Networked Geothermal Pilot Projects in Massachusetts, New York and (maybe someday) Connecticut

Peter Millman
People's Action for Clean Energy
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People's Action for Clean Energy

Beyond Gas CT

- Conservation Law Foundation
- Save the Sound
- Sierra Club
- Acadia Center
- People’s Action for Clean Energy
- Connecticut Citizen Action Group

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NEWS NORTHEAST

Innovative geothermal micro-district concept moves ahead in Massachusetts

Screenshot

Utilities could prove useful partners in the projects, which involve drilling, trenching and laying pipe to bring underground heat into buildings.

ENERGY

Massachusetts Pilot Project Offers Gas Utilities a Possible Path to Survival

Utility Eversource is partnering on Boston-area district geothermal pilots as the state contemplates a gas-free future for buildings.

JUSTIN GERDES | AUGUST 06, 2020

2

Energy Source Used for Home Heating (share of households)	Connecticut	New York	Rhode Island	Massachusetts	Period
Natural Gas	36.3 %	60.7 %	55.3 %	52.3 %	2019
Fuel Oil	38.9 %	18.7 %	28.6 %	24.4 %	2019
Electricity	17.3 %	12.2 %	10.3 %	16.9 %	2019
Propane	4.9 %	4.3 %	3.6 %	3.7 %	2019
Other/None	2.7 %	4.1 %	2.3 %	2.7 %	2019

NOTE: Does not include commercial buildings!

Source: EIA

menu

FUTURE OF GAS | Future of Gas Overview

Screenshot

On October 29, 2020, the Massachusetts Department of Public Utilities (DPU) issued an order opening an investigation into the role of local natural gas distribution companies (LDCs) in the Commonwealth's goal to achieve net zero greenhouse gas emissions by 2050. As part of this effort, LDCs will prepare a report and solicit stakeholder feedback as a means to safeguard customer interests and se afe, reliable

close

Related Resources

- Massachusetts 2050 Decarbonization Roadmap ↗
- The Massachusetts Interim Clean Energy and Climate Plan for 2030 ↗
- MDPU 20-80 Docket ↗
- US Energy Information Administration FAQs ↗

Mass.gov

Search Mass.gov SEARCH

Commission on Clean Heat

Screenshot

Governor Charlie Baker has signed Executive Order No. 596, establishing the Commission on Clean Heat in the Commonwealth to advise the Baker-Polito Administration on a framework for long-term greenhouse gas emission reductions from heating fuels.

The Commission will explore options to accelerate the deployment of energy efficiency programs and clean heating systems in new and existing buildings and transition existing distribution systems to clean energy. This work will be conducted in accordance with the 2050 Decarbonization Roadmap and will consider financing mechanisms, incentives, and other regulatory options, including a framework for a cap on greenhouse gas emissions from heating

Feedback

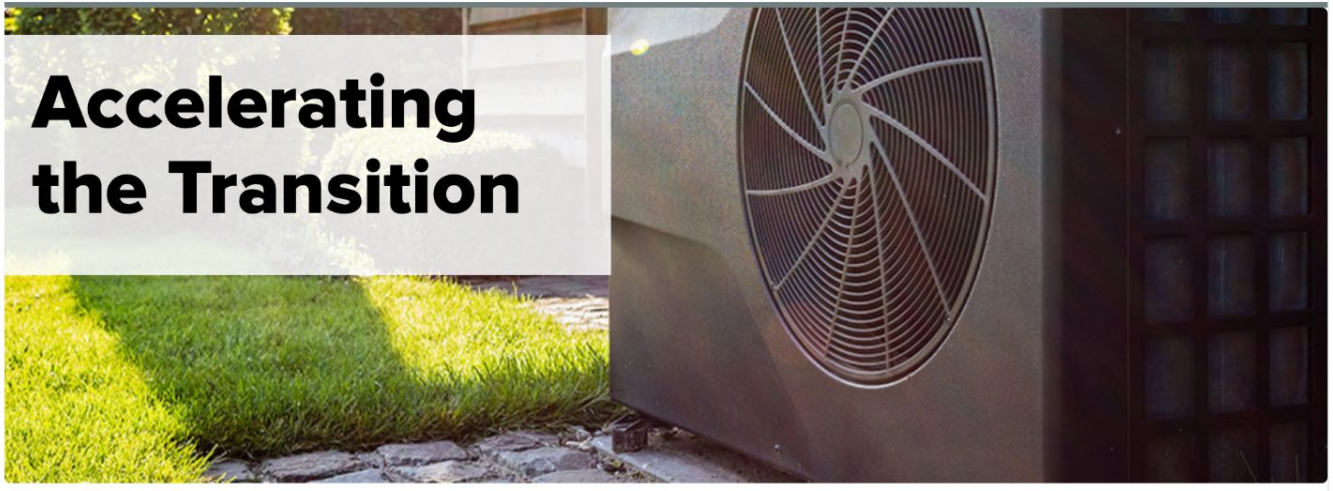
Heating Sector Transformation in Rhode Island

Pathways to Decarbonization by 2050

PREPARED FOR

Rhode Island Division of Public Utilities and Carriers

Rhode Island Office of Energy Resources

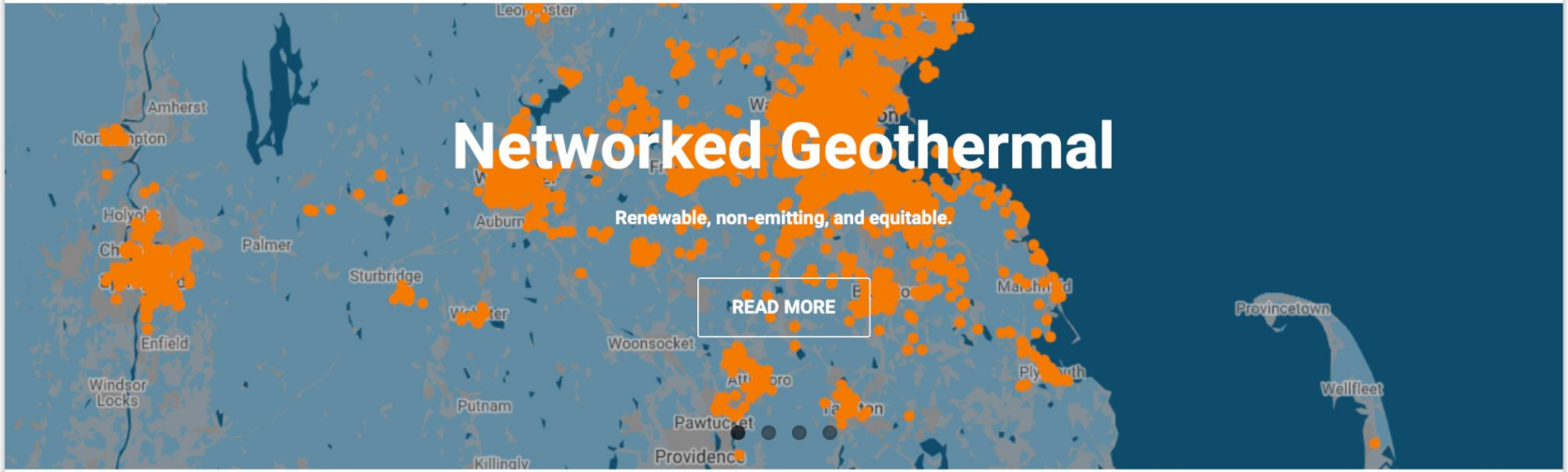


BACK TO HOME PAGE

From Natural Gas to a Low-Carbon Future: Leading a Phased and Just Transition Off Fossil Fuels

To achieve New York's climate goals, we're working to move

	Feasibility Studies	Approved Installation(s)	Legislation
DC	Yes	Yes ($5 million)	
Maryland			Geothermal Heating & Cooling Systems (H.1007)
Oregon	Yes		
Minnesota	Yes		Natural Gas Innovation Act (216B.2427)
New York	38 studies	2	Utility Thermal Energy Network & Jobs Act (S.9422)
Philadelphia	Yes ($500k)		City approval
Vermont	Yes		
Federal			Being proposed (stay tuned)



Networked Geothermal

Renewable, non-emitting, and equitable.

READ MORE

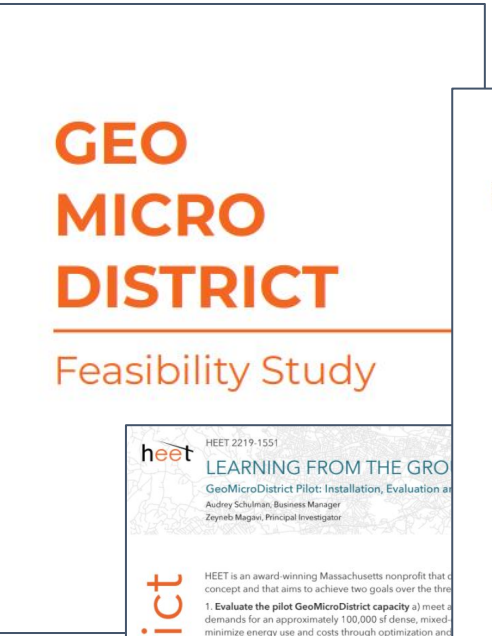
Mission: To cut carbon emissions NOW by driving systems change.

Latest Updates

MA Makes Strides Towards Clean Thermal Energy Policy

Exciting legislation and regulations are moving forward in Massachusetts that have the potential to significantly help the state meet its emission reduction mandates, reduce building carbon footprints, and create thermal utilities that can

Research


GEO
MICRO
DISTRICT
Feasibility Study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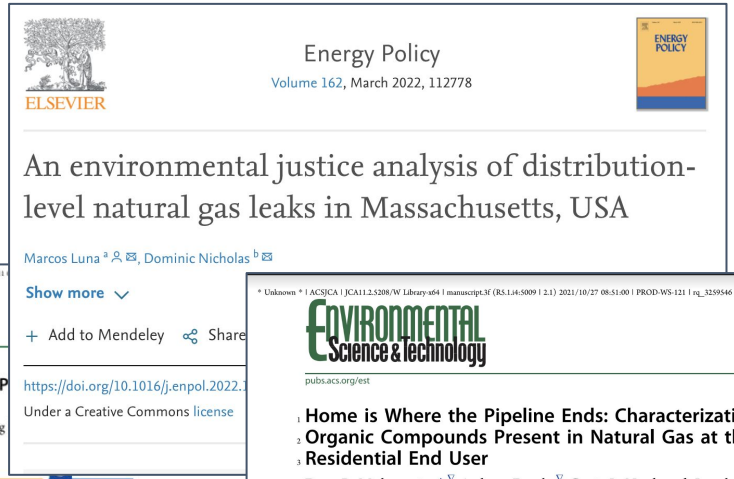
Significant Environmental Impact (SEI)
Natural Gas Leaks
Shared Action Plan Year 1 (2019/2020)
Utilities Enacting the Lea
April 27th 202


ELSEVIER
Energy Policy
Volume 162, March 2022, 112778
ENERGY POLICY
An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, USA
Marcos Luna [a], Dominic Nicholas [b]
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https://doi.org/10.1016/j.enpol.2022.
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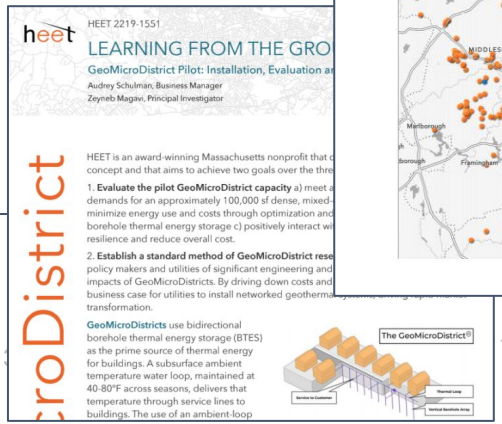
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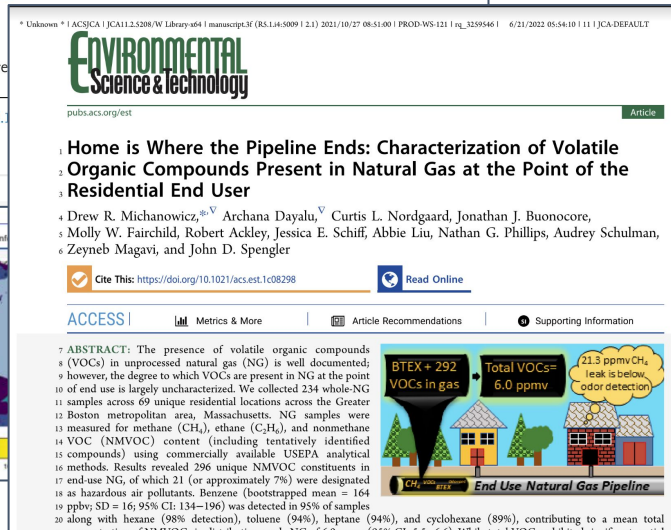
HEET 2219-1551
LEARNING FROM THE GRO
GeoMicroDistrict Pilot: Installation, Evaluation a
Audrey Schulman, Business Manager
Zeyneb Magavi, Principal Investigator
HEET is an award-winning Massachusetts nonprofit that
concept and that aims to achieve two goals over the thre
1. Evaluate the pilot GeoMicroDistrict capacity a) meet
demands for an approximately 100,000 sf dense, mixed-
minimize energy use and costs through optimization and
borehole thermal energy storage c) positively interact wi
resilience and reduce overall cost.
2. Establish a standard method of GeoMicroDistrict rese
policy makers and utilities of significant engineering and
impacts of GeoMicroDistricts. By driving down costs and
business case for utilities to install networked geotherma
transformation.
GeoMicroDistricts use bidirectional borehole thermal energy storage (BTES) as the prime source of thermal energy for buildings. A subsurface ambient temperature water loop, maintained at 40-80°F across seasons, delivers that temperature through service lines to buildings. The use of an ambient-loop
The GeoMicroDistrict


ENVIRONMENTAL Science & Technology
pubs.acs.org/est
Repair Failures Call for New P
Distribution Systems
Morgan R. Edwards,* Amanda Giang, Gregg
Robert Ackley, and Audrey Schulman
Cite This: https://doi.org/10.1021/acs.est.0c07531
ACCESS | Metrics & More | Article Recommendations | Supporting Inf
Failure Rate %


ENVIRONMENTAL Science & Technology
pubs.acs.org/est
Article
Home is Where the Pipeline Ends: Characterization of Volatile Organic Compounds Present in Natural Gas at the Point of the Residential End User
Drew R. Michanowicz,*[,V] Archana Dayalu,[V] Curtis L. Nordgaard, Jonathan J. Buonocore, Molly W. Fairchild, Robert Ackley, Jessica E. Schiff, Abbie Liu, Nathan G. Phillips, Audrey Schulman, Zeyneb Magavi, and John D. Spengler
Cite This: https://doi.org/10.1021/acs.est.1c08298
Read Online
ACCESS | Metrics & More | Article Recommendations | Supporting Information
ABSTRACT: The presence of volatile organic compounds (VOCs) in unprocessed natural gas (NG) is well documented; however, the degree to which VOCs are present in NG at the point of end use is largely uncharacterized. We collected 234 whole-NG samples across 69 unique residential locations across the Greater Boston metropolitan area, Massachusetts. NG samples were measured for methane (CH_4), ethane (C_2H_6), and nonmethane VOC (NMVOC) content (including tentatively identified compounds) using commercially available USEPA analytical methods. Results revealed 296 unique NMVOC constituents in end-use NG, of which 21 (or approximately 7%) were designated as hazardous air pollutants. Benzene (bootstrapped mean = 164 ppbv; SD = 16; 95% CI: 134−196) was detected in 95% of samples along with hexane (98% detection), toluene (94%), heptane (94%), and cyclohexane (89%), contributing to a mean total
BTEX + 292 VOCs in gas
Total VOCs= 6.0 ppmv
21.3 ppmv CH_4 leak is below odor detection
End Use Natural Gas Pipeline

Community Activist

Utility Executive

Steelworkers Union Leader

MIT academic

Networked Leadership

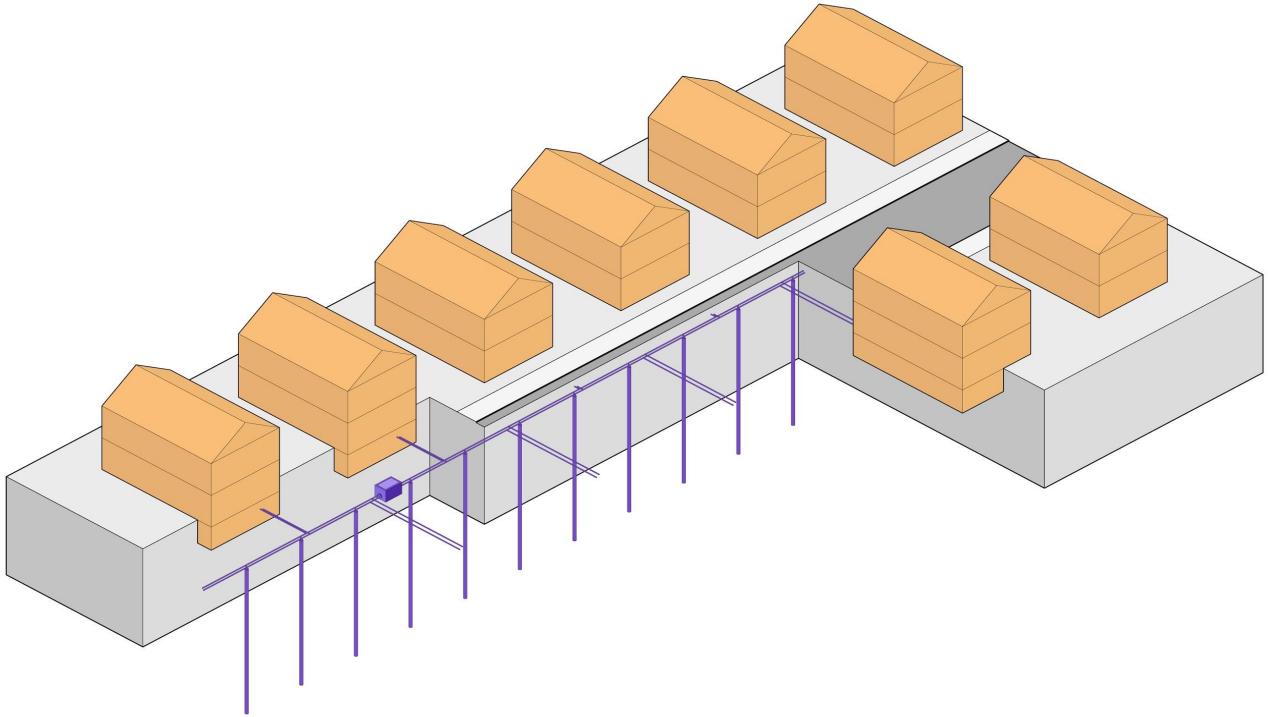
State Regulator

Geothermal Expert

Governor's Office

"Gas is the Bridge Fuel" originator

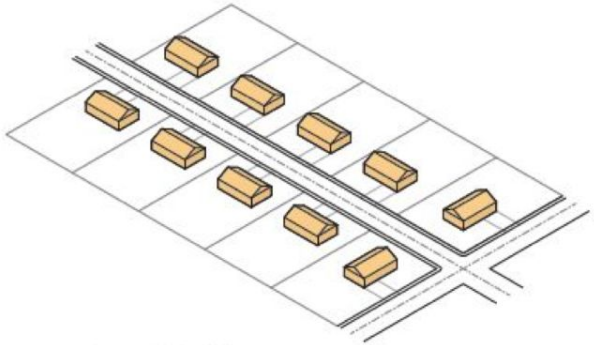
HEET's GeoNet (AKA GeoGrid, GeoMicroDistrict, etc.)



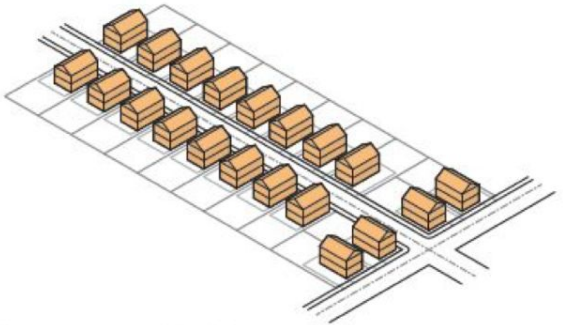
BUROHAPPOLD ENGINEERING heet

Prototype Street Segments

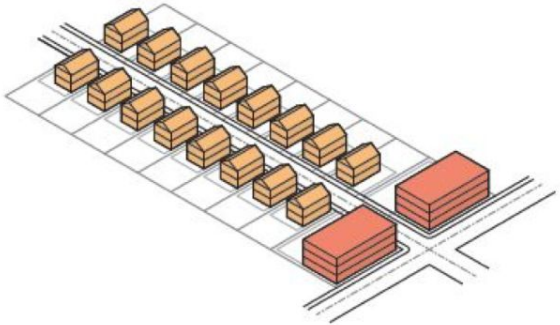
Four prototype street segments created and analyzed are:



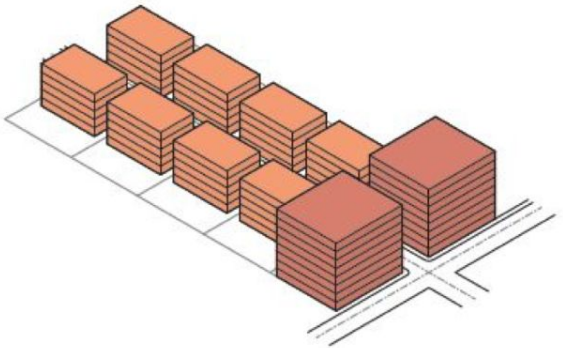
Low density residential



Medium density residential



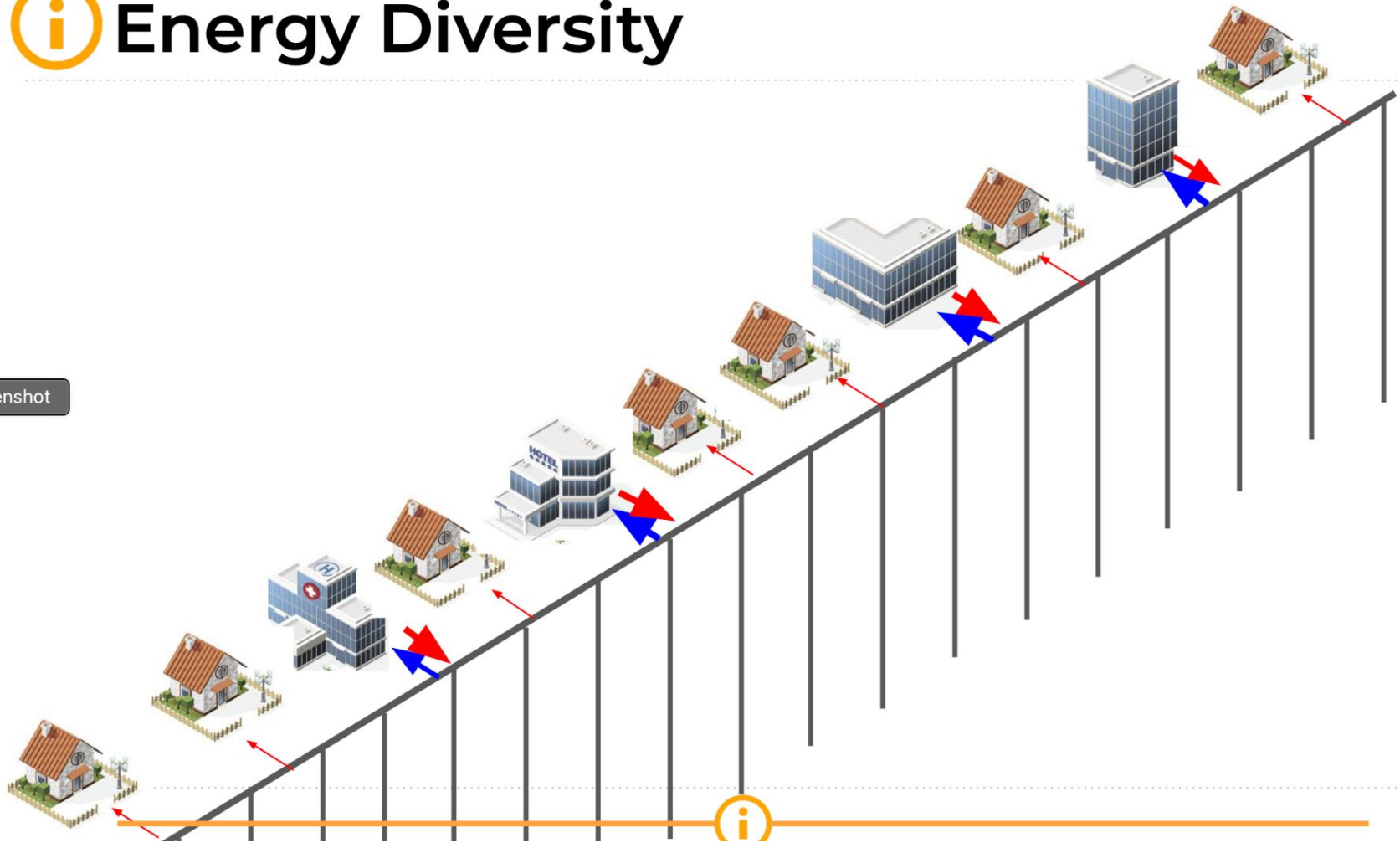
Medium density mixed-use



High density mixed-use

Screenshot

Energy Diversity



Screenshot

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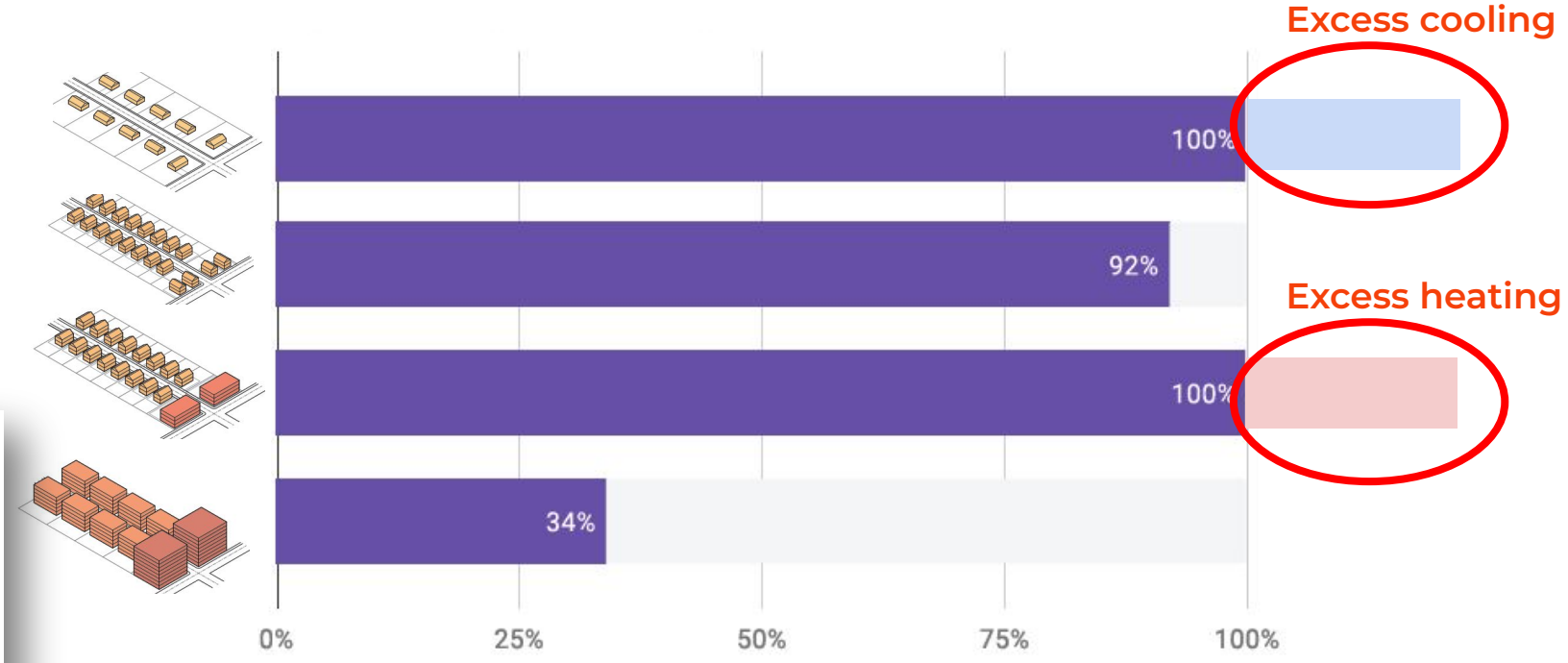
Technical Feasibility (by street segment)

Ability to meet energy demand through ‘shallow’ boreholes in the street only



GEO MICRO DISTRICT

Feasibility Study

heet BUROHAPPOLD ENGINEERING

GeoMicroDistrict Feasibility Study, Buro Happold Engineering, 2019

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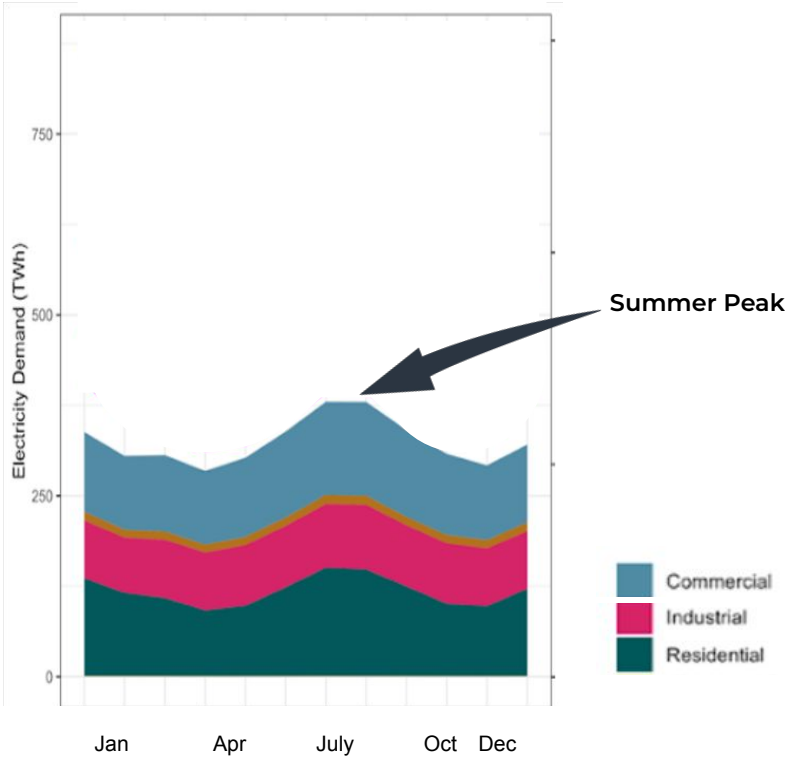
Current US Seasonal Electric Peaks



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

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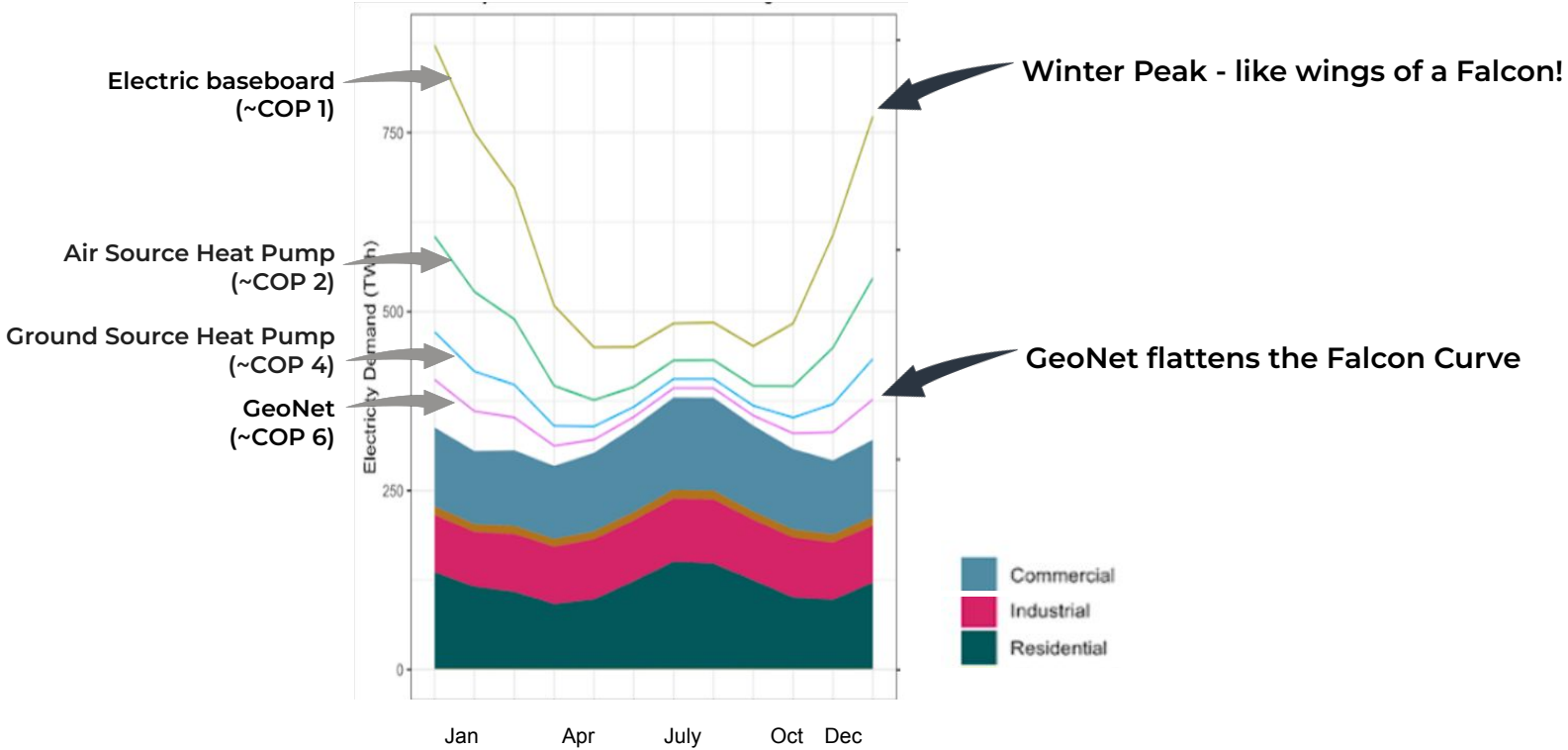
Future US Electric Peaks (as we electrify heating)



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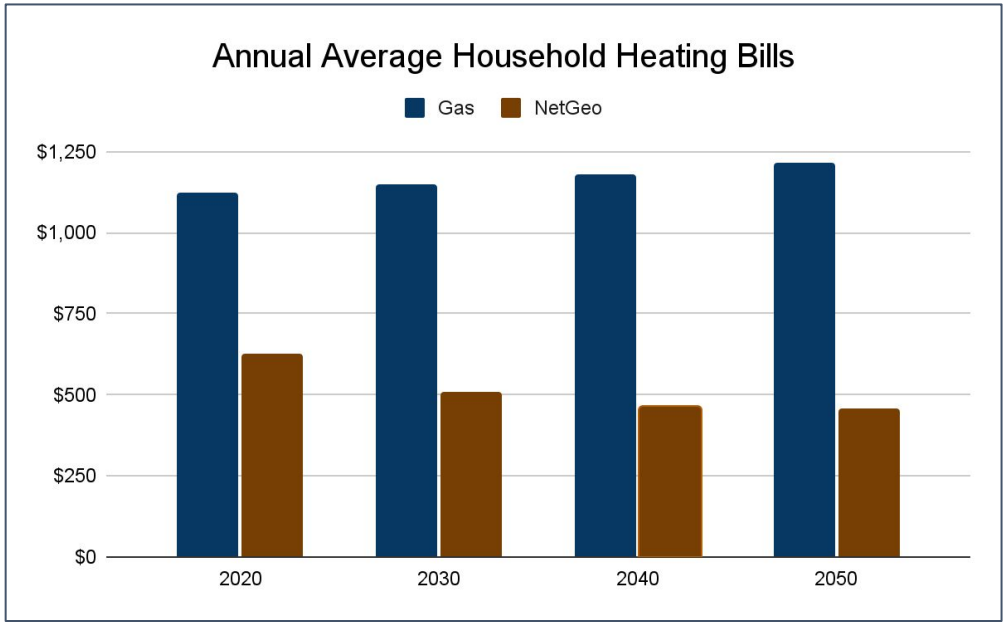
Benefits

- Safer
- Provides cooling

Benefits

- Safer
- Provides cooling
- Energy bill savings

MA Energy Bill Projection
(Applied Economics Clinic Brief)



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

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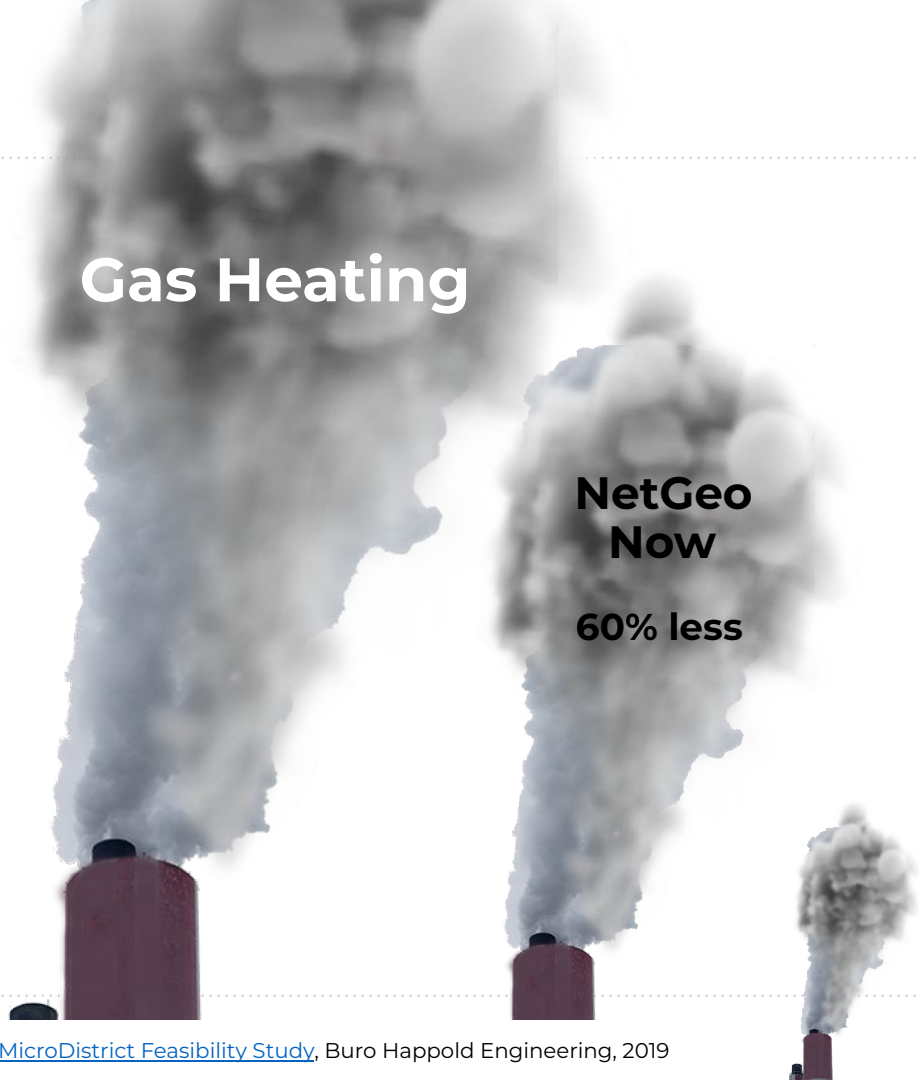
Benefits

- Safer
- Provides cooling
- Energy bill savings
- Cuts emissions



GeoMicroDistrict Feasibility Study, Buro Happold Engineering, 2019

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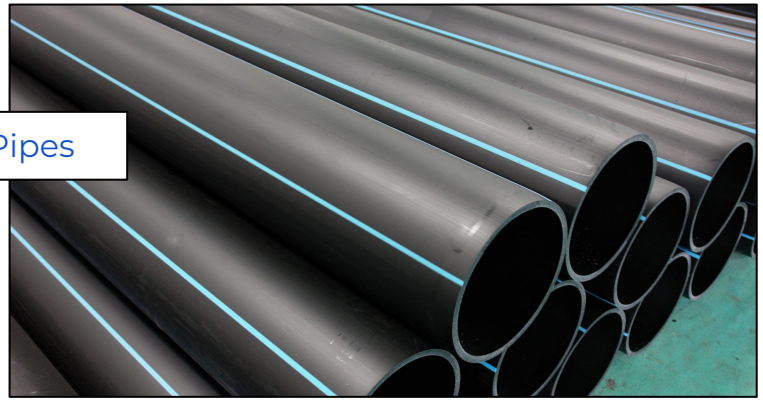
Benefits

- Safer
- Provides cooling
- Energy bill savings
- Cuts emissions
- Retraining easy

Gas Pipes

Water Pipes



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MA Eversource GeoNet Installation

Framingham, MA

- @ 100 units, including low income, govt and municipal buildings

Monthly customer costs/ heat pump

- Residential: $9/month, Low income: $7, Commercial/Industrial: $21

Schedule

- Construction - late 2022

MA National Grid Installations

4 sites total

- 20 to 40 customers per site

Monthly customer costs/ heat pump

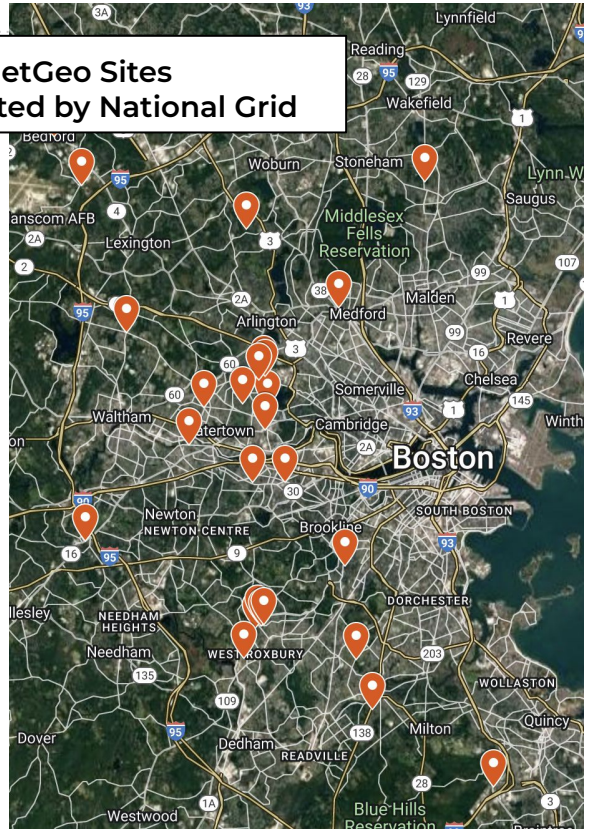
- Homes $60/month, low income homes $45

Site selection (at least 1 of following)

- Leakprone gas infrastructure or gas constraints
- Low income customers
- Mixed energy use

Schedule

- Site selection - 2023



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Geothermal Pilot Project
Mass Bay Community College
Normandy Rd
Flagg Dr
Army National Guard Recruiting Office
Concord St
The Corner Cabinet Shop
Framingham Housing Authority
Rose Kennedy Lane
Framingham Fire Department
Hampden Rd
Gulf Gas Station
Berkshire Rd
Hampshire Rd
CVS
Hillcrest Rd
Lindbergh Rd
Prindiville Ave
Burdette Ave
Dennison Ave
Concord St
Route
Borefield drilling sites
Participant
Landmark (not participants)


Concord Street

Geothermal Pilot Project Overview

EVERSOURCE

- Project began with rate case in 2020 and site selection work starting in 2021.
- One pipe system of approximately 1 mile of main
- 37 buildings with 140 individual customers throughout
- 90 boreholes to provide capacity of approximately 375 tons of load

Main Installation

EVERSOURCE

- Over 80% of main installation complete as of Oct.
- HDPE pipe is being used for the distribution loop
- Installation method similar to water or gas line work in the public right of way
- Installation depth of 5 feet underneath roadways

Customer equipment

EVERSOURCE

- Conversions are a critical portion of converting to geothermal
- Depending on the existing system and building, it can be complex
- Domestic water and appliances can be converted or left on original energy source

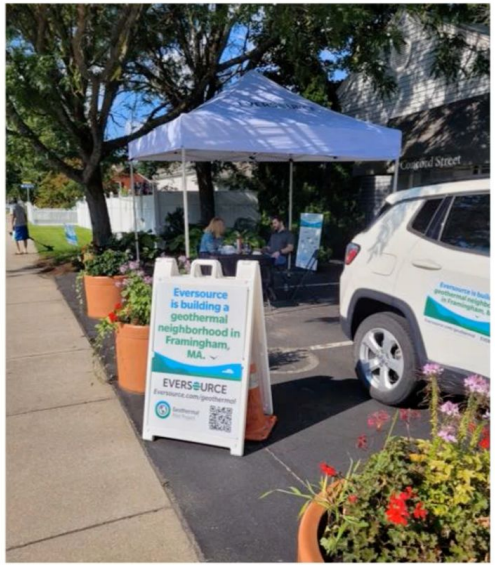
Customer engagement

EVERSOURCE

-Weekly communications to pilot customers with updates on schedule, traffic impacts, parking and in-home visit information

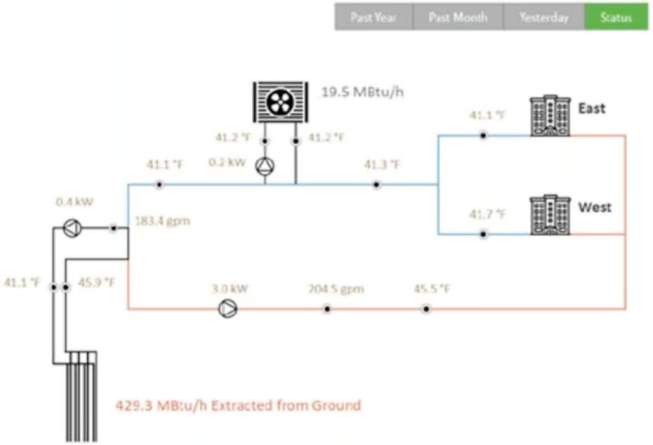
-Weekly on-site Informational Tent for in-person customer support

-Close communication with the City and community stakeholders on any permissions/updates



Operations and Monitoring

EVERSOURCE



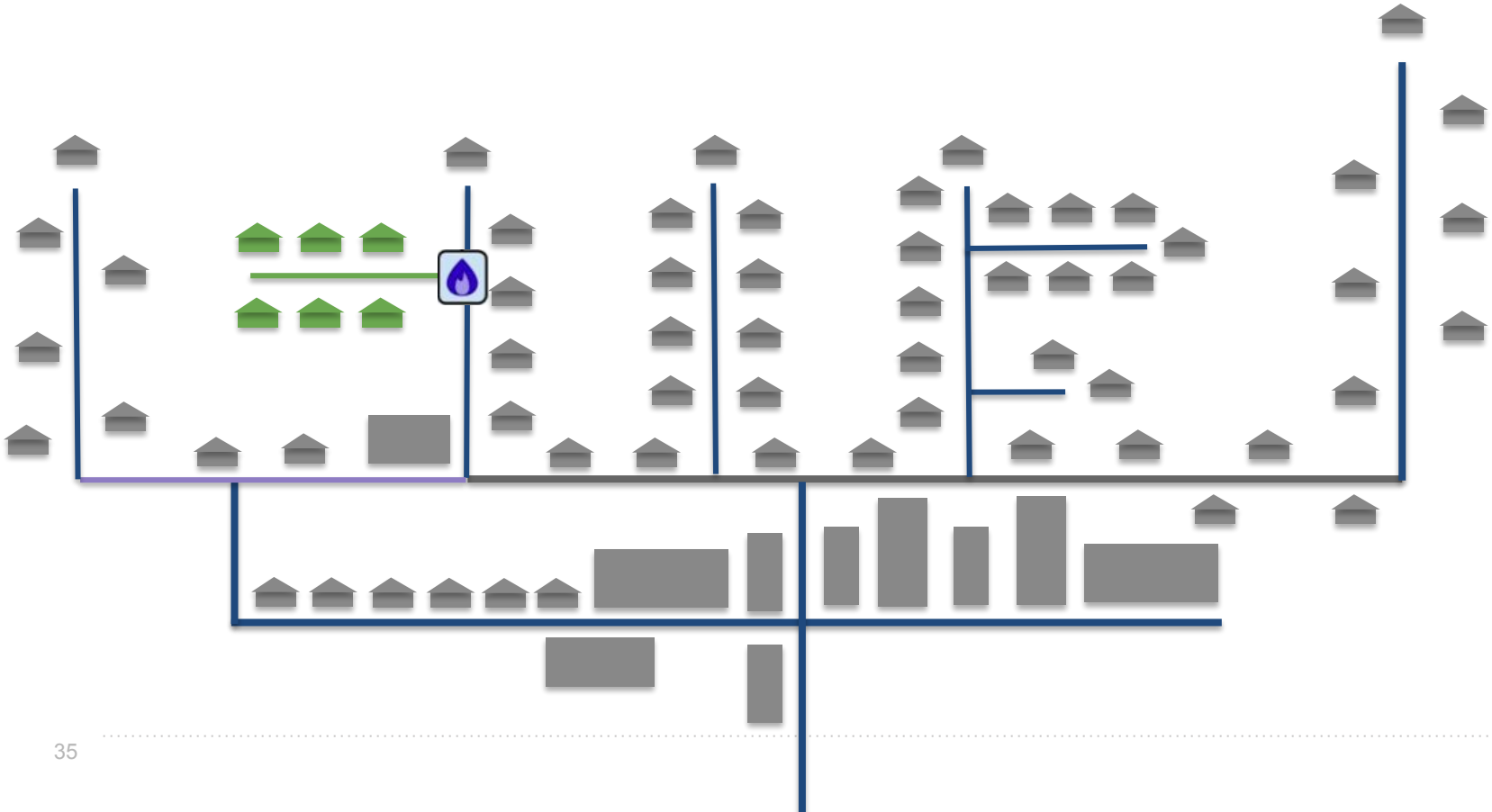
- Pilot run length is planned for 2x heating and 2x cooling seasons
- Loop performance will be closely monitored throughout the duration
- Backup heat and cooling will be available for the loop (electric boiler and dry cooler)
- Data will be gathered on costs to operate as well as frequency of maintenance events
- Pilot operation will be an opportunity to train internal workforce on unique aspects of geothermal and identify crossover skills

What Does Success Look Like?

EVERSOURCE

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

Phase 1: Initial Demonstration



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Phase 2: Iterate & Scale

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Phase 3: Geo/Gas Hybrid

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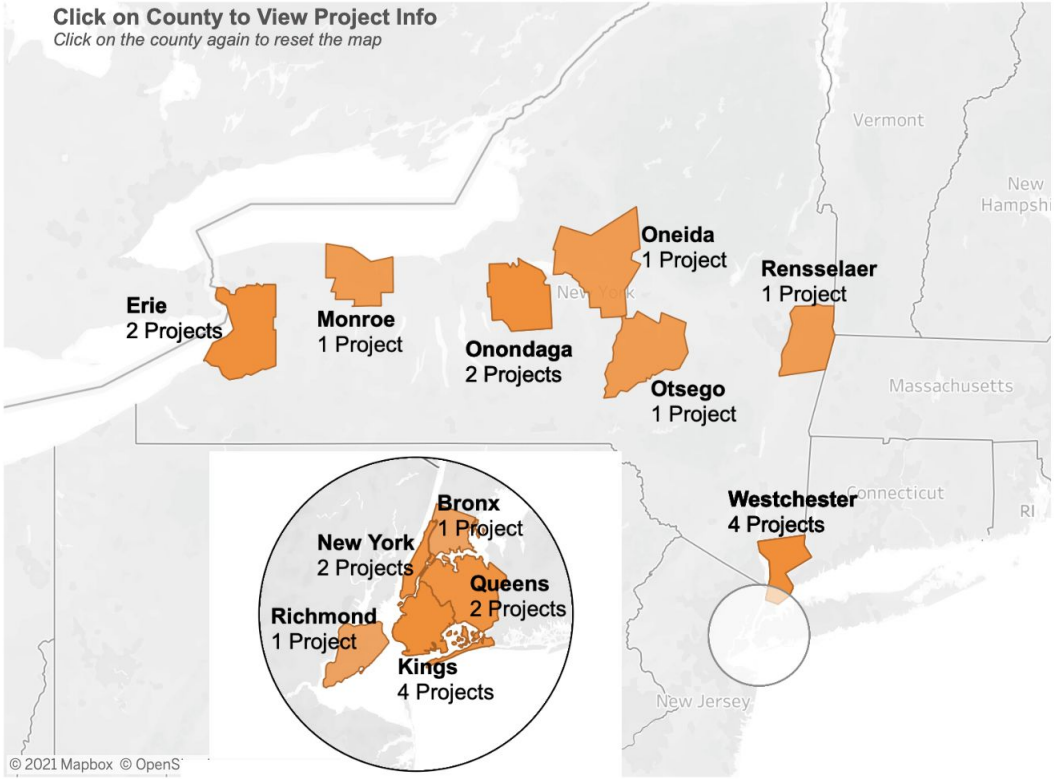
Click on County to View Project Info
Click on the county again to reset the map
Erie
2 Projects
Monroe
1 Project
Onondaga
2 Projects
Oneida
1 Project
Otsego
1 Project
Rensselaer
1 Project
Westchester
4 Projects
Bronx
1 Project
New York
2 Projects
Queens
2 Projects
Richmond
1 Project
Kings
4 Projects
Vermont
Massachusetts
Connecticut
New Jersey
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Screenshot

July 11, 2022

Governor Hochul signs bill promoting utility-operated thermal energy networks in New York State

FOLEY HOAG LLP

[co-author: Mack Ramsden, Summer Associate]

On July 5, 2022, Governor Kathy Hochul signed into law the Utility Thermal Energy Network and Jobs Act (the "Act"), a bill which amends New York State's Public Service Law to authorize the State's utilities to own and operate thermal energy networks, and which charges the State's Public Service Commission ("PSC") with initiating proceedings to support and regulate thermal energy network deployment.

Until now, New York State utilities interested in developing thermal energy networks have been frustrated by legal and regulatory barriers. Unlike traditional heating and cooling systems, which operate within a single building, thermal energy networks (also known as "community thermal

WRITTEN BY:

Foley Hoag LLP - Energy & Climate Counsel

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Questions?

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PACE
People's Action for Clean Energy

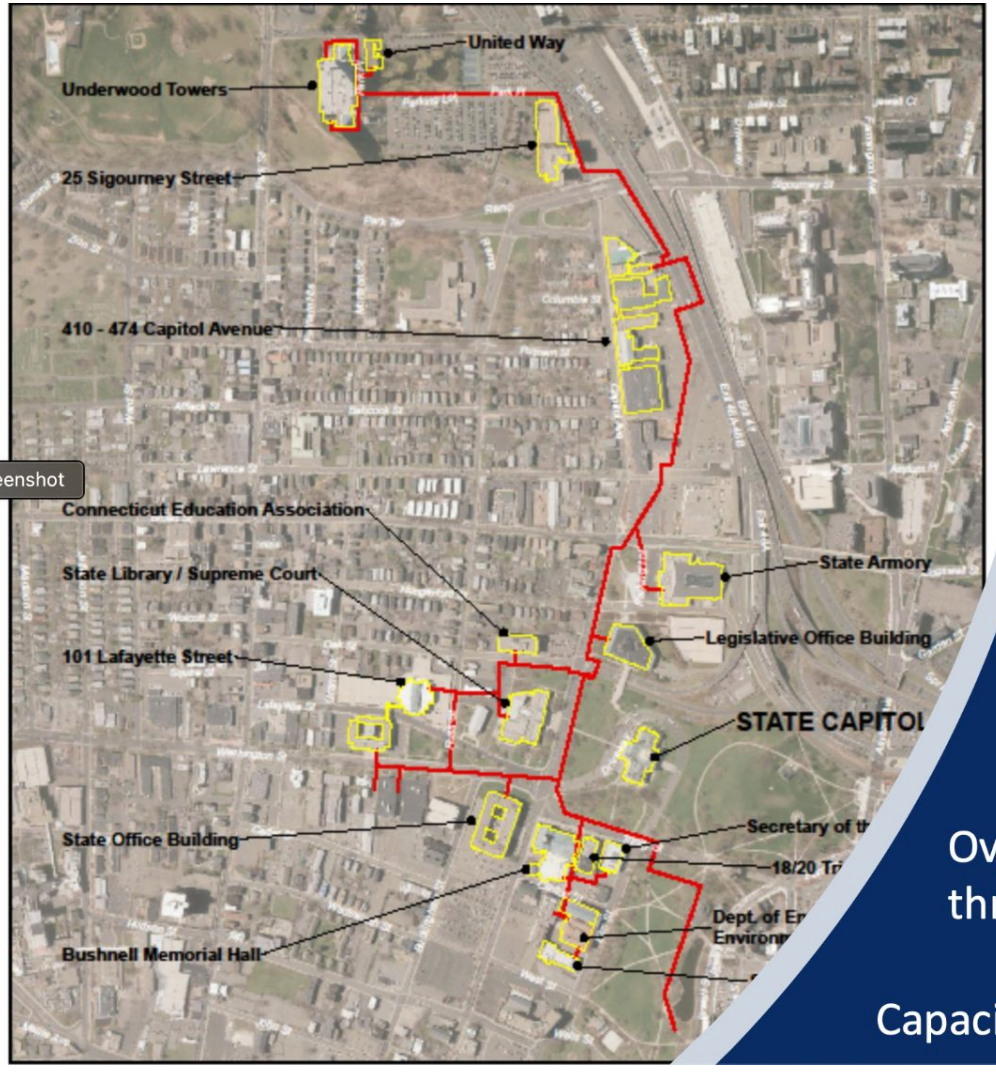
Screenshot

Formerly Known As

CDECCA – Capitol District Energy Center Cogeneration Associates

CAS
Capitol Area System

Capitol Area System (CAS) Loop



Facilities hot and chilled water piping and production

Serving 15 public and private buildings

Over 3 miles of underground piping throughout the Capital Area

Capacity for expansion

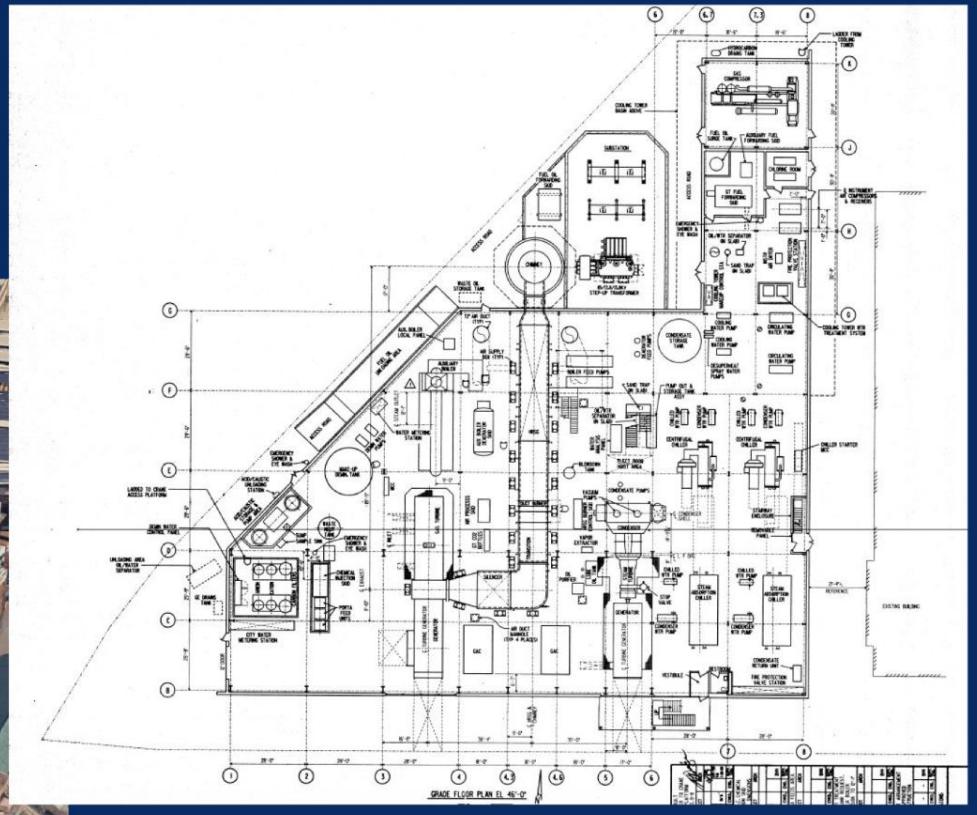
CLIENT FACILITIES SERVED

State Owned CAS users	Private CAS users
Legislative Office Building	Underwood Tower A (residential)
231 Capitol (State Library/Supreme Court)	Underwood Tower B (residential)
Armory (State's Emergency Operations Center)	Bushnell Theater
79 Elm (DEEP)	United Way
75 Elm (Judicial)	18/20 Trinity
410-474 Capitol – Cap Ave Complex (multiple State agencies)	30 Trinity
101 Lafayette (Judicial)	21 Oak St (CT Education Association)
165 Capitol – State Office Building	

The CAS Plant

490 Capitol Ave, Hartford
Year built: 1988 (34 years in 2022)
Building Area: 38,280 Square feet
Lot Area: 53,970 Square Feet

Screenshot



Facility Background

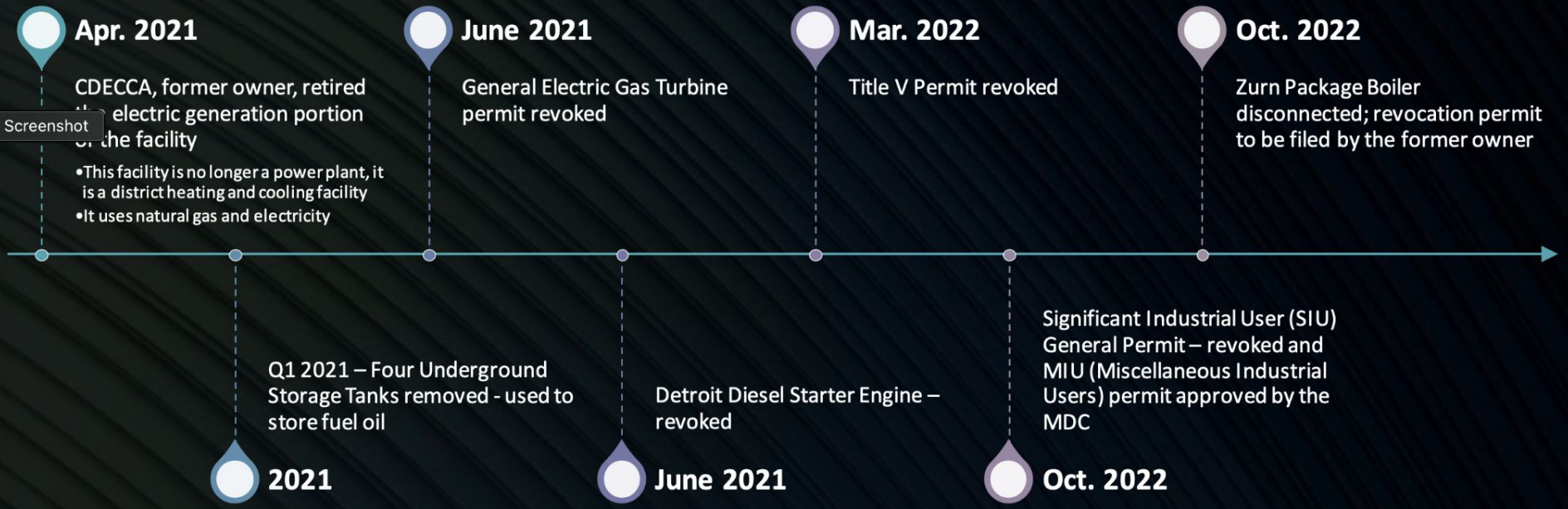
- The plant was originally a natural gas-fired, dual fuel capable, combined-cycle cogeneration merchant plant with a generation nameplate capacity of 62.1 MW. Previously CDECCA provided peaking energy to the ISO New England power market as well as steam and chilled water to the Hartford Capitol district heating network.

- Initially the facility consisted of a General Electric model PG 6531 (Frame 6) gas combustion turbine generator (CTG) with an in-line three (3) pressure Heat Recovery Steam Generator (HRSG) with duct-firing capabilities, a 22.5 MW Alstom condensing/extraction steam turbine generator (STG), one (1) 900- ton two-stage absorption chiller (de-rated to 350-400 tons), two (2) 1,800-ton centrifugal chillers , one (1) 900-ton variable speed centrifugal chiller, a diesel starter engine, two (2) package boilers to provide steam to the CAS loop and Capitol Ave Complex, a four (4) cell BAC-Pritchard Cooling tower with 3,750 Ton rating per cell.

- As of April 2021, the electrical turbines have been decommissioned and the facility is no longer an electric generation plant. The only equipment used now is chillers, a small boiler, cooling tower and pumps.

- The 4-fuel oil storage tanks (under OPM parking lot) have been cleaned and removed . The facility is no longer dual fuel capable.

Improvements since 2021



Screenshot

Screenshot

Fuel Usage Comparison

Year	Gas Usage (mmbtu)	Oil Usage
2016 (pre-decommissioning)	1,284,850	9,529
2019 (pre-decommissioning)	262,946	
2020/21 (post-decommissioning)	43,150	

Screenshot

Path Forward

Goals:

- CT EO1 Compliance
- Maximum Decarbonization
- Social Environmental Equity
- Environmental Sustainability
- Operational Efficiency
- Reduce Fuel Costs

Next Steps

- Feedback from Stakeholders
- Collaboration with DEEP and other experts
- Hire an experienced design team
- Budget Capital Expenses
- Finance