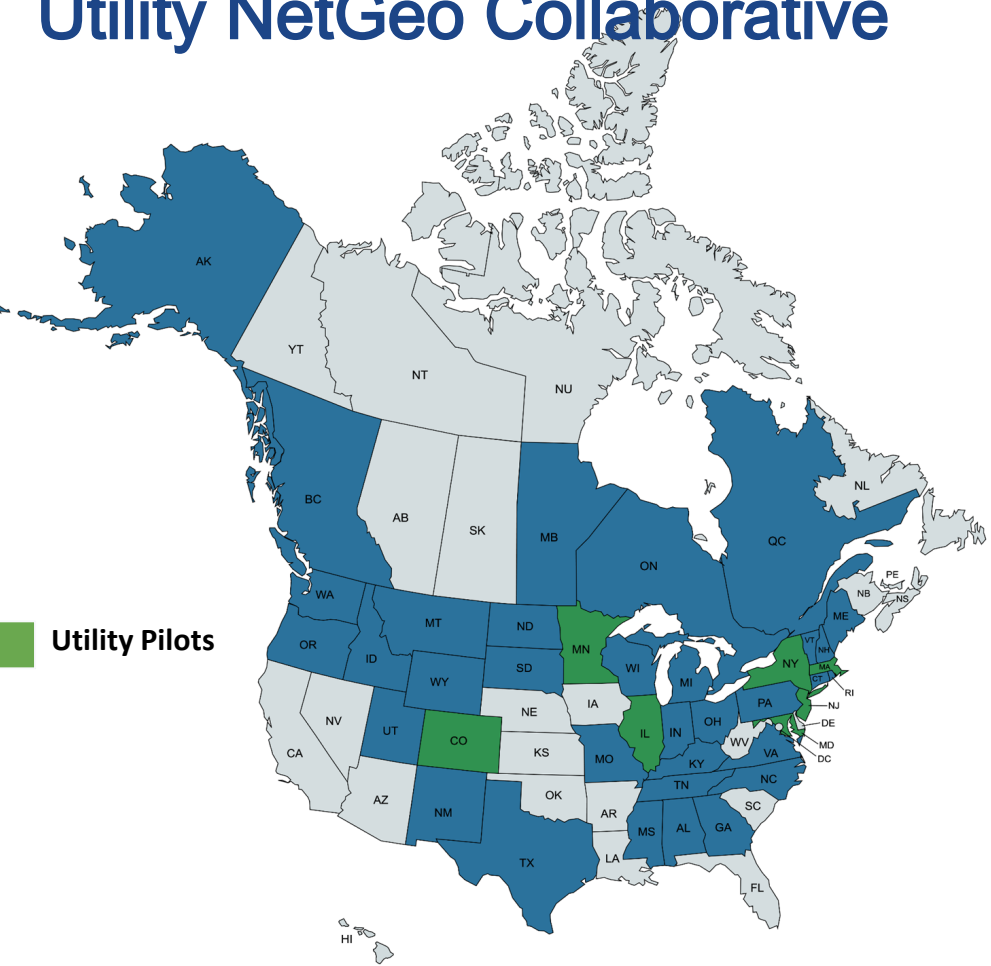
Midwest BDC states

As of 3/20/2024

BUILDING DECARBONIZATION COALITION

heet

Utility NetGeo Collaborative



Utility Pilots

CenterPoint Energy · spire · nationalgrid · BGE An Exelon Company · AVANGRID · National Fuel · Avista · PGW · Xcel Energy · Unitil · VGS · conEdison · NiSource · gti · EVERSOURCE ENERGY · PSE Puget Sound Energy · NW Natural · Cascade Natural Gas Corporation · ENBRIDGE · CMS ENERGY · Nicor Gas · FORTIS BC · Liberty · Consumers Energy Count on Us · Southern Company Gas · energir · Manitoba Hydro · Richmond Gas Works · New Jersey Natural Gas · Washington Gas

Updated 3/17/2025

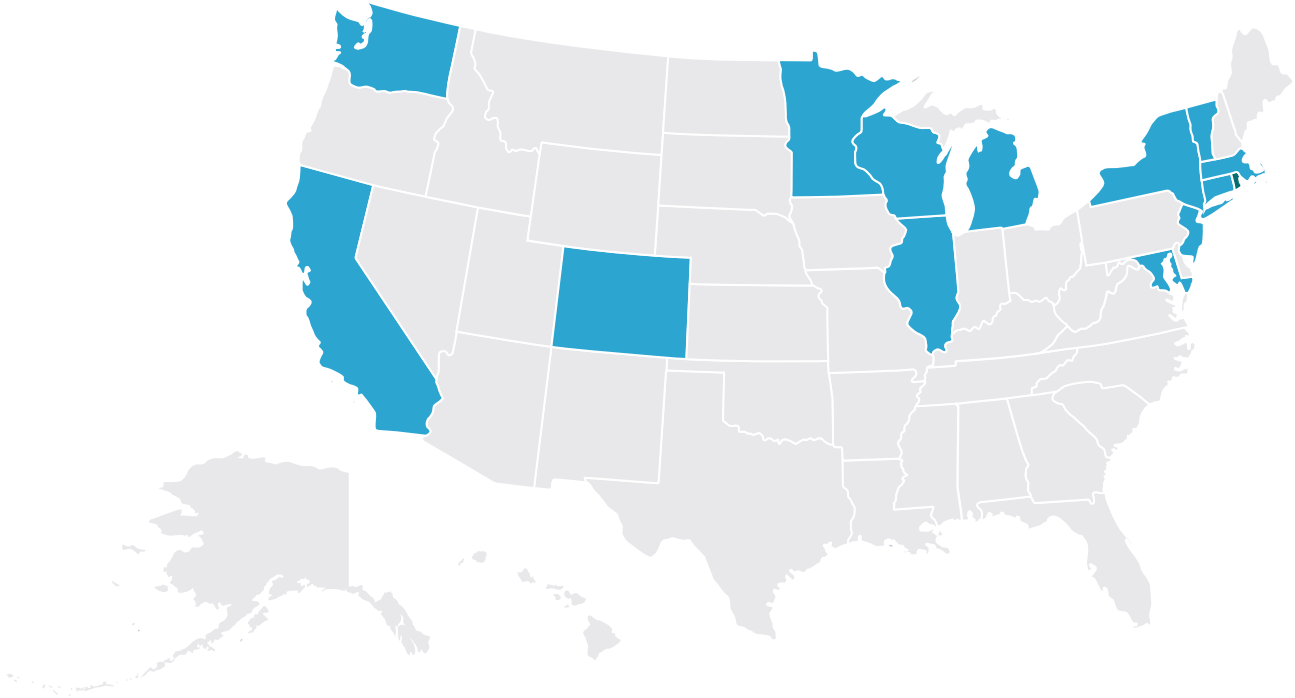
TENs Industry Workgroup

BUILDING DECARBONIZATION COALITION

GEOEXCHANGE

As of 4/1/, 2025

Regulator Forum Quarterly Meetings



As of Nov 1, 2023

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Communication Materials - What are TENs?

BUILDING DECARBONIZATION COALITION

THERMAL ENERGY NETWORKS

A NEIGHBORHOOD-SCALE SOLUTION FOR HEATING AND COOLING

Thermal energy networks (TENs) provide an opportunity to reimagine how we heat and cool our homes, free from fossil fuels.

Thermal energy networks are an elegant solution to a complex problem faced by communities across the country: how to eliminate the use of fossil fuels in our buildings, at scale. With TENs, the existing gas pipe system that currently heats buildings is replaced by an underground water loop system to provide highly efficient heating and cooling to connected buildings.

Illustration of a networked geothermal system along a street. Water circulates through boreholes and a shared loop of pipe to deliver temperature to ground source heat pumps in connected buildings.

To build to scale, thermal energy networks can be designed in many configurations and be connected to each other over time. *Networked geothermal*, for example, is an ultra-efficient type of TEN that uses shallow boreholes (100 to 750 ft) to access the earth's ambient temperature (~55° F) to heat and cool buildings *and* store excess thermal energy for use later. TENs do not always need boreholes; other sources of thermal energy—such as bodies of water, wastewater systems, or even energy intensive buildings (e.g. a datacenter, skating rink, grocery store)—can also be used.

Efforts underway

Several states are pursuing novel approaches to using this technology at neighborhood-scale. Eight states have passed innovative legislation either allowing or mandating that their largest gas utilities file plans to pilot TENs.

- The New York and Colorado bills include labor provisions, and New York specifically mandates training and including workers that are displaced by the gas transition.
- In New York, utilities filed 13 TEN pilot projects with their regulatory commission; 9 have advanced to an engineering phase.
- In June 2024, Eversource Energy officially launched the first gas utility-installed networked geothermal system in the nation. Located in Framingham, MA, the system provides heating and cooling to 140 customers, which include both homes and businesses. Video description of Eversource demonstration project.

Colleges and universities have been installing TENs for years to successfully decrease emissions, save on energy costs, and reduce water use.

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Examples of different systems include Colorado Mesa University, Weber State University, Stanford University, Carleton College, Princeton University, SUNY at Albany.

Communities and developers are seeing the value of installing these networks, like Whisper Valley in Texas, Springwater Mattamy Homes in Ontario, and communities in New York that have proposed many new networks. In 2023, the Department of Energy awarded $13 million in federal grants to 11 communities across the country to explore thermal energy systems.

Benefits

- **Safety**: No gas in the pipes, just water.
- **Emissions**: No onsite emissions. The only emissions for a system come from the fuel used to generate the electricity used by the heat pumps in the buildings.
- **Indoor air quality**: Replacing all gas appliances with electric ones will eliminate combustion indoors. The indoor air pollution caused by combustion exacerbates many health problems, such as asthma and heart disease.
- **Cooling**: Thermal energy networks provide both efficient heating and cooling. As the climate heats up and heat waves become more common, access to reliable indoor cooling will become critical. Heat waves are already more deadly than any other severe weather event.
- **Lower energy bills**: Current predictions estimate that the customer TENs bills will be lower because they will no longer include a fuel cost (gas/propane) as a part of the bill.
- **Pathway for utility workers**: Fossil fuel workers can use the skills they already have to install the networks.
- **Efficiency and reduced demand on the electric grid**: Thermal energy networks are the most efficient system known for delivering heating and cooling and they provide energy 24/7 regardless of outdoor conditions, thereby flattening the demand for electricity on the hottest and coldest days when there is peak demand.
- **Thermal storage**: Networked geothermal boreholes can store thermal energy in the bedrock to be used months later, reducing the variability that often plagues renewable electricity generation. This energy storage increases the overall efficiency of the system further by allowing the excess heat in the summer to be stored until it's needed in the winter.
- **Local energy independence and reduced price volatility**: TENs customers will be protected from volatile energy price spikes since the energy is always available and sourced locally. Networked geothermal combined with local electric generation can achieve 100% energy independence for entire communities.
- **Reliability**: Natural gas must travel hundreds or thousands of miles from wellhead to end user, making it vulnerable to single point failures. The thermal energy for TENs is local and systems are designed with backup power.
- **Reduced water use**: Because connected commercial buildings can be cooled by the networked geothermal system, rather than by chillers (which cool through evaporation), the system can save significant amounts of water. For example, the Colorado Mesa University thermal energy network cut its water use by 60% per square foot of conditioned space.

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Access our webpage:

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Frequently Asked Questions

What are thermal energy networks?

How can my community, campus, or neighborhood manage the costs of TENs installation?

What are geothermal energy networks?

Should regulated utilities install thermal energy networks?

What are the cost impacts on consumers?

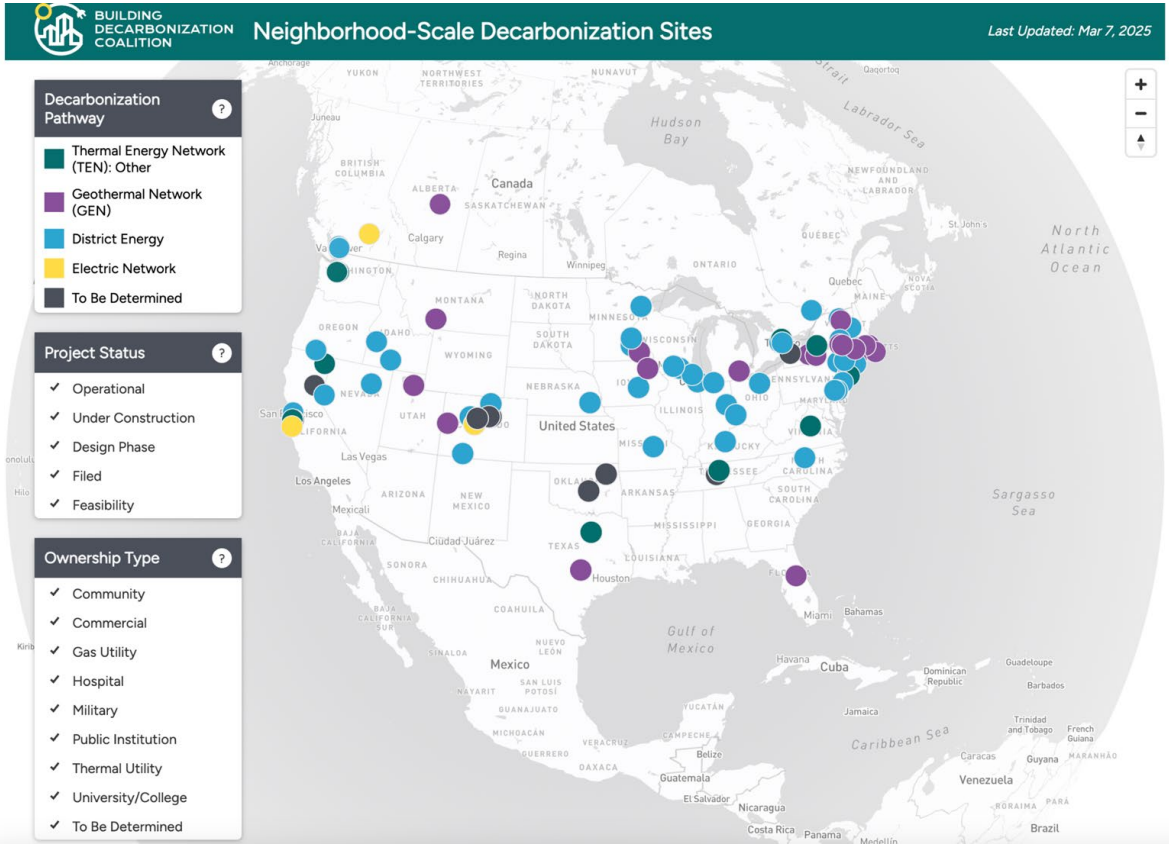
Are TENs secure?

How do TENs affect jobs?

Can entities *other* than regulated utilities install thermal energy networks?

Are TENs reliable?

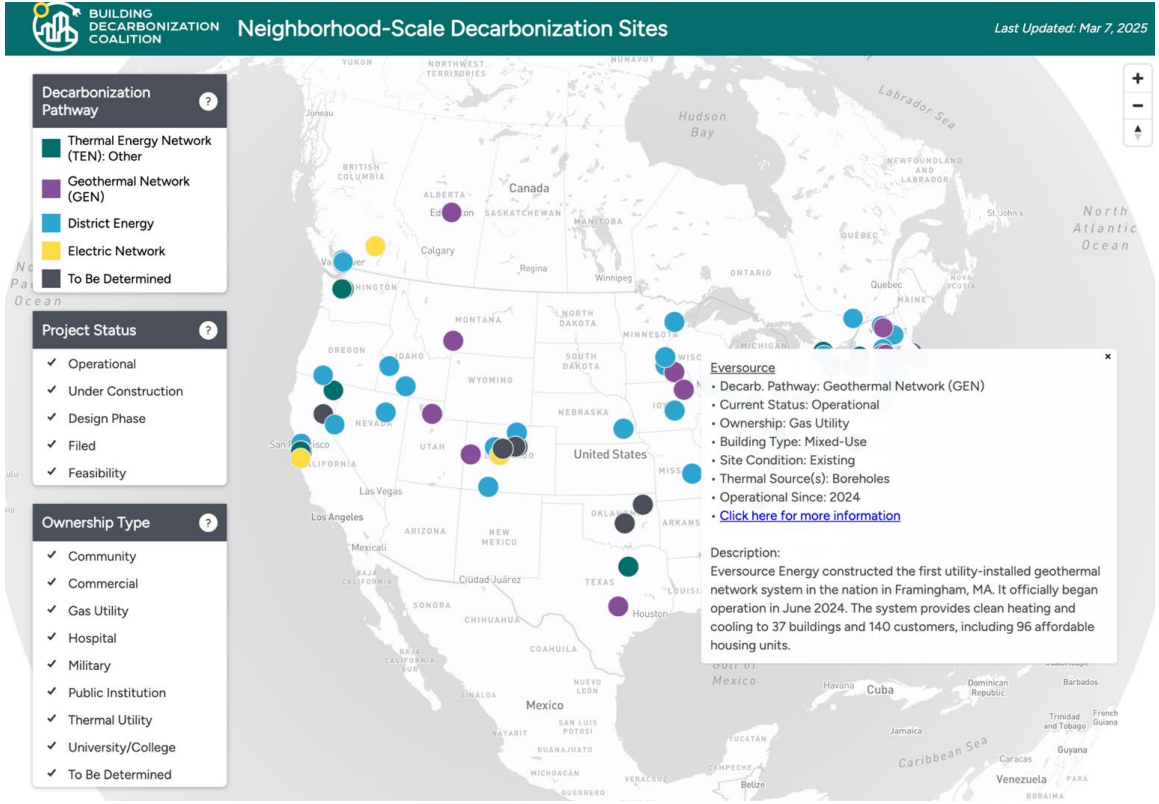
Neighborhood Scale Decarb Map



Add or Edit Sites

Access the map:

Neighborhood Scale Decarb Map: 100+ sites



Add or Edit Sites

Access the map:

Filter by Country, Ownership, Status & More

Explore the **106** projects below

Filter projects using the dropdown menus to the right

Hover over the information icons for more details

State or Province	City	Owner	Decarbonization Pathway
Alberta	Edmonton	Edmonton District Energy	Geothermal Network (GEN)
British Columbia	Richmond	City of Richmond	Geothermal Network (GEN)
	Vancouver	Creative Energy - Seńáḵw	District Energy
		Creative Energy - Sewell's Landing	District Energy
		Creative Energy - Thompson Rivers University	Electric Network
		False Creek Neighborhood Energy Utility (NEU)	District Energy
		Musqueam Capital Corporation	Thermal Energy Network (TEN): Other
		Oakridge Energy	District Energy
California	Alturas	Alturas Elementary School, Modoc Middle Scho..	Thermal Energy Network (TEN): Other
	Berkeley	University of California, Berkeley	District Energy
	Mountain View	Google Bay View Campus	Unknown or TBD
	Palo Alto	Stanford Central Energy Facility (CEF)	Thermal Energy Network (TEN): Other
	Quincy	Feather River College	Unknown or TBD
	Santa Cruz	University of California, Santa Cruz	Electric Network
Colorado	Breckenridge	Xcel Energy (proposed 1 of 5 sites)	Unknown or TBD
	Denver	National Western Center (NWC)	Thermal Energy Network (TEN): Other
		Xcel Energy (proposed 1 of 5 sites)	Unknown or TBD
	Eagle County	Eagle County Building Geoexchange	District Energy
	Fort Collins	Colorado State University	District Energy
	Frisco	Xcel Energy (proposed 1 of 5 sites)	Unknown or TBD
	Golden	Xcel Energy (proposed 1 of 5 sites)	Unknown or TBD
	Grand Junction	Colorado Mesa University	Geothermal Network (GEN)
	Lake County	Residents	Electric Network
	Pagosa Springs	Pagosa Springs Heating District Revitalization	District Energy
	South Frisco	Xcel Energy (proposed 1 of 5 sites)	Unknown or TBD
Connecticut	Meriden	Meriden Housing Authority	Geothermal Network (GEN)
	New Haven	Union Station Area Thermal Energy Network (U..	Geothermal Network (GEN)
		Yale University	District Energy
Florida	Apopka	Avian Pointe	Geothermal Network (GEN)
Idaho	Boise	Boise State University	District Energy
		City of Boise	District Energy
	Twin Falls	College of Southern Idaho	District Energy
Illinois	Chicago	Blacks in Green	Geothermal Network (GEN)
		CenTrio	District Energy

Select your view

Table

Charts

Filter the table using the menus below

Country: (Multiple values)

State or Province: (All)

Decarbonization Pathway: (All)

Current Status: (All)

Ownership: (All)

Building Type: (All)

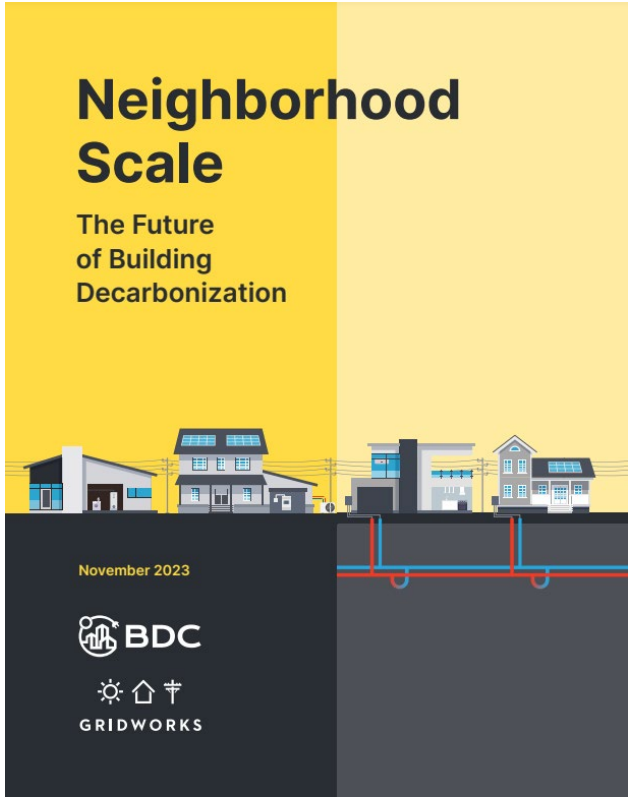
Site Condition: (All)

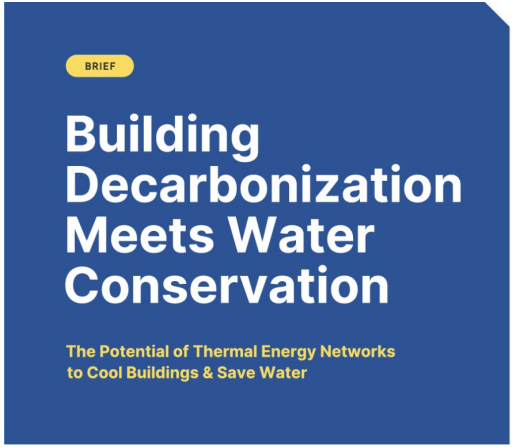
Owner: (All)

Add or Edit Sites

Access the map:

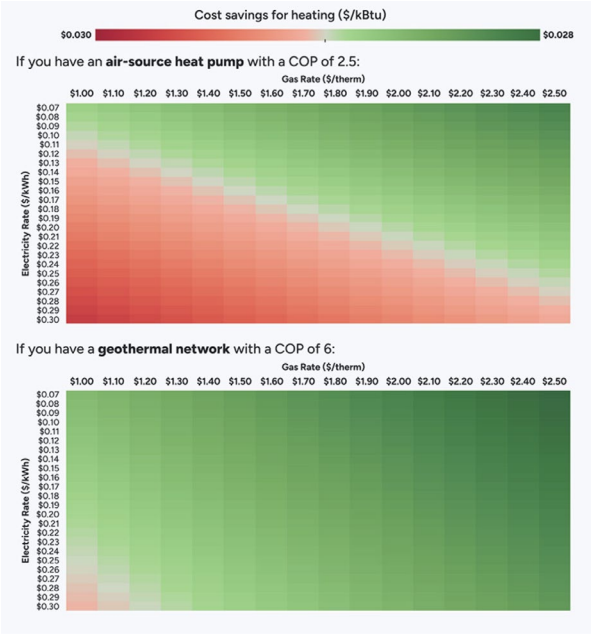
Research Materials





Affordable Heat, Efficient Grid:

Using Thermal Energy to Save Time, Money, and Energy



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Blogs and News

BLOG

A Visit to the Future of Energy: BDC Leads Tour to Vancouver to Study Thermal Energy Networks

JAN 14, 2025

NEW YORK

Learn More →

BLOG

NY Thermal Energy Networks Summit Explores How State Is Scaling Up Clean Heat and Cooling

MAY 6, 2024

NEW YORK

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BLOG

Seeing the Invisible: A Trip to Framingham, Massachusetts' Geothermal Network

FEB 26, 2025

MASSACHUSETTS

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Legislative Guidebook: Three Interconnected Parts

Landing Page

Guidebook

Statutory Language

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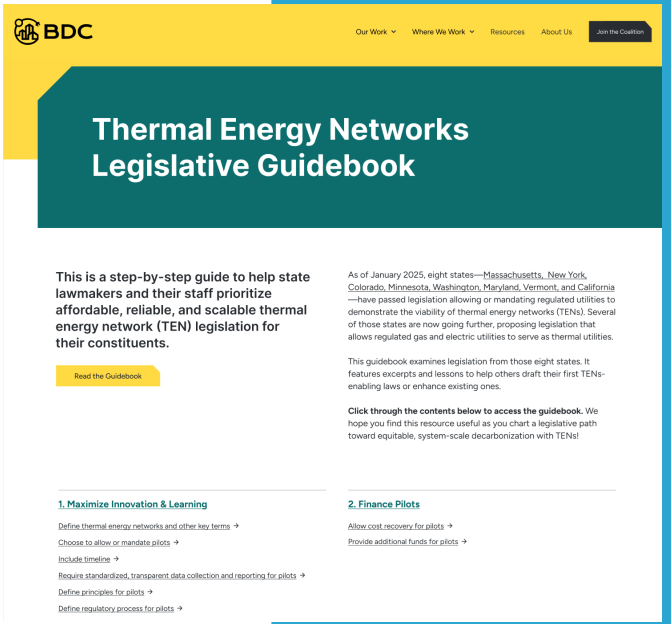
Walk Through: Landing Page

- Table of contents
- Click each URL to be directed to a specific chapter
- Link here



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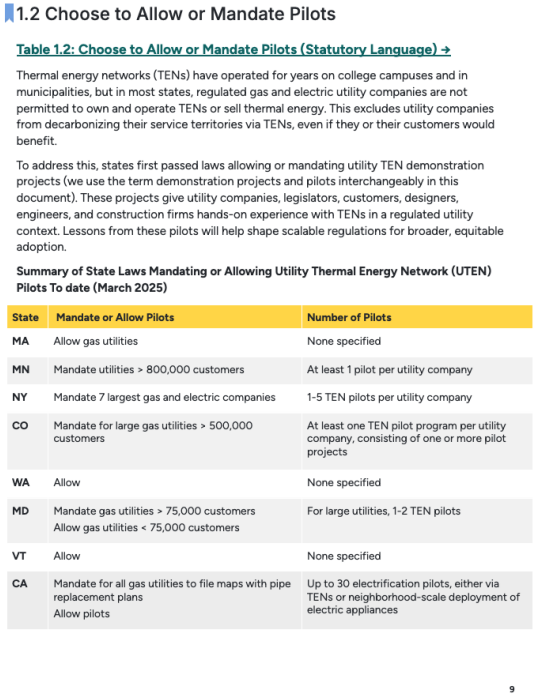
Walk Through: Guidebook

- Divided into topical sections + subsections
  - E.g.: *1. Maximize Innovation & Learning→ 1.2 Choose to Allow or Mandate Pilots*
- Tables provide quick comparison
- Subsections link to example statutory language (when applicable)
- Link here



1.2 Choose to Allow or Mandate Pilots

Table 1.2: Choose to Allow or Mandate Pilots (Statutory Language) →

Thermal energy networks (TENs) have operated for years on college campuses and in municipalities, but in most states, regulated gas and electric utility companies are not permitted to own and operate TENs or sell thermal energy. This excludes utility companies from decarbonizing their service territories via TENs, even if they or their customers would benefit.

To address this, states first passed laws allowing or mandating utility TEN demonstration projects (we use the term demonstration projects and pilots interchangeably in this document). These projects give utility companies, legislators, customers, designers, engineers, and construction firms hands-on experience with TENs in a regulated utility context. Lessons from these pilots will help shape scalable regulations for broader, equitable adoption.

Summary of State Laws Mandating or Allowing Utility Thermal Energy Network (UTEN) Pilots To date (March 2025)

State	Mandate or Allow Pilots	Number of Pilots
MA	Allow gas utilities	None specified
MN	Mandate utilities > 800,000 customers	At least 1 pilot per utility company
NY	Mandate 7 largest gas and electric companies	1-5 TEN pilots per utility company
CO	Mandate for large gas utilities > 500,000 customers	At least one TEN pilot program per utility company, consisting of one or more pilot projects
WA	Allow	None specified
MD	Mandate gas utilities > 75,000 customers Allow gas utilities < 75,000 customers	For large utilities, 1-2 TEN pilots
VT	Allow	None specified
CA	Mandate for all gas utilities to file maps with pipe replacement plans Allow pilots	Up to 30 electrification pilots, either via TENs or neighborhood-scale deployment of electric appliances

9

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Walk Through: Statutory Language

- Excerpts from actual legislation
- Fully cited
- Link here

1. Maximize Innovation and Learning

1.1 Define Thermal Energy Networks And Other Key Terms

State	Bill	Relevant Language	Section of Law Amended	Bill Location
MA	Massachusetts General Court (2022) House Bill No. 5060 "An Act driving clean energy and offshore wind" https://malegislature.gov/Bills/192/H5060	147A. "Non-emitting renewable thermal infrastructure project," a utility-scale project that replaces natural gas distribution infrastructure with distribution infrastructure that supplies heating, or heating and cooling, from fuel sources whose combustion does not emit greenhouse gasses, as defined by section 1 of chapter 21N; provided, however, that a "non-emitting renewable thermal infrastructure project" may include, but shall not be limited to, a networked geothermal system."	Massachusetts General Laws, Chapter 164, section 147A (new added section) https://malegislature.gov/Laws/GeneralLaws/PartI/TitleXXII/Chapter164/Section147A	Section 59, Page 49, Lines 1015-1020
MN	Minnesota Legislature (2021) Chapter 4 - H.F. No. 6 https://www.revisor.mn.gov/laws/2021/1/Session+Law/Chapter/4/2021-09-08%2008:33:47+00:00/pdf	(f) "District energy" means a heating or cooling system that is solar thermal powered or that uses the constant temperature of the earth or underground aquifers as a thermal exchange medium to heat or cool multiple buildings connected through a piping network. (i) "Innovative resource" means biogas, renewable natural gas, power-to-hydrogen, power-to-ammonia, carbon capture, strategic electrification, district energy, and energy efficiency.	Minnesota Statutes. § 216B.2427 subdivision 1 (new added items (f) and (i)) https://www.revisor.mn.gov/statutes/cite/216B.2427/pdf	Article 8, Section 20, page 87
MN	Minnesota Legislature (2024) Chapter 126 - S.F. No. 4942 https://www.revisor.mn.gov/laws/2024/0/Session+Law/Chapter/126/2024-08-09%2008:14:18+00:00/pdf	(s) "Thermal energy network" means a project that provides heating and cooling to multiple buildings connected via underground piping containing fluids that, in concert with heat pumps, exchange thermal energy from the earth, underground or surface waters, wastewater, or other heat sources. "Geothermal energy system" means a system that heats and cools one or more buildings by using the constant temperature of the earth as both a heat source and heat sink, and a heat exchanger consisting of an underground closed loop system of piping containing a liquid to absorb and relinquish heat within the earth. Geothermal energy system includes: (1) a bored geothermal heat exchanger, as defined in section 103I.005; (2) a groundwater thermal exchange device, as defined in section 103I.005; and Official Publication of the State of Minnesota Revisor of Statutes Ch 126, art 6, s 42 LAWS of MINNESOTA 2024 84 (3) a submerged closed	Minnesota Statutes. § 216B.2427 subdivision 1, (new added item (s)) https://www.revisor.mn.gov/statutes/cite/216B.2427/pdf	Article 6, page 101, Section 22 Page 84, Section 45(c)

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Thank you!

New York's Utility Thermal Energy Network & Jobs Act Proceeding of the Dept. of Public Service

Jared Rodriguez, Emergent Urban Concepts

EMERGENT URBAN CONCEPTS

Thermal Energy Networks Provide for Neighborhood -scale Decarbonization

1. ACCELERATE DECARBONIZATION AT SCALE neighborhood by neighborhood

2. REDUCE COST OF NEW CONSTRUCTION & RETROFITS with the need for less in-building equipment and space dedicated to a mechanical plant

3. ENABLE LARGE-SCALE HEAT RECOVERY & RESOURCE EFFICIENT DECARBONIZATION to stack benefits and improve project economics

4. REDUCE TOTAL COST OF ECONOMY WIDE ELECTRIFICATION by limiting the size of the electric grid build-out, need for electric storage, and peaking generation

5. PRODUCE ECONOMIC DEVELOPMENT OPPORTUNITIES to cast neighborhood-scale decarbonization in a geographically targeted economic development framework

6. PROVIDE A POSITIVE NET PRESENT VALUE compared to alternative paths to decarbonization

U.S. States Advance Neighborhood -scale Decarbonization Policies

Neighborhood-scale building decarbonization is an emerging strategy that focuses on transitioning street segments, developments, or even entire neighborhoods to decarbonized energy sources and equipment with the end goal of managing the transition off fossil fuel. Thermal Energy Networks and shared infrastructure are vital to achieving Neighborhood Scale Decarbonization.

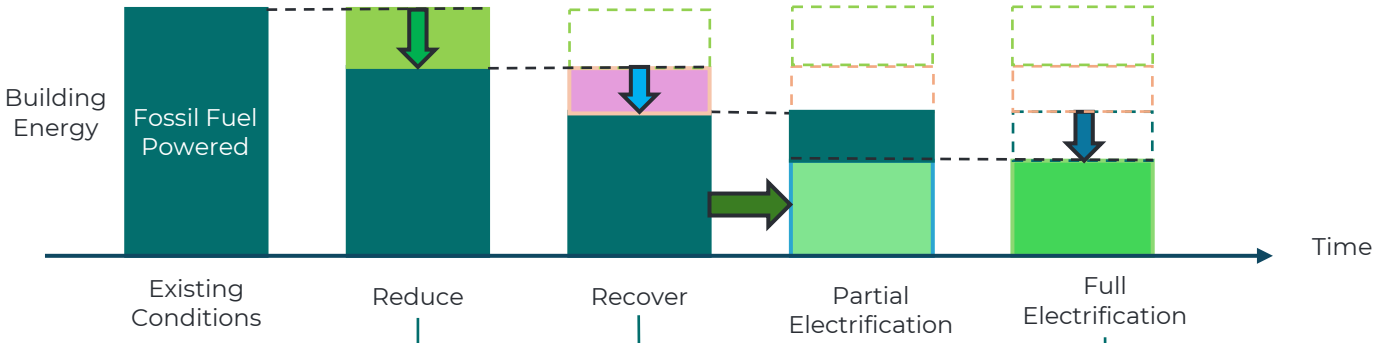
Policy Mechanisms to Advance Neighborhood -scale Decarbonization Should Follow the RED Approach

Apply the **Resource Efficient Decarbonization** model to help alleviate space constraints, optimize peak thermal capacity, increase operational efficiencies, **utilize waste heat, and reduce the need for oversized electric thermal energy systems**, creating retrofit cost compression. The model contains (4) steps:

1. **REDUCE** energy loads as much as possible.
2. **RECONFIGURE** systems to create thermal networks and enable low temperature distribution.
3. **RECOVER** as much heat as possible from air, water, and wastewater sources.
4. **REPLACE*** equipment incrementally over time until full decarbonization is reached.

* **"All-or-Nothing" is a false assumption**

Resource Efficient Decarbonization (RED)



Reduce Energy Load

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

Recover Wasted Heat

- Waterside Heat Recovery
- Airside Heat Recovery
- Wastewater Heat Recovery
- Thermal Energy Networks

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/Waterfall
- Target specific loads

Full Electrification

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

- Diverse Heat Pumps
- Thermal Energy Storage
- District/ Thermal Energy Network
- Grid-interactivity Efficient Buildings (GEBs)

(Some) Potential Policy Mechanisms

1. PERMANENT PEAK LOAD REDUCTION (gas + elec.)

2. MANDATORY HEAT RECOVERY from industrials, treatment plants, data centers, etc.

3. Non-wires Alternatives and Demand Management Zones that recognize thermal energy infrastructure as electric capacity

4. Non-pipes Alternatives that support strategic RED

5. Strategic Decarb Investment Zones cast neighborhood-scale decarbonization in a geographically targeted economic development framework

6. Affirm the Municipal Role in TENs Development and encourage heat planning with comprehensive planning

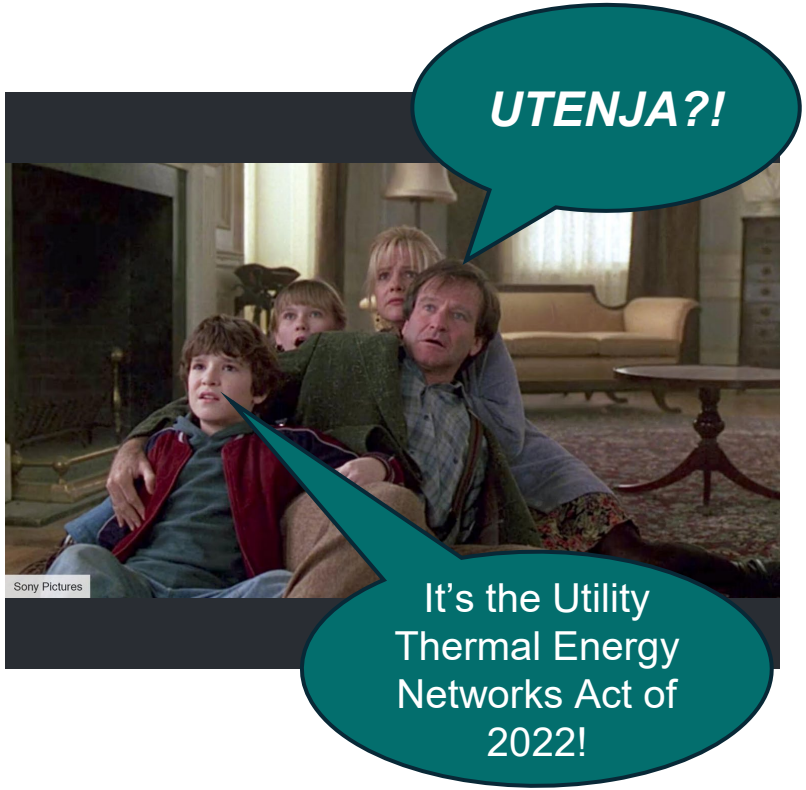
7. Authorize Regulated Investor-Owned Utilities to own/develop TENs

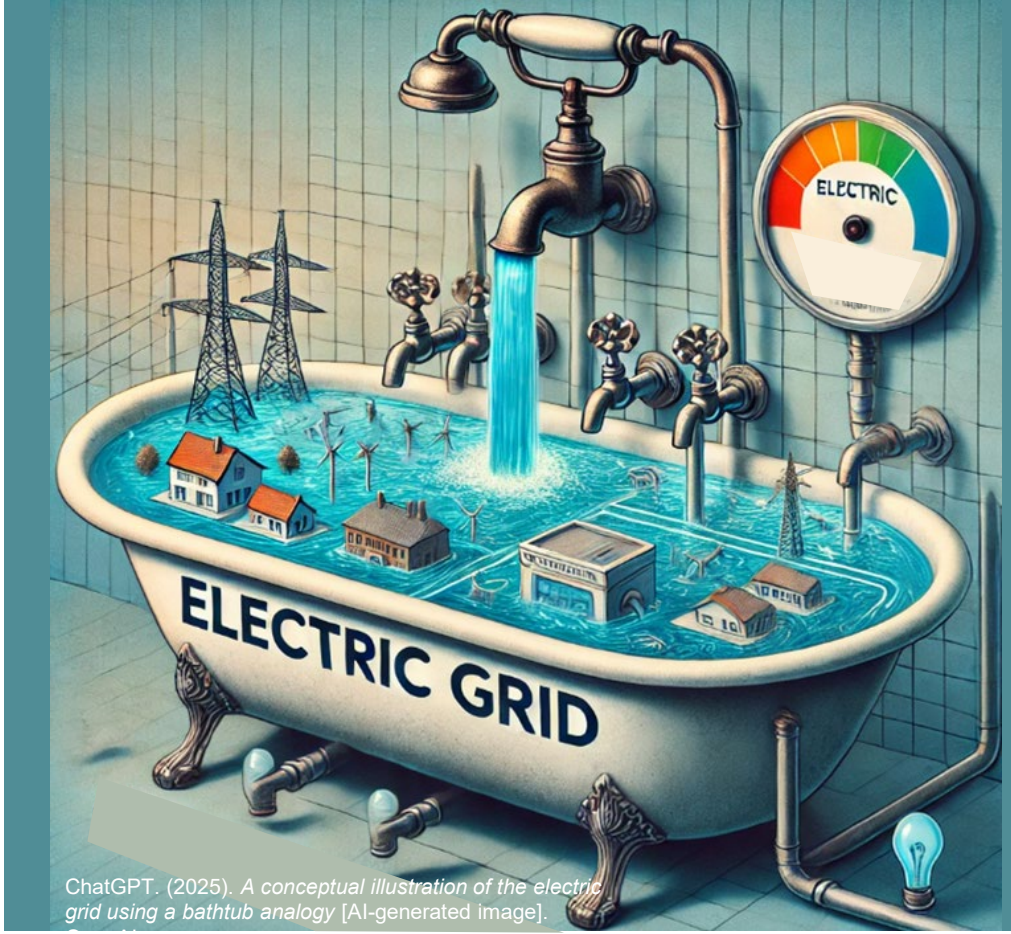
8. Create and Enforce a Thermal Energy Marketplace through a common carrier-based model

EMERGENT URBAN CONCEPTS

Emergent Trends from New York's UTENJA

1. **A regulatory framework** to support a **diversity of players** is needed to **create an open market.**
2. **Regulated IOUs** are not the only major players.
3. **Municipalities have a role** and perhaps should be lightly regulated/exempted.
4. **Campuses and customer-owned systems** (like coops) should be lightly-regulated/exempted.
5. **Perhaps IOUs should** only be allowed to distribute and not generate (borrow from the electric LDC model)
6. **The more competition, the better**
7. **System complexity** (sort of) makes this difficult, but we have models from other sectors





ChatGPT. (2025). *A conceptual illustration of the electric grid using a bathtub analogy* [AI-generated image].

Common Carrier Open Access regulatory frameworks ensure that TENs function similarly to open-access electric or natural gas grids, allowing multiple provider-suppliers to use the network to supply end-use customers.

Imagine the grid (thermal and electric) acting like a bathtub; energy is put in and taken out in multiple ways . . . and this must be in balance.

EMERGENT URBAN CONCEPTS

Key Takeaways

1. **Many parties** are needed for success, so it's important to empower as a diverse a set of players is a necessity. Developing consortia to pursue neighborhood-scale solutions is a fundamental best practice.
2. **Best Practice Standards** like common interconnection, operational parameters, standardized retrofits and new construction requirements are needed.
3. **Regulated IOUs** are not the only player, and parties with monopolistic tendencies should be controlled/regulated and fill a narrow role. Regulators must create open and fair markets.
4. **Municipalities** are critically important players needed to create local conditions that support neighborhood-scale approaches including thermal energy network development. Municipals do more with less, are the unsung hero when it comes to affordable shared infrastructure despite anti-municipal narratives.
5. **A Democratic Process Supports Fairness and Affordability** through support of cooperative and government models; yes, I still believe Democracy is our best option!
6. **Economic Development is Neighborhood-scale Decarbonization and Vice Versa:** let's get back to framing these efforts as infrastructure investment to improve economic outcomes and quality of life.

Beat the Peak.

https://hackaday.com/2016/02/22/a-field-guide-to-the-north-american-utility-pole/

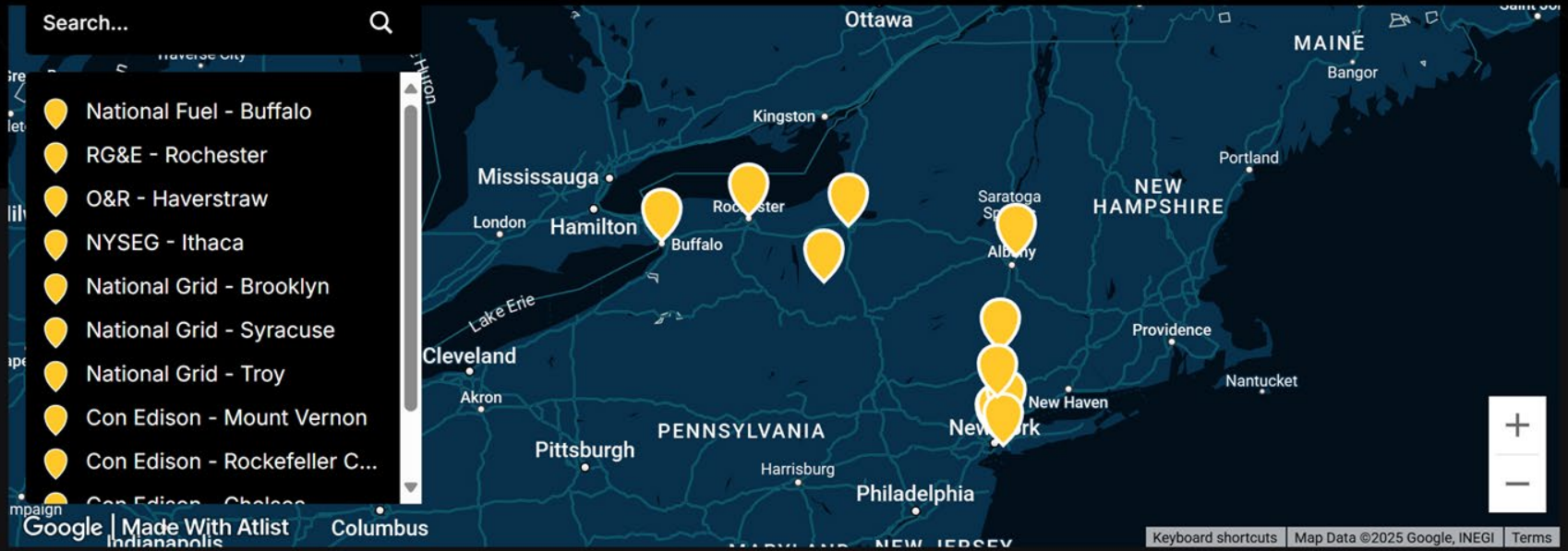
The biggest value proposition IDEA members can provide in a decarbonized future is peak electric demand modulation. Policymakers and regulators must as soon as possible equitably value thermal energy infrastructure and traditional electric network infrastructure.

EMERGENT URBAN CONCEPTS

www.upgradeny.org

UPGRADE NY

Resources | Thermal Energy Networks in NY

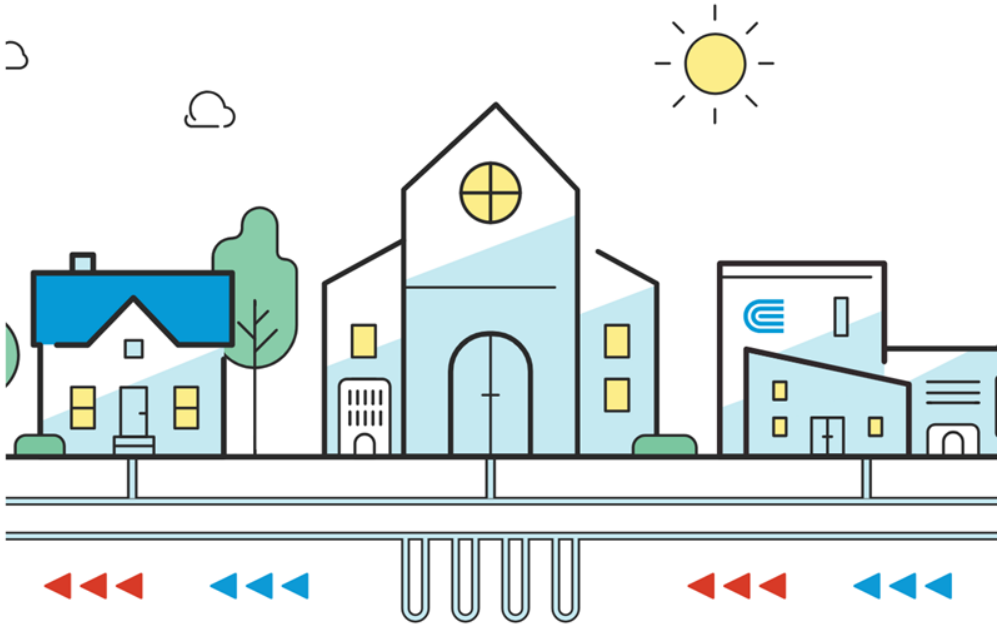


These are the pilot projects under consideration from the Public Service Commission (PSC). This map will be updated to reflect the progress made on these projects as they pass new benchmarks as well as future TENs in action beyond these pilots. **For more information on these projects visit the PSC Docket on UTENJA here.**

Pilot Project Highlights

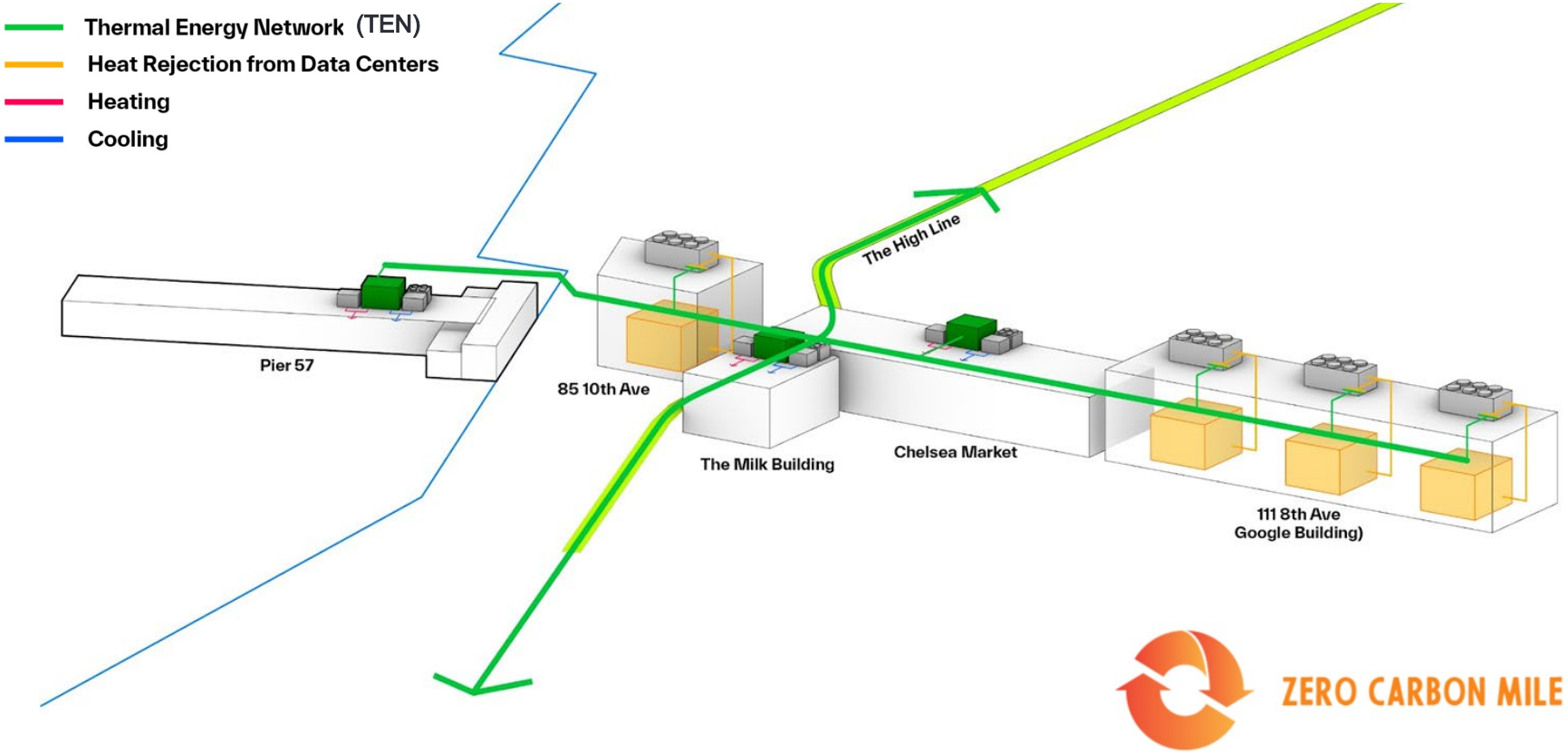
Mount Vernon Thermal Energy Network

We're exploring the creation of a thermal energy network (TEN) in Mount Vernon to provide residents with cleaner heating and cooling technology—and reduce carbon emissions more efficiently in the area.



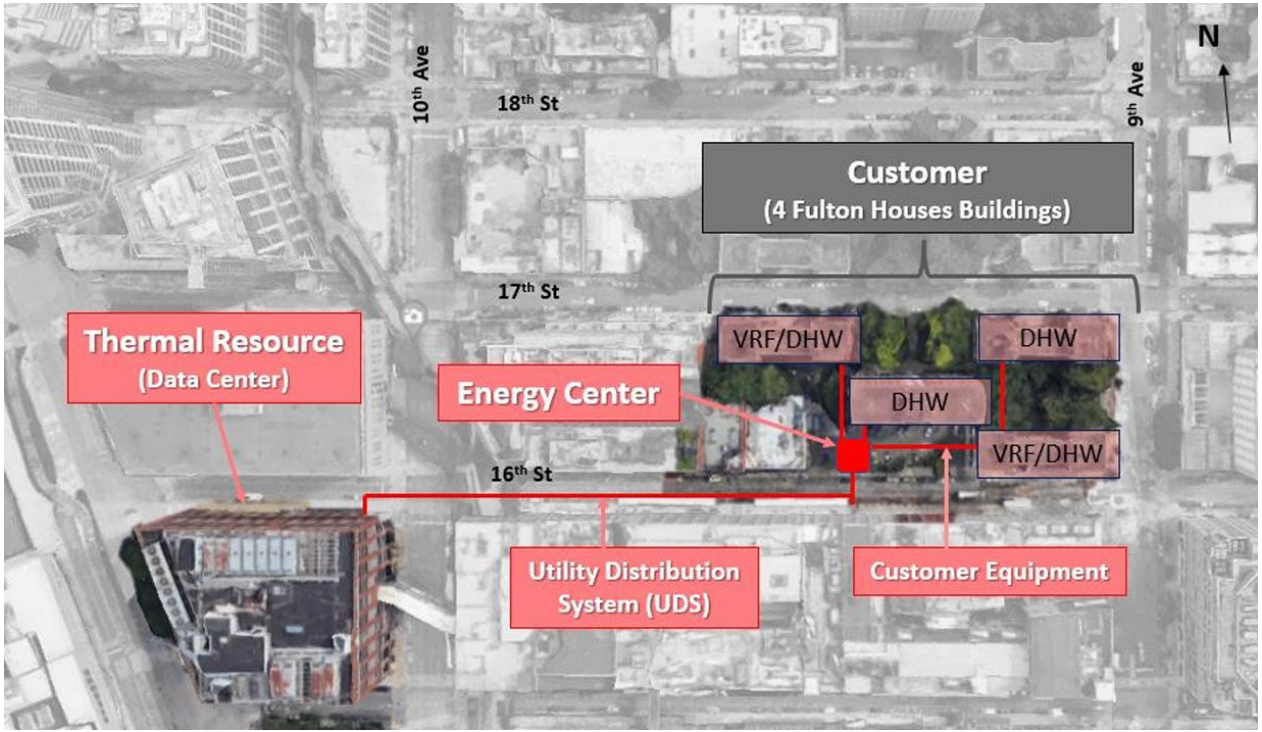
conEdison

Pilot Project Highlights: Chelsea



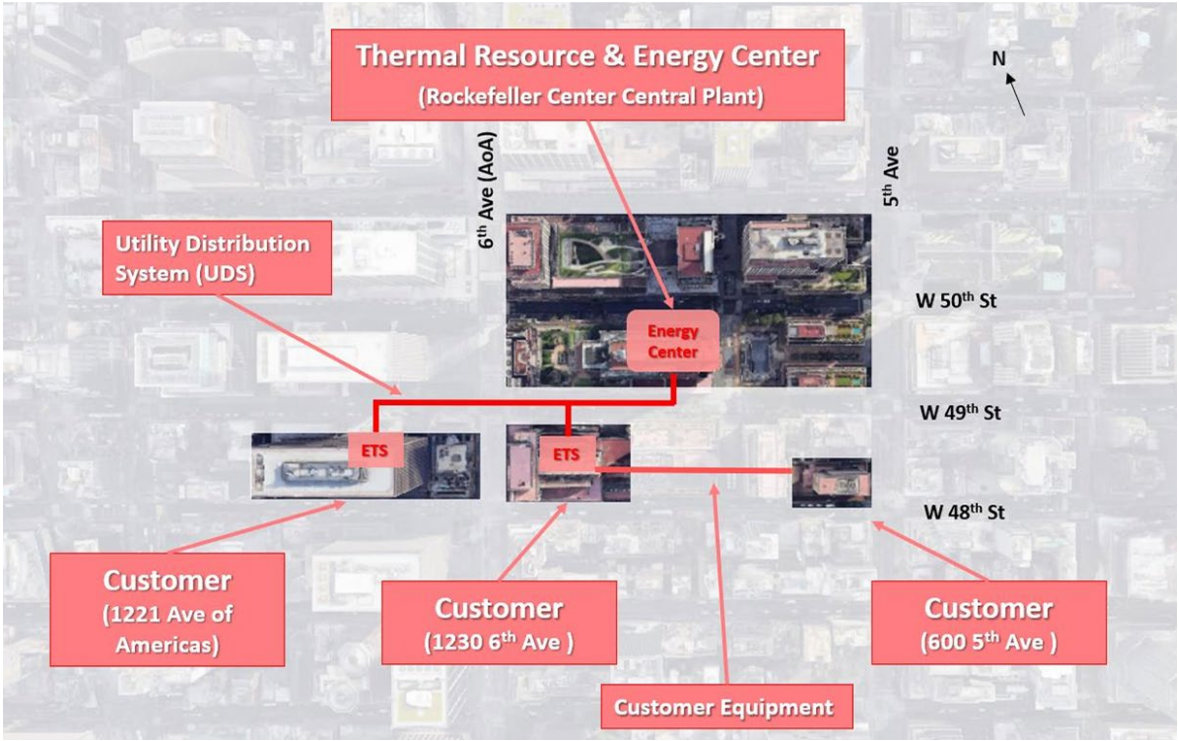
ZERO CARBON MILE

Pilot Project Highlights: Chelsea



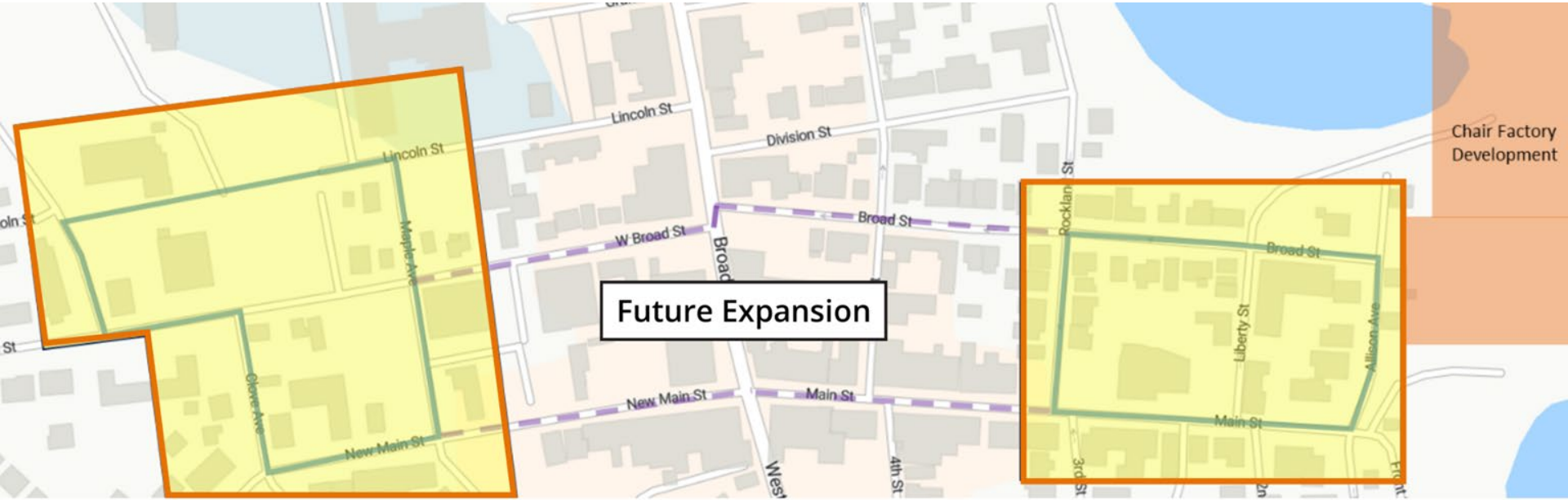
ConEdison

Pilot Project Highlights: Rockefeller Center



conEdison

Pilot Project Highlights: Haverstraw



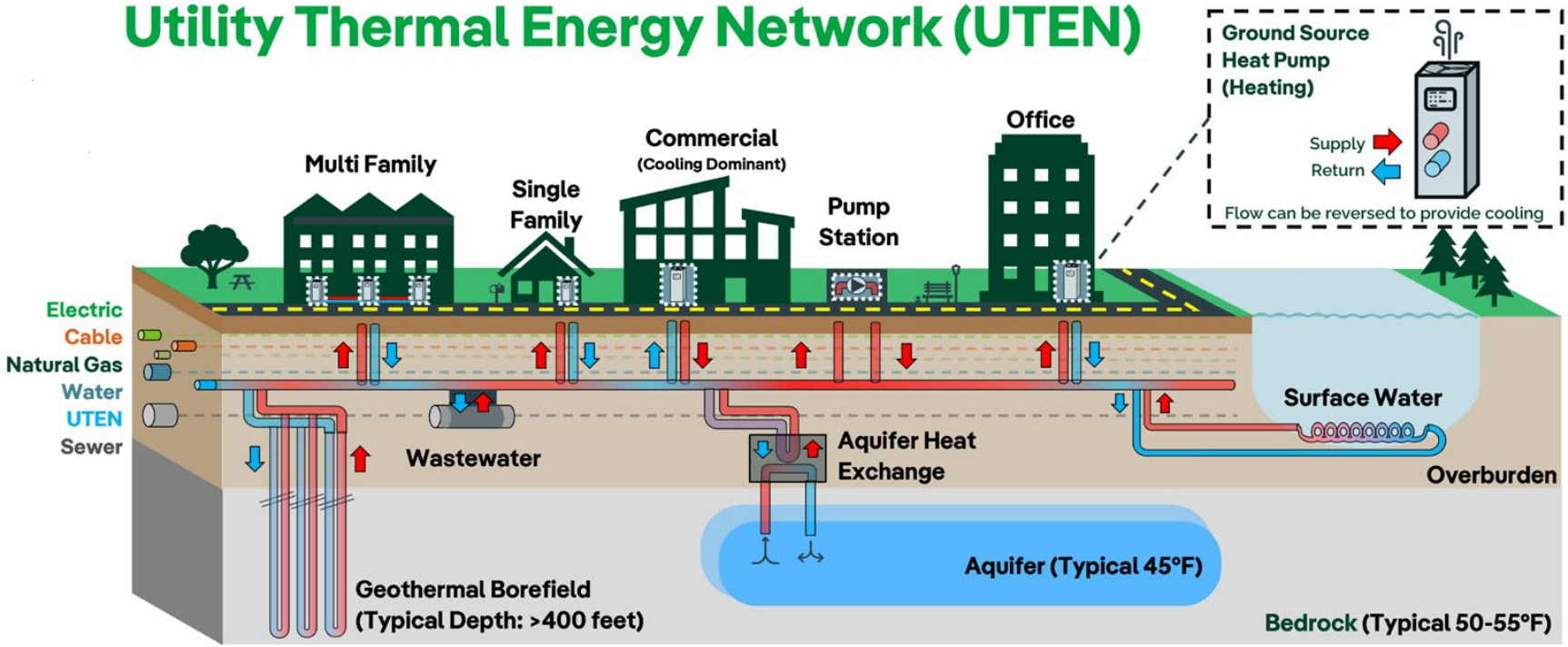
West UTEN Loop

East UTEN Loop

Orange & Rockland

Pilot Project Highlights: Haverstraw

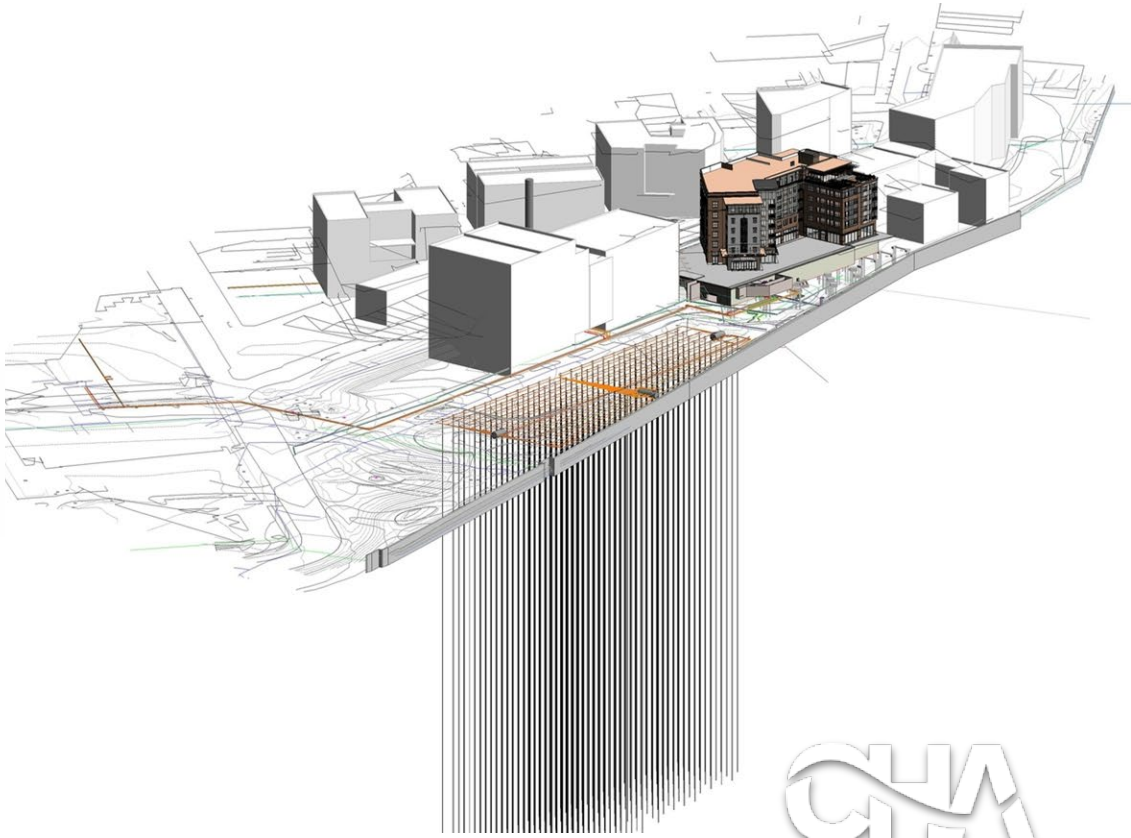
Pilot Project Highlights: Ithaca



NYSEG
An Avangrid company

Pilot Project Highlights: Troy

TROY.NY
LOCAL DEVELOPMENT CORPORATION



nationalgrid

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Beat the Peak.

https://hackaday.com/2016/02/22/a-field-guide-to-the-north-american-utility-pole/

The biggest value proposition IDEA members can provide in a decarbonized future is peak electric demand modulation. Policymakers and regulators must as soon as possible equitably value thermal energy infrastructure and traditional electric network infrastructure.

EMERGENT URBAN CONCEPTS

Tell the New York State Department of Public Service (NOW!):

- We don't need to expand the grid to meet new building electrification loads.
- Decarbonization can accelerate AND grid reliability can increase, and combustion isn't necessary
- We can avoid high-cost growth scenarios by choosing the obvious least cost solution (hint: thermal energy networks and GHPs)
- We need to mandate the least cost solution and by adequately compensating merchant suppliers for the value they provide.
- We can value thermal energy resources like we value power generation, transmission, and local distribution efforts to expand the grid. In kW!
- We can unlock a market for thermal energy suppliers (hint: NY-GEO members!) by demanding an open access common carrier regulatory framework.

Grid of the Future
24-00541/24 -E-0165

Utility Thermal Energy Networks and Jobs Act
22-01458/22 -M-0429

Utility Thermal Energy Networks and Jobs Act 22-01458/22-M-0429

Questions?

Grid of the Future
24-00541/24-E-0165

EMERGENT URBAN CONCEPTS

Thank You!

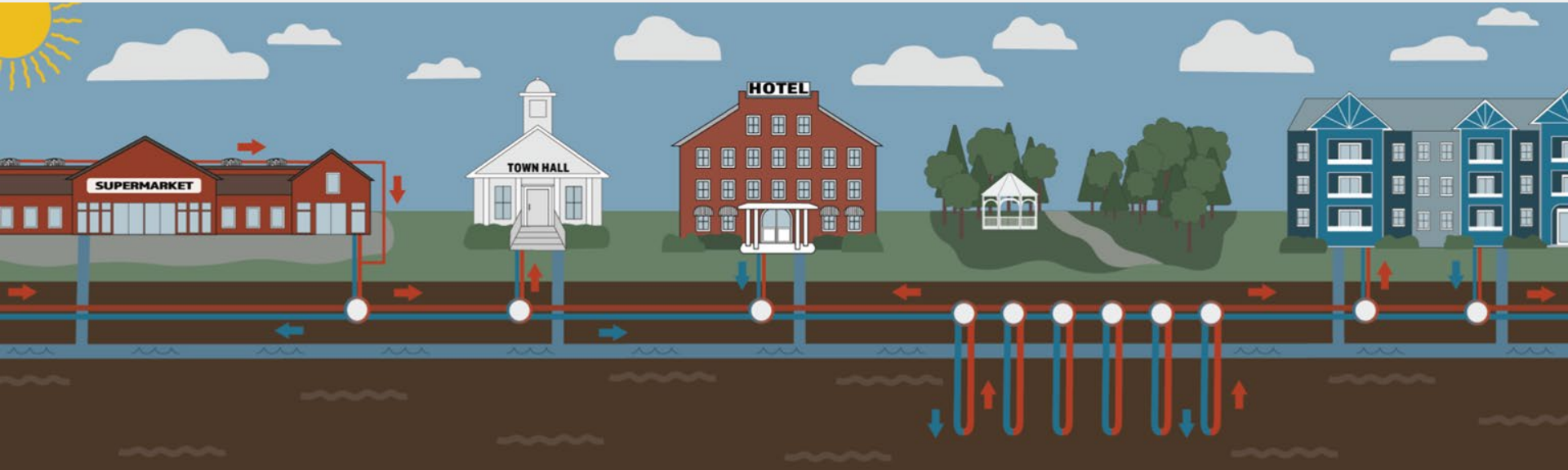
References, Resources, and Special Thanks:

Building Decarbonization Coalition (BDC): www.bdc.org “Neighborhood-scale Decarbonization” and policy tracker
Building Electrification Institute (BEI): www.beicities.org
Home Energy Efficiency Team (HEET): www.heet.org
New York State Energy Research and Development Authority (NYSERDA): www.nyserda.gov
Pace University Energy and Climate Center, Elizabeth Haub School of Law: www.energy.pace.edu
Vermont Community Thermal Networks (VCTN): http://www.vctn.org
CHA Consulting, Inc.: https://www.chasolutions.com/projects/community-heat-pump-geothermal-system-design-and-implementation/

EMERGENT URBAN CONCEPTS

Community-driven Thermal Energy Networks

- ★ Place-based
- Local goals & needs
- Multiple pathways



Potential Community Thermal Energy Networks

commercial bakery + factory + housing + health center

grocery store + hotel + brewery + bank

town hall + ice arena + housing + church

industrial park + school + theater

wastewater treatment plant + manufacturing

How to Develop a Thermal Energy Network

A practical guide to adding Thermal Energy Networks to decarbonization plans for your community

vctn.org/toolkit

START HERE

IDENTIFY OPPORTUNITIES

UNDERSTAND OWNERSHIP

DEVELOP YOUR PROJECT

1. START HERE

Identifying the right time and place to develop a Thermal Energy Network (TEN) is key to a successful project. Learning from experts, talking with stakeholders, and bringing your community along can be as important as the design of the system itself. There are multiple benefits of adding a TEN and many ways to involve others in building a neighborhood-scale thermal solution.

▶ **LEARN MORE:** *Where and When a TEN Makes Sense*

ACTIONS

- Watch and share this short video: tiny.cc/tens-video.
- Use the TEN Opportunities Chart to look for good local conditions and collect ideas.

WORKSHEET

- Thermal Energy Network Opportunities Chart

▶ **SUPPORTING MATERIALS** *(p. 32–35)*

- Fact Sheet: The Basics: Thermal Energy Networks
- Fact Sheet: The Benefits of Thermal Energy Networks
- Fact Sheet: How Thermal Energy Networks are Key to Successful Electrification

Thermal Energy Network Opportunities Chart

Jumpstart your thinking on where and when to build a Thermal Energy Network (TEN) by using this chart to consider which local conditions could be opportunities for a TEN.

Any one of these conditions can be a good reason to consider a TEN. The more you find, the more broadly you can think about implementing a larger network by creating TEN nodes and connecting new areas over time.

Local Conditions	YES	NO	Notes
Is your community updating or intending to update its energy plan, comprehensive plan, or zoning code?	☐	☐	
Does your community have a wastewater treatment plant?	☐	☐	
Will the wastewater treatment plant require repair or replacement over the next 5-10 years?	☐	☐	
Is the wastewater treatment plant within ¼ mile of other buildings?	☐	☐	
Are capital investments in the sanitary sewer system needed within the next 5-10 years?	☐	☐	
Does your community have a potable water system?	☐	☐	
Are capital investments for the water system needed in the next 5-10 years?	☐	☐	
If your community doesn't have a potable water system, are there plans to construct one within the next 5-10 years?	☐	☐	
Are street openings planned for other infrastructure work?	☐	☐	
Are new buildings, mixed-use, or housing developments in the early stages of planning?	☐	☐	
Does your community have access to open land that could contain a geothermal borefield? *(e.g. recreation fields, parking areas, or green space that could be drilled, then replanted or repaved)*	☐	☐	
Does your community include potential thermal energy resources?	☐	☐	
Buildings with large refrigeration or cooling systems? *(e.g. ice arena, grocery store, cold storage, office cooling, data center)*	☐	☐	
Food or beverage manufacturing? *(e.g. brewery/distillery, drying processes, canning, bakery)*	☐	☐	
Other industrial facilities that likely produce waste heat or significant volumes of wastewater?	☐	☐	
Bodies of water that could be thermal reservoirs, providing and/or accepting thermal heat? *(e.g. rivers, lakes, ponds, reservoirs, quarry/mine)*	☐	☐	
Local or regional electric distribution system interconnections or substations?	☐	☐	

For a more detailed chart and next steps, go to *How to Get a Head Start on a TEN*.

2. IDENTIFY OPPORTUNITIES

Whether or not you're ready to launch a Thermal Energy Network (TEN) now, you can lay the groundwork for an effective process and a successful project. To get a head start on a TEN, it helps to know your buildings and local thermal energy resources, to integrate TENs into local and regional plans, and to upgrade systems in need of replacement with a TEN in mind.

▶ **LEARN MORE:** ***How to Get a Head Start on a TEN***

ACTIONS

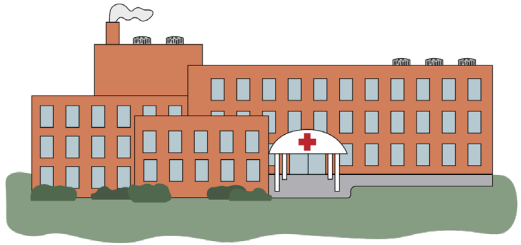
- Inventory local thermal energy resources.
- Inventory potential TEN buildings.
- Identify opportunities to tie in to upcoming developments.

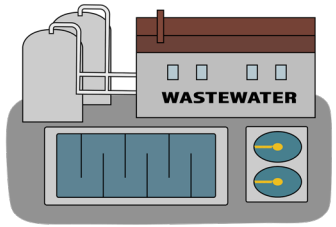
RESOURCES

- Site Selection for a Thermal Energy Network
- Site Selection Factors to Consider

▶ **SUPPORTING MATERIALS** *(p. 36–44)*

- Fact Sheet: Moving Heat
- Fact Sheet: Energy from Wastewater
- Worksheet: Site Selection Chart





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▶ **LEARN MORE:** ***How to Get a Head Start on a TEN***

ACTIONS

- Inventory local thermal energy resources.
- Inventory potential TEN buildings.
- Identify opportunities to tie in to upcoming developments.

RESOURCES

- Site Selection for a Thermal Energy Network
- Site Selection Factors to Consider

▶ **SUPPORTING MATERIALS** *(p. 36–44)*

- Fact Sheet: Moving Heat
- Fact Sheet: Energy from Wastewater
- Worksheet: Site Selection Chart

1. Inventory thermal energy resources.

2. Inventory potential TEN buildings.

3. Create a simple map.

4. Identify upcoming development projects.

5. Add TENs to local and regional plans.

6. Retrofit buildings along a potential TEN route.

3. UNDERSTAND OWNERSHIP

There are many ways to own and operate a Thermal Energy Network (TEN). Different kinds of ownership determine how a project can be financed. Weighing the advantages and challenges of a few common ownership models can help identify which approach is most beneficial for your project.

▶ **LEARN MORE:** ***Which Ownership Model?***

ACTIONS

- Explore ownership models and for-profit, low-profit, or non-profit business models that may fit your community or project.
- Identify related financing and incentive opportunities from the Inflation Reduction Act and other sources.

▶ **SUPPORTING MATERIALS** *(p. 45–62)*

- Financing a Thermal Energy Network
- IRA Incentives for Thermal Energy Networks
- Deeper Dive: Ownership Guide for Thermal Energy Networks

Cooperative

Municipal

Third-Party

ADVANTAGES

CHALLENGES

QUESTIONS TO CONSIDER

FINANCING OPPORTUNITIES

4. DEVELOP YOUR PROJECT

As with any infrastructure project, implementing a Thermal Energy Network (TEN) depends on good planning, communication, and coordination throughout the process. A core team that understands each phase, maintains stakeholder and community engagement, and can envision the process as a whole can help to build a successful project.

▶ **LEARN MORE:** *What Does a TEN Project Look Like?*

ACTIONS

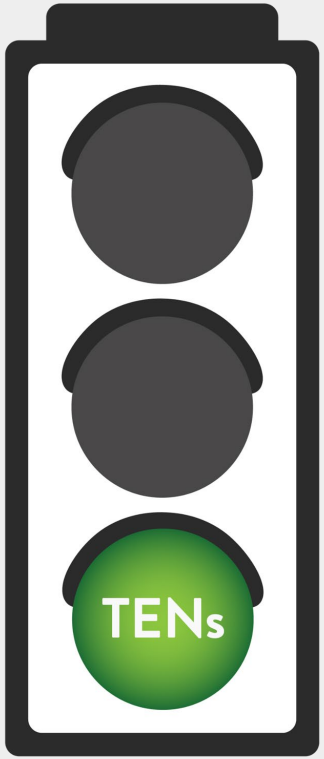
- Assemble a working group to sketch out a project.
- Identify a core project team.
- Create an initial plan for your project.

▶ **SUPPORTING MATERIALS** *(p. 63–79)*

- Worksheet: Project Phases Chart
- Deeper Dive: Project Phases for a Thermal Energy Network

1. Exploration
2. Planning
3. Design & Permitting
4. Construction
5. Operations

MAY 30, 2024



Vermont's Thermal Energy Networks Act

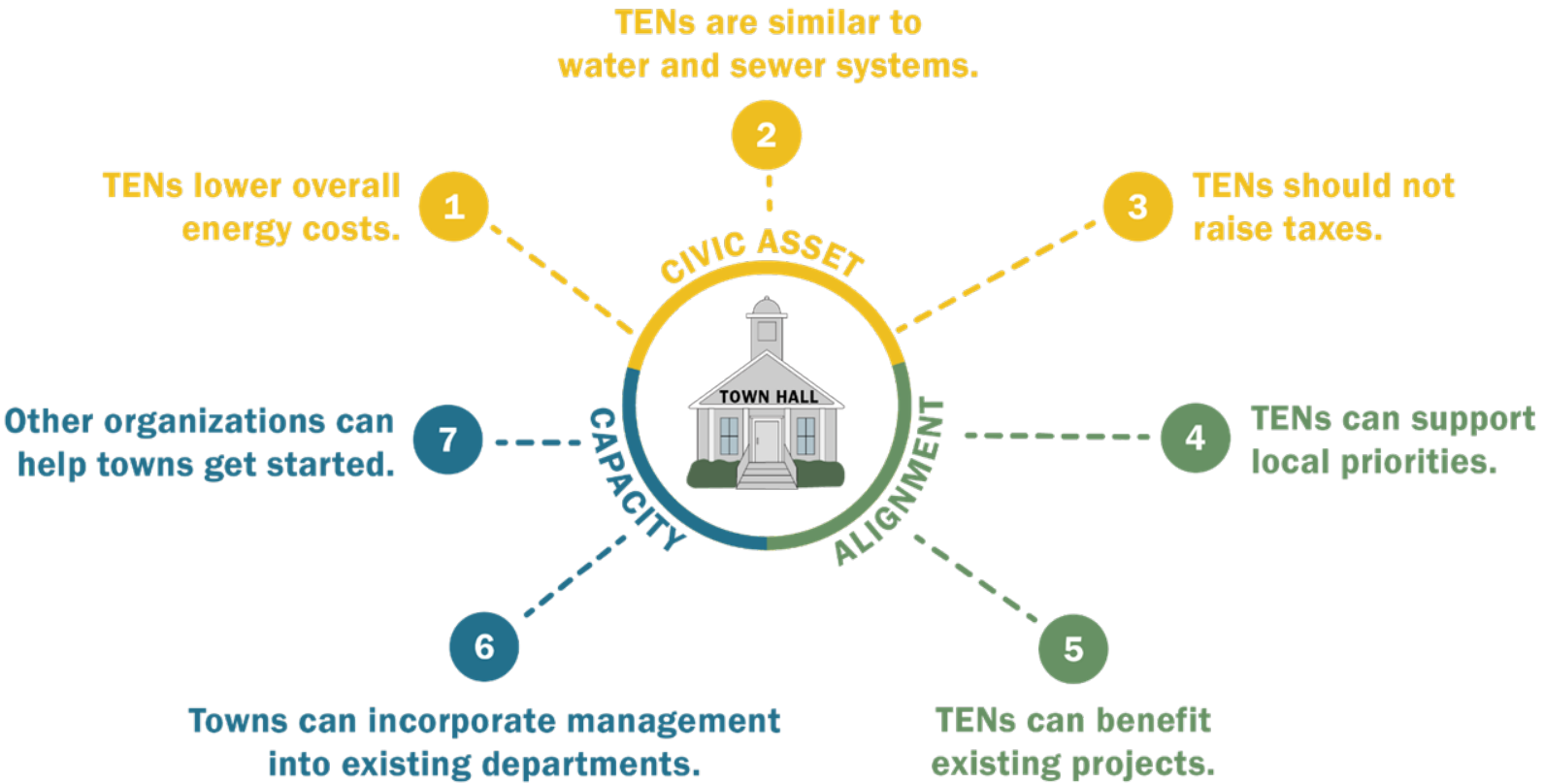
A green light for local heating & cooling solutions

- **All municipalities can build Thermal Energy Networks and establish thermal energy utilities without Public Utility Commission approval or regulation**, just as municipal water and sewer utilities operate under local control.

- **Campuses, condominiums, cooperatives, and landlords** can already provide a Thermal Energy Network on their properties.

- ❑ What's already happening?
- ❑ Where could this work?
- ❑ Who's needed?

GOAL: Identify an approach that's acceptable locally


TENs are similar to water and sewer systems.
2
TENs lower overall energy costs.
1
TENs should not raise taxes.
3
CIVIC ASSET
TOWN HALL
CAPACITY
ALIGNMENT
Other organizations can help towns get started.
7
4
TENs can support local priorities.
6
5
Towns can incorporate management into existing departments.
TENs can benefit existing projects.

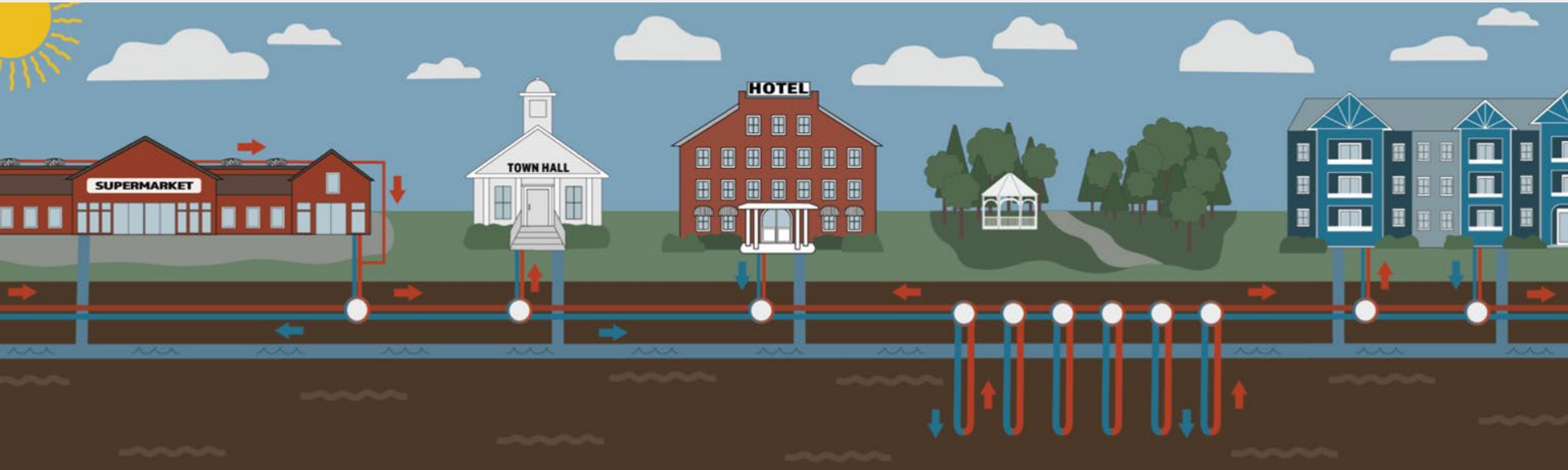
“The technology is straightforward and well -established. Small groups of people can actually do this. It’s achievable.”

“I like that we’re not just replicating something pre -packaged. We’re asking questions, we’re learning, and we’re implementing it ourselves, so people are more receptive. Our town has agency.”

Community-driven Thermal Energy Networks

- ★ Place-based
- □ Local goals & needs
- □ Multiple pathways

vctn.org/toolkit



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GAS to GEO

We never take money from industry, gas or geo. We're funded by generous individuals and foundations:

Thank you NY-GEO

MASSACHUSETTS CLEAN ENERGY CENTER

PIVOT

CEDAR TREE FOUNDATION

Barr Foundation

E4 THE FUTURE

ENERGY FOUNDATION

heet

GAS to GEO

Kickstart Massachusetts

Unlocking local data for informed decisions

Funded by:

MASSACHUSETTS CLEAN ENERGY CENTER

Kickstart MA

8 communities received up to $50,000 to conduct initial feasibility studies

4 communities received up to $10,000 to conduct community engagement

Kickstart Mass is a funding opportunity for Massachusetts cities and towns to conduct **initial feasibility studies** to assess potential sites for networked geothermal, a clean, renewable, non-combusting way to heat and cool our homes and businesses.

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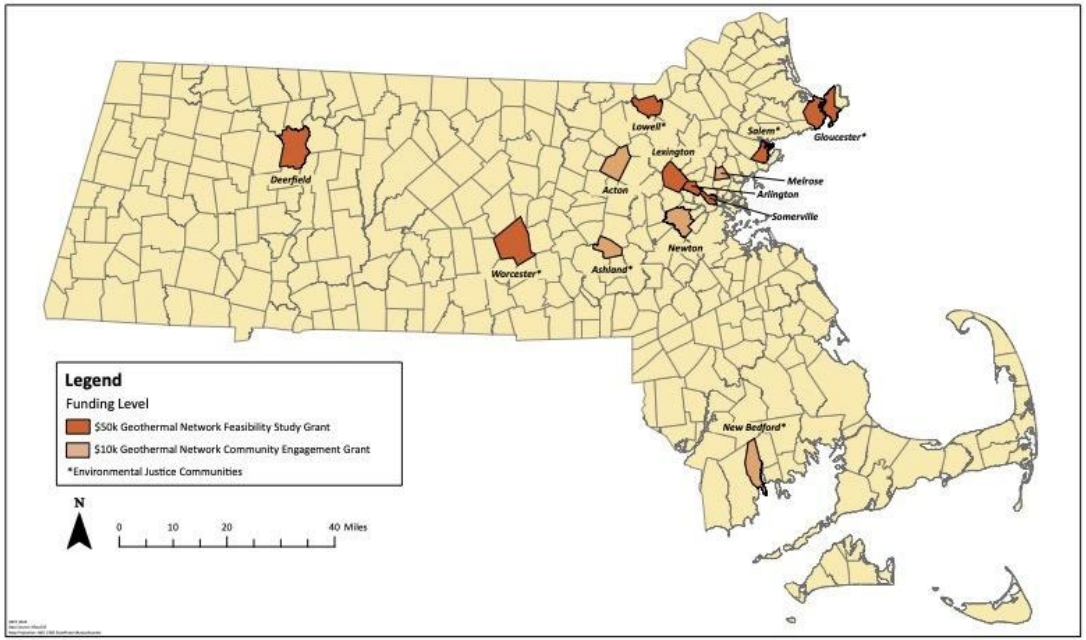
Kickstart MA Awardees



Applicants included:

- ❑ Sustainability Orgs.
- ❑ Municipalities
- ❑ Faith Leaders
- ❑ Development Corps.

Diverse applications:

- ❑ Affordable Housing
- ❑ Industrial Campus
- ❑ Life Sciences Buildings
- ❑ Social Programs Buildings
- ❑ Rural Municipal Campus

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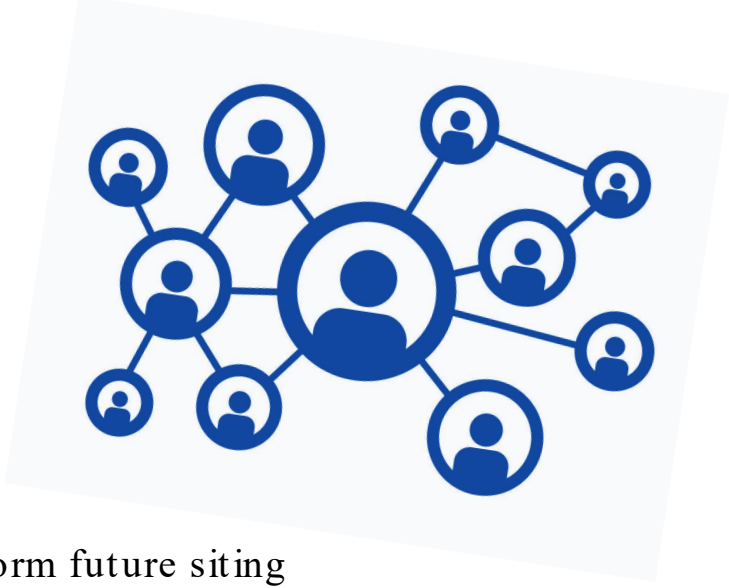
Goals



Support the transition beyond gas by developing a pipeline of shovel-ready geothermal energy network projects that:

- Launch local project nodes to build visibility and inform future siting
- Unlock local data to support decision-making
- Lay the groundwork for smart utility policy and regulation, and equitable implementation

heet

Barriers

Policy & regulatory hurdles remain a challenge to non-geothermal expert stakeholders

There is perceived risk of regulatory hurdles demonstrating the need for state-level alignment to support geothermal deployment.

Expectations and Requirements

Tier 1 - $10,000 grants

Acton, Ashland, Melrose, Newton, New Bedford

1. **Conduct** robust community engagement to both educate and elicit feedback about the opportunities and concerns
2. **Listen** for motivations, opportunities and synergies
3. **Capture** feedback, learnings, partnerships and willing participants
4. **Conduct** a geological review
5. **Identify** at least one site for a feasibility study

Tier 2 - $50,000 grants*

Arlington, Deerfield, Gloucester, Lexington, Lowell, Salem, Somerville, Worcester

1. **Narrow down** to a single site
2. **Analyze** site selection
3. **Deepen** geological review
4. **Survey** thermal sources
5. **Survey** buildings
6. **Energy modeling**
7. **Identify** synergies with parallel investments
8. **Conduct** a regulatory review
9. **Produce** a feasibility study report that indicates fitness

ment

* All Tier 1 requirements should also be completed

heet

Results

Regulatory Setting

REGIONAL ENVIRONMENTAL CONDITIONS

The following observations are based on the MassMapper on-line database and a MassDEP Bureau of Waste Site Cleanup Phase 1 Site Assessment Map (Attachment 1):

1. The site is located within medium- and high-yield aquifers; however, the aquifers are denoted as "Non-Potential Drinking Water Source Areas," which should not pose regulatory limitations to developing GSHE at the site.
2. There are no landfills, Interim Wellhead Protection Areas (IWPAs), or Zone II water resource protection districts within 0.5 mile of the potential borefield(s).
3. The proposed borefield areas (Figure 1) are not within a mapped wetland and are not within a 100-ft buffer zone of the closest mapped wetlands, which are roughly 200 ft east of the northern portion of the proposed borefield(s).
4. The project area is not within an Area of Critical Environmental Concern (ACEC).

SITE ENVIRONMENTAL CONDITIONS

A soil and groundwater characterization program previously performed by Beta identified concentrations exceeding Massachusetts Contingency Plan (MCP) Reportable Concentrations for Soil Category 1 (RCS-1) standards.

Releases at the site have previously been identified and reported to MassDEP. The releases judged to be relevant to potential drilling at the site are summarized below.

Release Tracking Number (RTN) 2-22147
RTN 2-22147 is associated with Light Non-Aqueous Phase Liquid (LNAPL) encountered in the subsurface beneath the hydraulic pump room of Building 417. The currently understood extents of the LNAPL

RTN 2-22145
RTN 2-22145 is associated with trichloroethene (TCE) in groundwater and lead in soil within the existing 400-series building block. The currently understood extents of the release in soil and groundwater are shown on Figure 1. Additional subsurface assessment and evaluation of remedial response alternatives is anticipated within the next two years.

RTN 2-21014
RTN 2-21014 is associated with LNAPL in the general vicinity of the former location of multiple above-ground storage tanks (ASTs). The currently understood extents of the release in soil and groundwater are shown on Figure 1. IRA activities, including monitoring the nature and extent of the LNAPL, are ongoing.

RTN 2-20461
RTN 2-20461 is associated with a sheen that was observed in Weasel Brook in March 2018, that was associated with a leaking pipe previously used to transport fuel oil #2. The discovery of LNAPL in a nearby monitoring well was later added to the RTN. The leaking pipe was repaired and the LNAPL was determined to have micro-scale mobility. The release was therefore determined to be eligible for closure with a Permanent Solution with Conditions including an Activity and Use Limitation (AUL), which was submitted to MassDEP in December 2021. Uses inconsistent with the AUL include the uncontrolled excavation of soils greater than 5 ft bgs without proper management and supervision by a Licensed Site Professional (LSP), and use of groundwater for potable or non-potable uses.

RTN 2-22149
RTN 2-22149 is associated with semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), volatile petroleum hydrocarbons (VPH), and arsenic found in soils across the site during various exploration programs from 2015 to 2023, that were attributed to historical industrial manufacturing activities and the use/storage of chemicals at the site. Impacted soil was found at depths up to 20 ft across the site. A Phase II Comprehensive Site Assessment or Permanent Solution Statement is anticipated to be submitted for the release by November 2026.

If borefield drilling is completed near the reported groundwater releases (RTNs 2-22147, 2-22145, 2-21014, or 2-20461), groundwater management during the drilling program must consider the extent of the plume, the likely concentrations that may be encountered, health and safety measures to prevent or minimize the drill-rig operators' contact with the water, and treatment requirements to comply with permit discharge limits established by U.S. Environmental Protection Agency (EPA) through the National Pollution Discharge Elimination System (NPDES), the local public-owned treatment works (POTW) if discharge is to a sanitary or combined sewer, or other regulatory entities.

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PERMITTING

Approvals, permits, and registrations that will likely be required for construction and operation of a closed-loop GSHE borefield include:

- **NPDES Dewatering and Remediation General Permit (DRGP) (Federal and Local):** Based on a review of the existing conditions plan provided to us (BETA, 2020), storm drainage and sanitary sewerage appear to run separately along C Street, which runs north-south through the center of the site. If inflows from drilling are greater than the recharge capacity of the site soils, off-site discharge will be necessary to manage drill water and maintain schedule. Generally, it is prudent to obtain an off-site discharge permit prior to beginning borefield construction, to accommodate higher inflows; rates typically vary widely from borehole to borehole.

  Discharge of drill water to a storm drain would require a NPDES DRGP. The DRGP program has specific monitoring requirements and water quality discharge standards that dictate the treatment system sizing and design. Treatment systems for water generated during air-rotary drilling typically include a combination of sedimentation, filtration, and chemical settling by flocculants and/or coagulants. Alternatively, if a NPDES Construction Dewatering General Permit (CGP) is obtained for the project to manage construction dewatering and stormwater, the drill water can be managed under the NPDES CGP.

  Following approval of the NPDES permit, the City of Worcester's Department of Public Work requests a copy of the NPDES permit and water management plan be provided prior to discharge.

- **Underground Injection Control (UIC) (Federal and State):** GSHE closed loops are exempt from the MassDEP UIC registration requirement, provided they adhere to "Guidelines for Ground Source Heat Pump Wells" (MassDEP, 2013); however, geothermal systems must comply with EPA Class V guidelines and UIC regulations. The minimum setback distances from closed loops to water or sewer lines is 10 ft, per UIC regulations. During future design phases, it is important to check this criterion based on proposed utility alignments.
- **Well Permitting (Local):** The City of Worcester does not require a well permit for GSHE drilling.
- **Well Registration (State):** Each GSHE borehole must be registered through the state's on-line program for Water Well Completion Reports. This is a requirement for Massachusetts-registered well drillers.

Resources

- ➔ Portfolio of Feasibility studies in HEET Library
  - ◆ *everything HEET does is open source*
- ➔ Gas to Geo Wiki – open learning platform
- ➔ Gas to Geo Resource Hub: https://www.heet.org/gas -to-geo-transition

Insights

Community trust is foundational –

Across all sites, early engagement with municipal leaders and residents significantly impacted project momentum. Clear, transparent communication about short -term and long -term impacts is critical.

Case Study: Eversource Pilot Community Engagement

Engaged with all stakeholder groups including; *municipal officials, residents, businesses, schools, and community groups*

Utilized multiple engagement strategies; *municipal briefings, direct mailings, on-site and virtual meetings, door-to-door outreach, host "office hours" and participation in community events*

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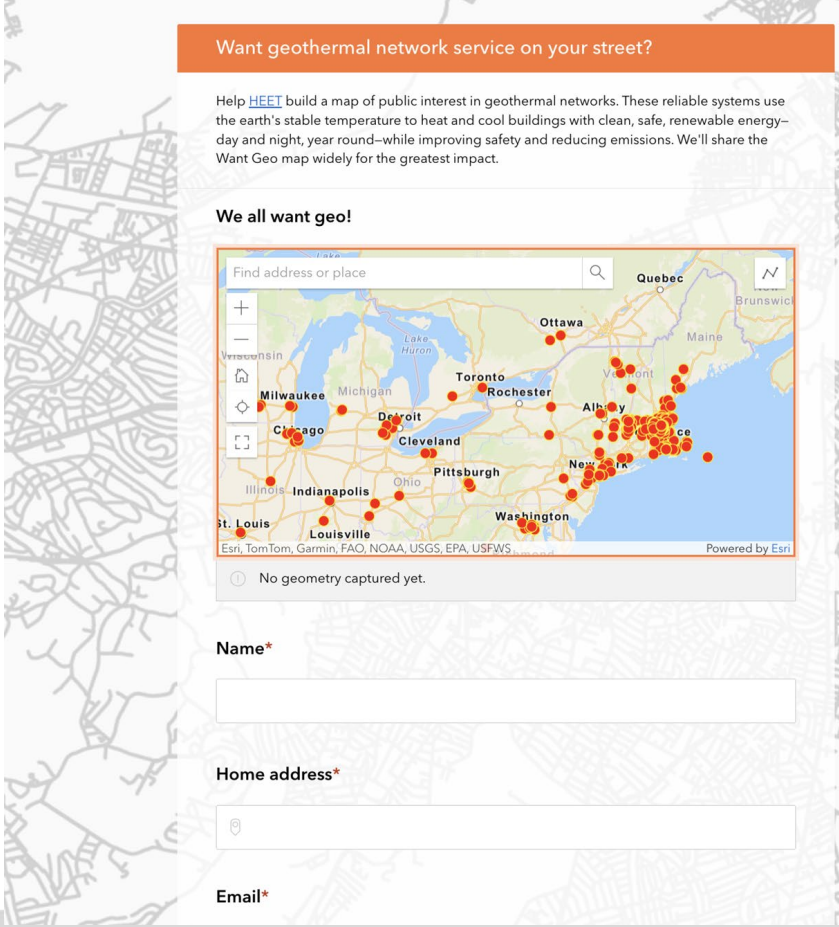
Result: Pilot recruited 37 buildings (32 residential, 5 commercial), a total of 140 customers.

About 80% of residential homes in the pilot area opted to participate and there was more interest from homes outside of the pilot area.

Resources

- ➔ Want Geo? map to visualize demand
- ➔ Gas to Geo Toolkit
  - ◆ Community engagement tools
  - ◆ FAQs for residents & businesses
  - ◆ Site Selection Tools
  - ◆ RFP Template
- ➔ MIT Renewable Energy Clinic



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MASSACHUSETTS CLEAN ENERGY CENTER

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ENERGY FOUNDATION

Thermal Energy Network Tools & Resources

Speakers: Ania Camargo Cortés / *Building Decarbonization Coalition*
Angie Alberto Escobar / *HEET*
Jared Rodriguez / *Emergent Urban Concepts*
Debbie New / *Vermont Community Thermal Networks*