Site Selection for Geothermal Networks

Moderator:

Joseph Hitt / *NYS DPS*

Panel:

Aaron Schauger / *Labella Associates*
Daniel Flaherty / *CDM Smith*
Mitchell DeWein / *CHA Consulting*
Zeyneb Magavi / *HEET*

Presented Live at the NY-GEO 2023 Conference Albany, New York on April 26, 2023

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Site Selection for Geothermal Networks

Building Electrification, Salon D, 1:00 – 2:00 PM

Geothermal networks, combining a number of buildings with either a centralized or distributed renewable thermal energy source, are being evaluated, designed and built with much greater frequency. So what makes a good geothermal network? Where should we start and why?

Moderator

Joe Hitt / NYS DPS

Panelist

Daniel Flaherty / CDM Smith

Aaron Schauger / LaBella Associates

Mitchell DeWein / CHA Consulting

Zeyneb Magavi / HEET

Networked Geothermal Site Selection

Feasibility Screening Analysis

Dan Flaherty

April 26, 2023

CDM Smith

WATER + ENVIRONMENT + TRANSPORTATION + **ENERGY** + FACILITIES

Where to Start?

<u>Loads - Buildings</u>

- Customer Willingness
- Types of Loads
- Conversion Opportunities
- Client Goals

<u>Distribution</u>

- Hydronics
- Pumps and Hydronic Equipment
- Obstacles

<u>Source (Borefield)</u>

- Geology
- Environmental Contamination
- Permitting

Loads - Customer Willingness

Desktop Assessments

- Local News
- Social Media

Letters of Support

- Local Government
- Local Public Works
- Community Organizations

Canvassing

- Knocking on doors meeting with cusomers

Loads - Types of Loads

Heating Dominant

- Low proportion of conditioned volume to surface area (ambient temp. specific)
- Single family housing and smaller multifamily housing.

Cooling Dominant

- Offices
- Retail
- Schools (depends on summer occupancy)

Load Granularity

- Single load can dominate the system.
- Can large loads be subdivided?
- Is it worth capturing very small loads?

Loads - Conversion Opportunities

Good

- Water source heat pumps with boiler cooling tower to maintain the condenser water loop.
- Four pipe fan coils with low temperature boilers and chillers.
- Air source rooftop air handling units.
- Single and multifamily housing with central air conditioning.

Poor

- Steam heated buildings.
- Buildings and houses with perimeter finned tube radiation.
- Buildings with insufficient electrical capacity

Loads – Client Goals

- Leak Prone Pipe (LPP)
- Constrained gas distribution areas
- Avoid under appreciated asset replacement
- Environmental Justice
- Low income

Distribution – Hydronics

Closed loop geothermal systems are subject to the same physics as closed loop hot water or chilled water systems.

- Elevation changes and working pressure of the piping
- Expansion and contraction
- Air entrapment and flushing
- Customer and utility isolation
- Leak sensing and system isolation

Distribution – Pumps and Equipment

<u>Pumping Equipment</u>

- Redundant Pumps
- VFDs or motor starters
- Control Panels
- Chemical feeder
- Glycol feeder
- Air separator
- Expansion tanks

<u>Services</u>

- Electrical
- Water connection
- Floor drains
- Heating and Cooling

Distribution – Obstacles

- Obstacles to avoid
  - Aboveground rail lines
  - Public transit tunnels
  - Drinking water tunnels
  - Streams and Rivers
  - Natural resources (wetlands, sensitive receptors, etc)
  - Superfund sites
  - Very shallow bedrock
  - Newly paved streets

- Obstacles to work around
  - Heavily concentrated utilities (overhead and underground)
    - Gas
    - Water
    - Sewer
    - Stormwater
    - Electrical
    - Telephone
    - Etc.
  - Dense pedestrian and automobile usage areas

Source – Geology

Criteria	Description
Depth to Bedrock	Shallow bedrock is desirable to minimize the need for and costs associated with steel casing to support the overburden. This metric ranks from deepest to shallowest depth to bedrock.
Bedrock Conditions/Drillability	Drilling conditions within various bedrock formations can vary. This metric ranking ranges from “competent” to “fractured/unstable,” meaning the borehole walls may not be able to be supported long enough to install a loop and/or cannot be drilled to desired depth.
Groundwater-Producing Formation(s)	The amount and quality of groundwater encountered that must be managed and disposed varies by the type of bedrock formation and location. This metric reflects the amount of effort, support equipment and pumps, and associated costs needed to manage and dispose of groundwater generated during drilling.
Overburden-Type Drillability	The density and thickness of coarse-grained materials (e.g., boulders, cobbles, and large rock pieces) determines how quickly and easily it is to drill through the shallow geologic materials (i.e., “overburden”). This metric ranges from the hardest to drill to the easiest, based on the anticipated or known type of overburden present.
Thermal Conductivity	Thermal conductivity is a measure of how easily heat moves through the ground. Higher thermal conductivity improves the efficiency of and reduces the size of a geothermal system, minimizing capital cost. This metric ranges from lowest to highest thermal conductivity.

Source – Environmental Contamination

- Urban environments have potential for subsurface contamination
- Assess risks due to nearby documented environmental sites, e.g., leaking storage tanks, spills, etc.

Source – Permitting

- Confirm local permitting for borehole drilling and geothermal system construction is not required or will not cause excessive costs or schedule impacts
- Wetland or natural resources regulation potentially applicable

April 26, 2023

SITE SELECTION FOR GEOTHERMAL NETWORKS

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PRESENTING TODAY

Aaron Schauger, PE, CEM, CPHC

Energy Engineer | Project Manager

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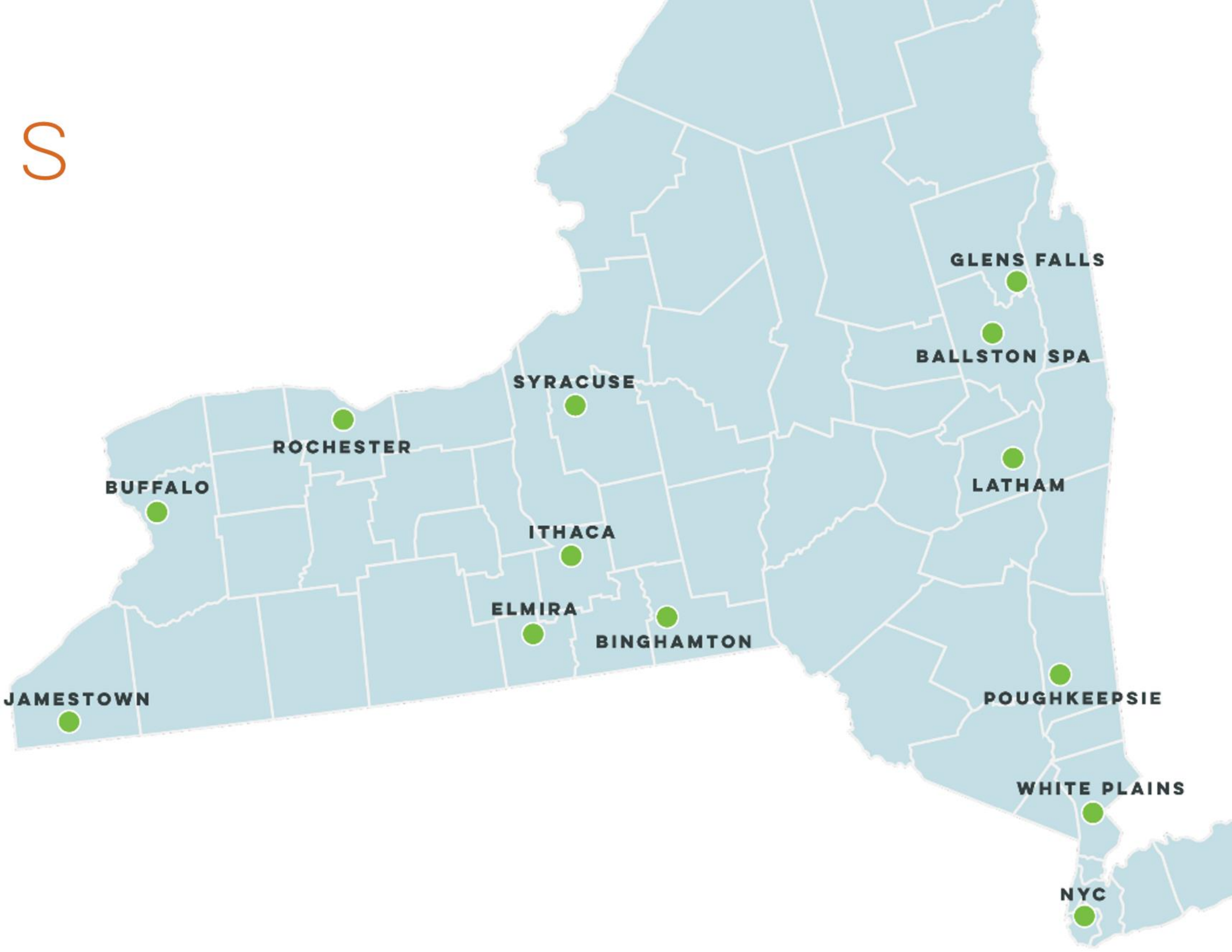


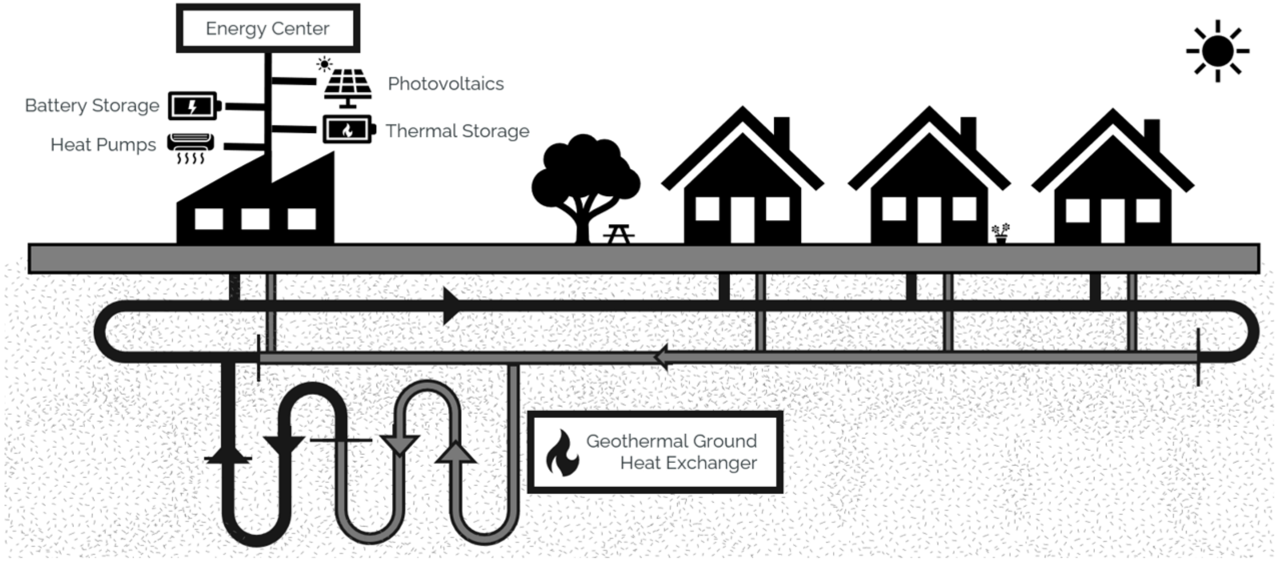
THERMAL NETWORKS

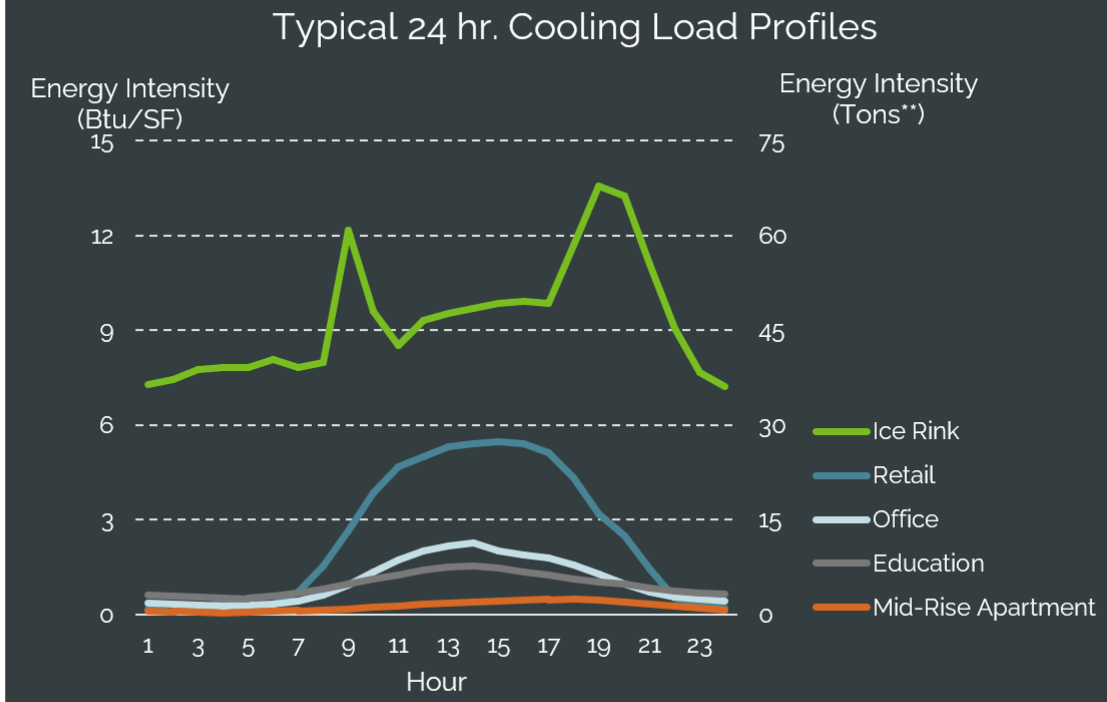
WHAT IS IT?

Series of buildings connected to central water loop that share common thermal source

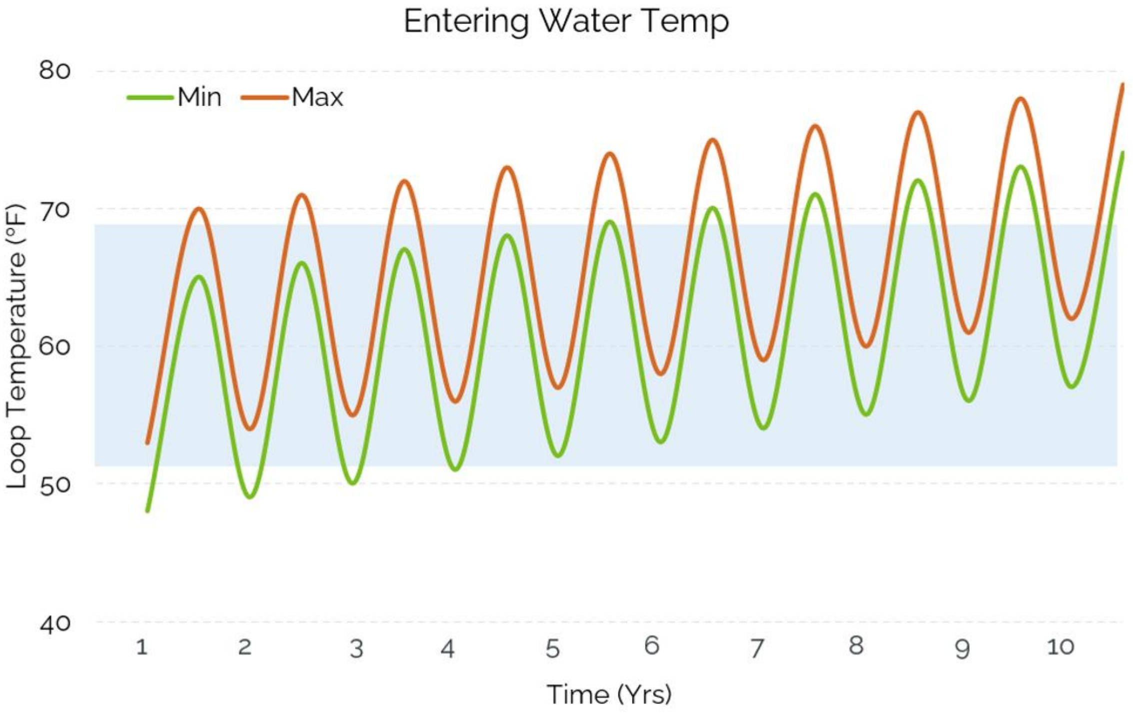
BENEFITS

Shared cooling and heating load allows for reduced number of boreholes, reducing cost of system while still providing energy savings and reduction in emissions

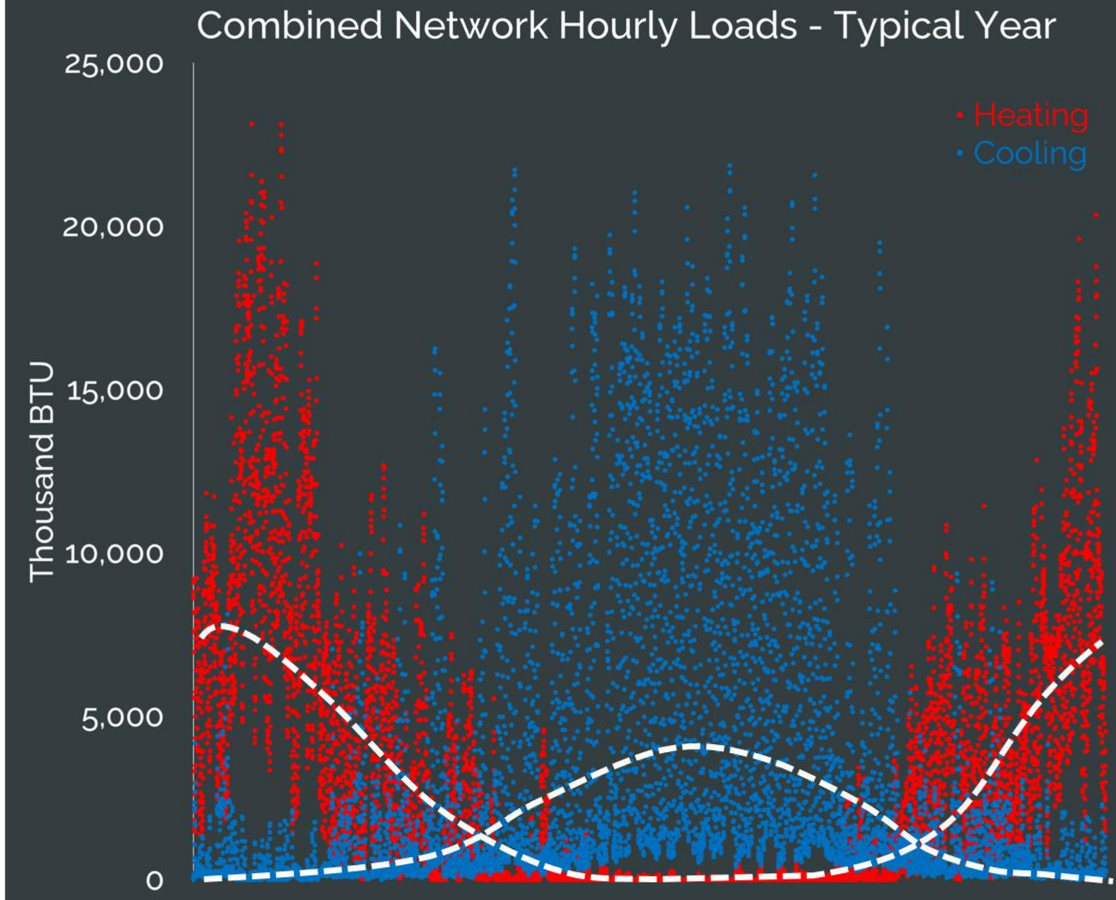


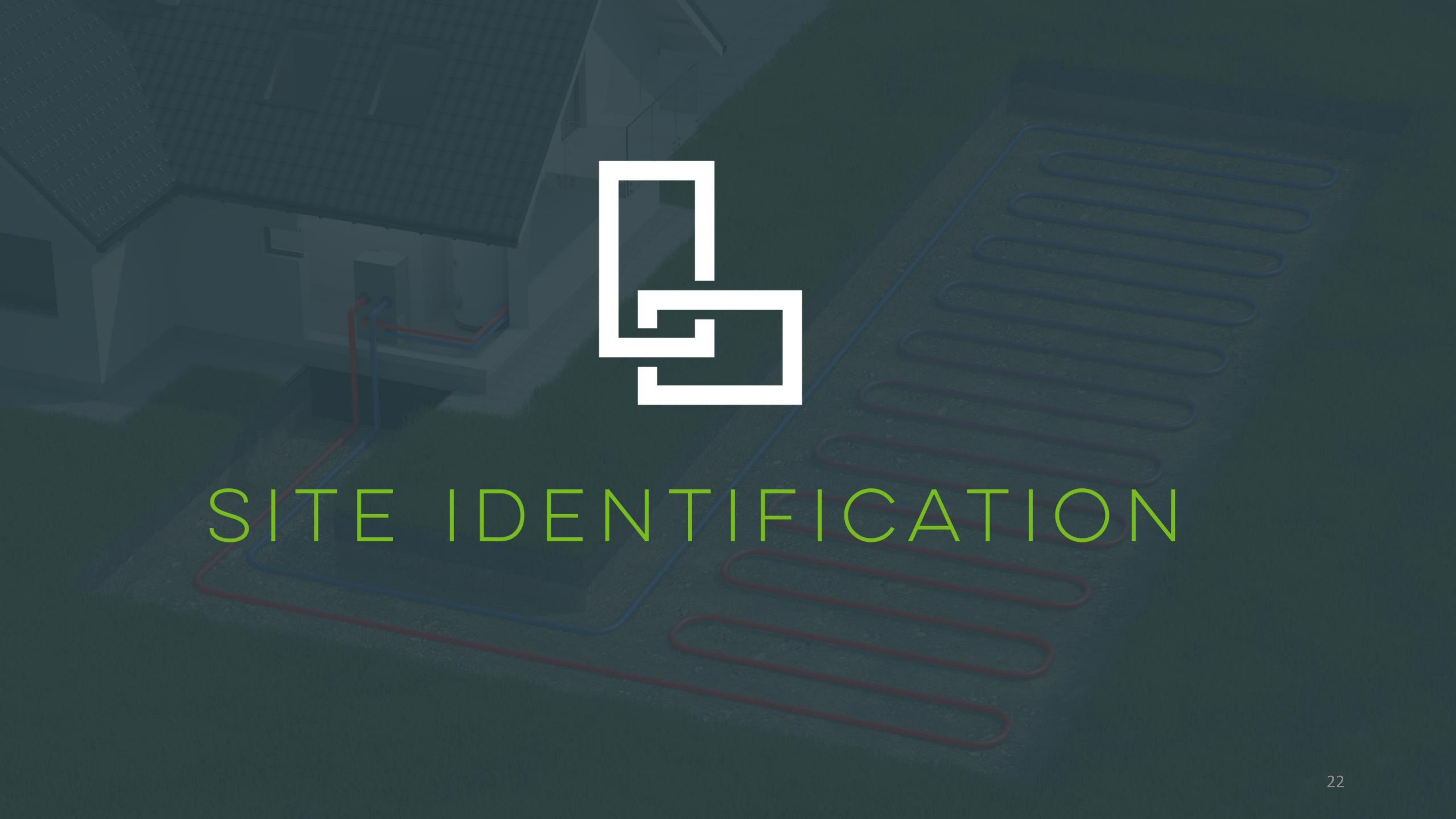

Typical 24 hr. Cooling Load Profiles

THERMAL BALANCING

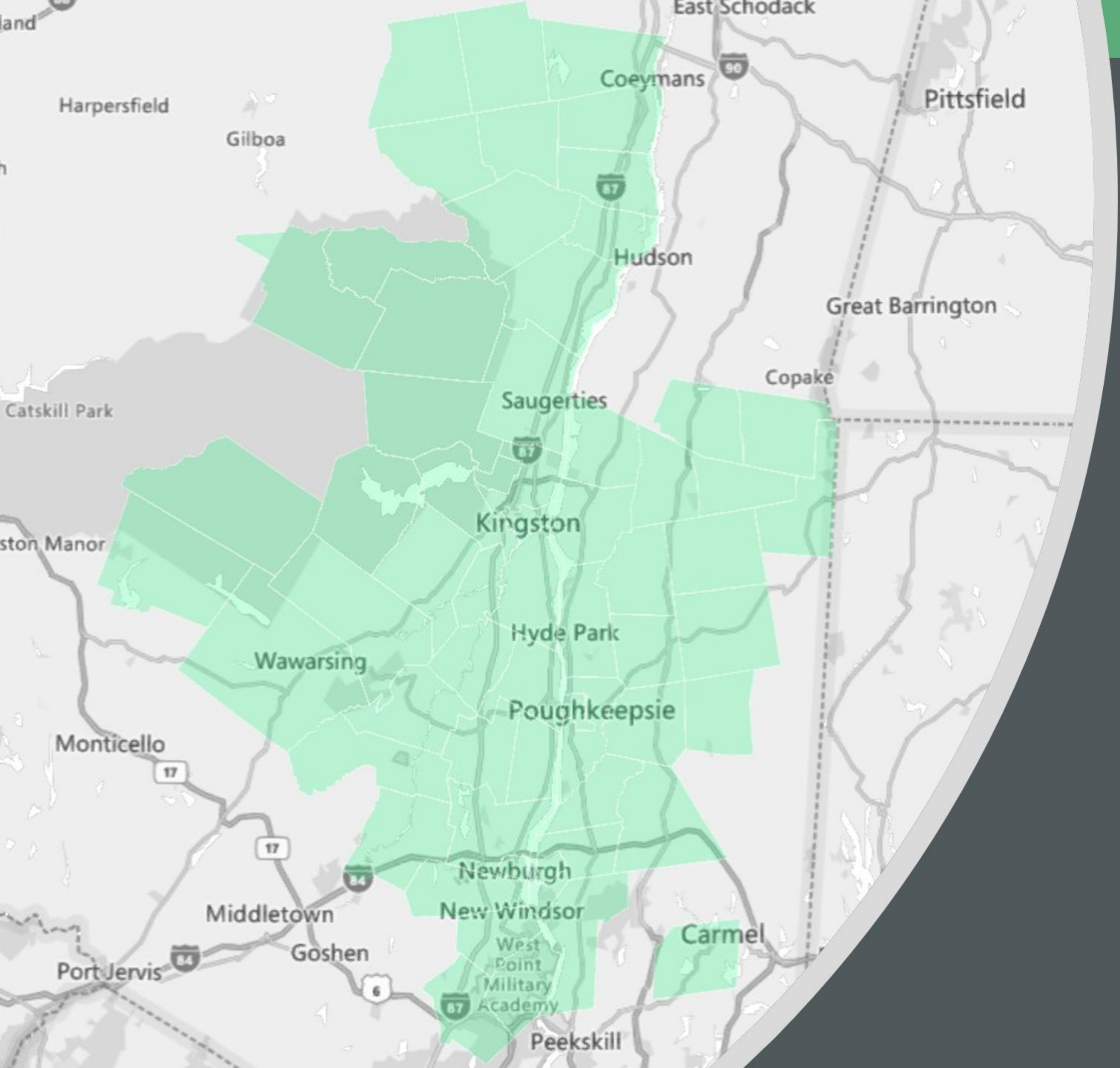


A “Saturated Loop” leads to long-term operational issues,



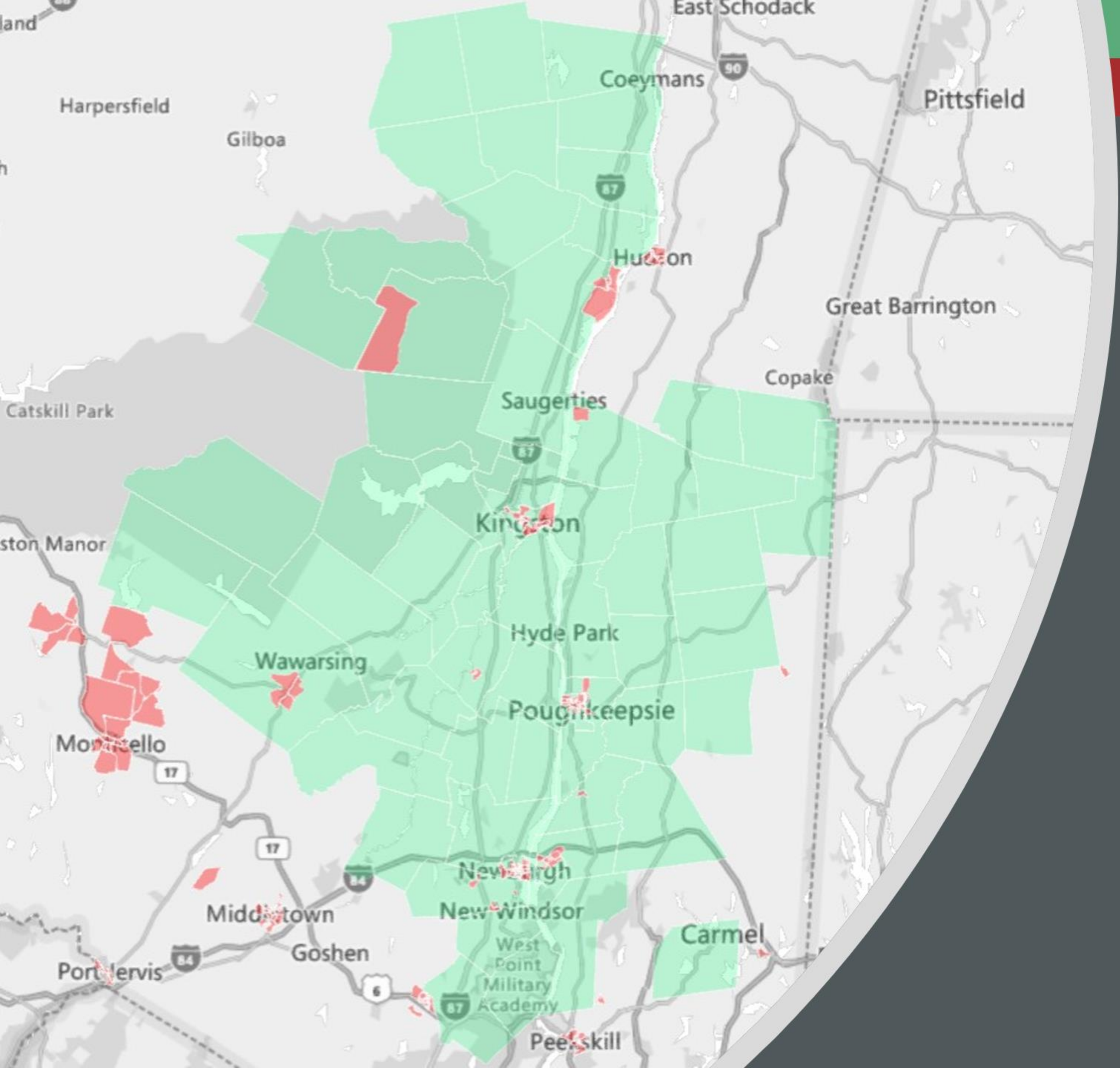


SITE IDENTIFICATION



Project Boundary

All areas of interest were used as the base map

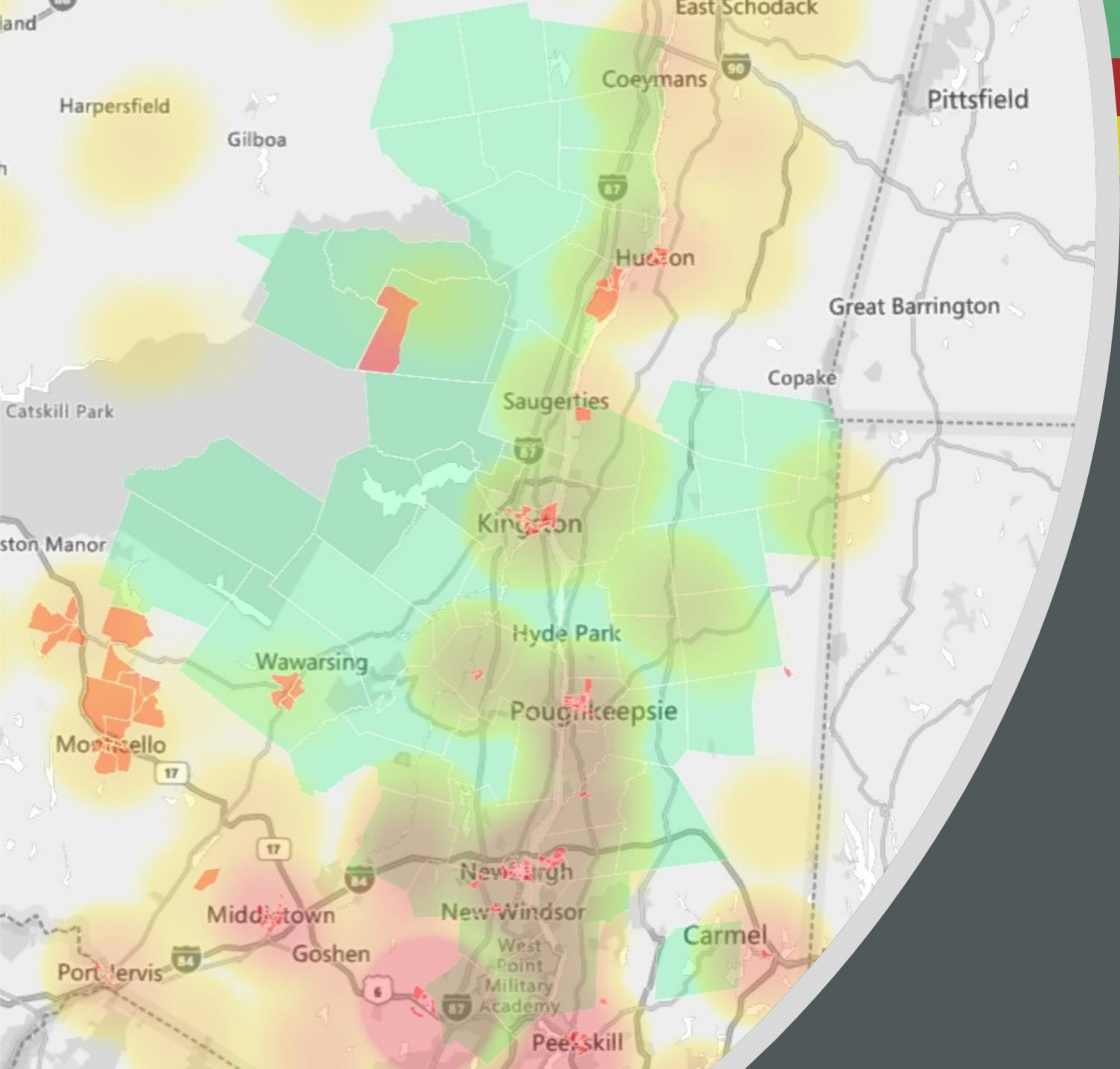


Areas of Interest

Disadvantaged Communities

Disadvantaged Communities

The project location is preferred to lie within a DAC.



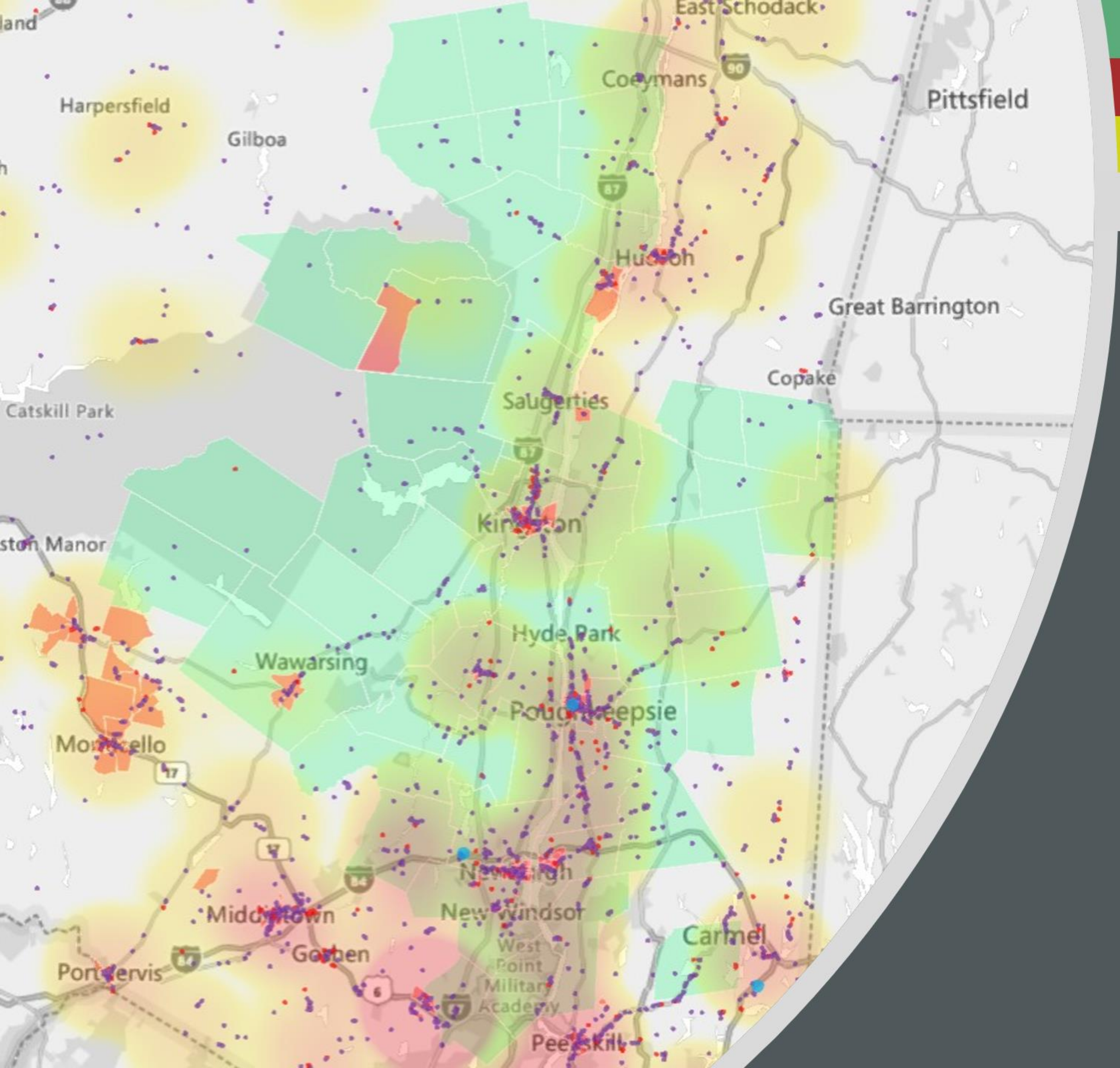
🟩 Areas of Interest

🟥 Disadvantaged Communities

LESS Population Density MORE

Population Centers

Population centers with a high density of people per square mile of land will more likely have load diverse sites in a more compact area.



🟩 Areas of Interest

🟥 Disadvantaged Communities

LESS Population Density MORE

● Hospitals ● Food retail ● Ice Rinks

Anchor Buildings

Because most buildings in New York are heating dominant, identifying an anchor building that is cooling dominant will help to balance a geothermal system.

DEVELOPING SHORT LIST

Potential Sites narrowed down based on the following:

Buildings

- Building density
- Building diversity (residential vs. commercial)
- Number of buildings

Renewable Energy Potential

- Rooftop availability
- Parking lot carports
- Open space for battery storage

Thermal Resources

- Parking lots, open fields
- Surface water (ponds, lakes, rivers)
- Sanitary sewer mains

SITE EVALUATION

CANDIDATE FEASIBILITY PARAMETERS

The following factors are used to rank potential sites in the decision matrix, each with a respective weighting:

Customer Acquisition Risk (30%) Estimated risk of key buildings electing not to participate

Load Diversity (25%): Diversity in building loads – specifically heating vs cooling loads

On-site Thermal Resources (20%): Potential for thermal sources in the area (ground source, solar heating, surface water, wastewater), includes analysis of site geology

Building Diversity (10%): Number of different building types and respective size of each

Ease of Conversion (10%): How many owners need to be consulted? Any major technical challenges?

Conversion Risk (0% | 5%): How dependent is the loop on one or two nonresidential customers?

Other Non-Weighted Considerations:

Expandability: Does the surrounding area lend itself to future expansion?

Replicability: How repeatable is the project across the service territory?

DECISION MATRIX				Weighted Criteria					Weighted Total	Weighted Total	Unweighted Criteria		
				Customer Acquisition Risk	Load Diversity	Thermal Resources	Building Diversity	Ease of Conversion			Conversion Risk*	Replicability	Expandability
County	Location	DAC?	Utility Service	30%	25%	20%	10%	10%	(Exc. Risk)	(Inc. Risk)	0% | 5%	-	-
Specific Sites Confidential		✓	E+NG	10	3	10	6	7	7.1	6.8	8	7	9
		✗	E+NG	5	10	6	4	5	6.1	5.7	4	3	1
		✓	E+NG	8	9	8	6	5	7.4	7.1	10	5	8
		✓	E+NG	5	3	6	5	6	4.6	4.4	6	10	7
		✓	E+NG	4	9	7	5	4	5.8	5.4	4	10	6
		✓	E+NG	4	4	4	4	5	3.9	4.0	10	5	9
		✓	E+NG	4	9	6	4	5	5.6	5.5	10	9	6
		✓	E+NG	8	10	6	7	5	7.3	7.1	10	5	10
		✗	E+NG	5	3	8	6	6	5.1	4.9	6	10	6
		✗	E+NG	4	10	7	6	6	6.3	6.2	10	10	4
		✗	E+NG	5	2	7	5	5	4.4	4.5	10	2	6
		✗	NG	3	10	5	7	5	5.6	5.5	10	10	6
		✓	E	4	10	7	4	5	6.0	5.7	6	8	2

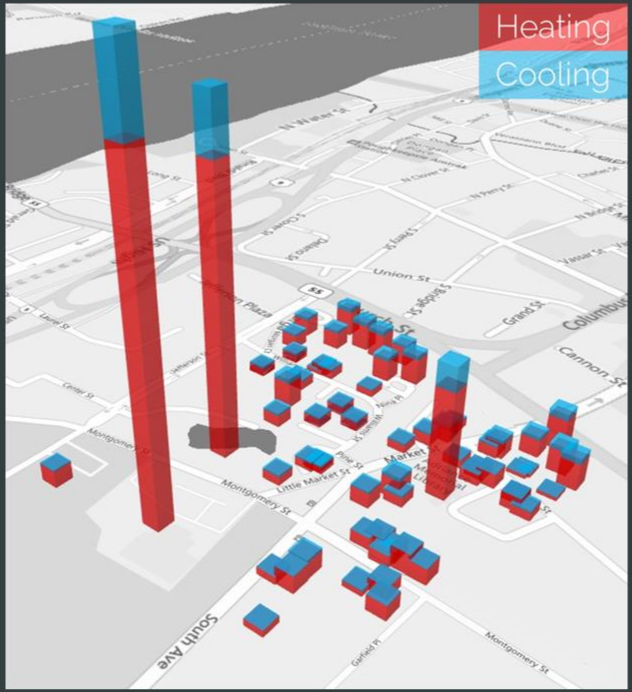
Note: Weighted totals shown with and without conversion risk factor.

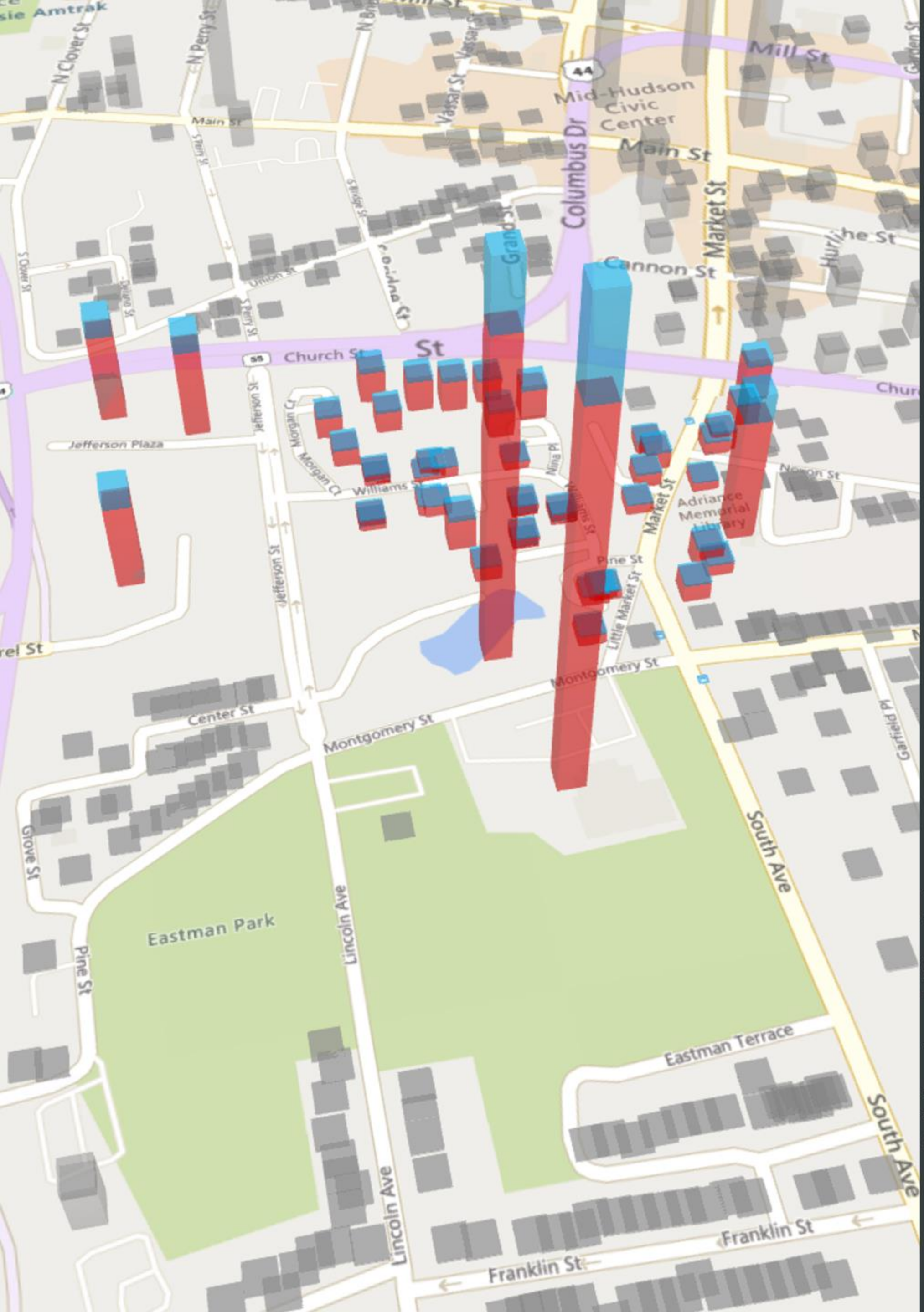
DECISION MATRIX

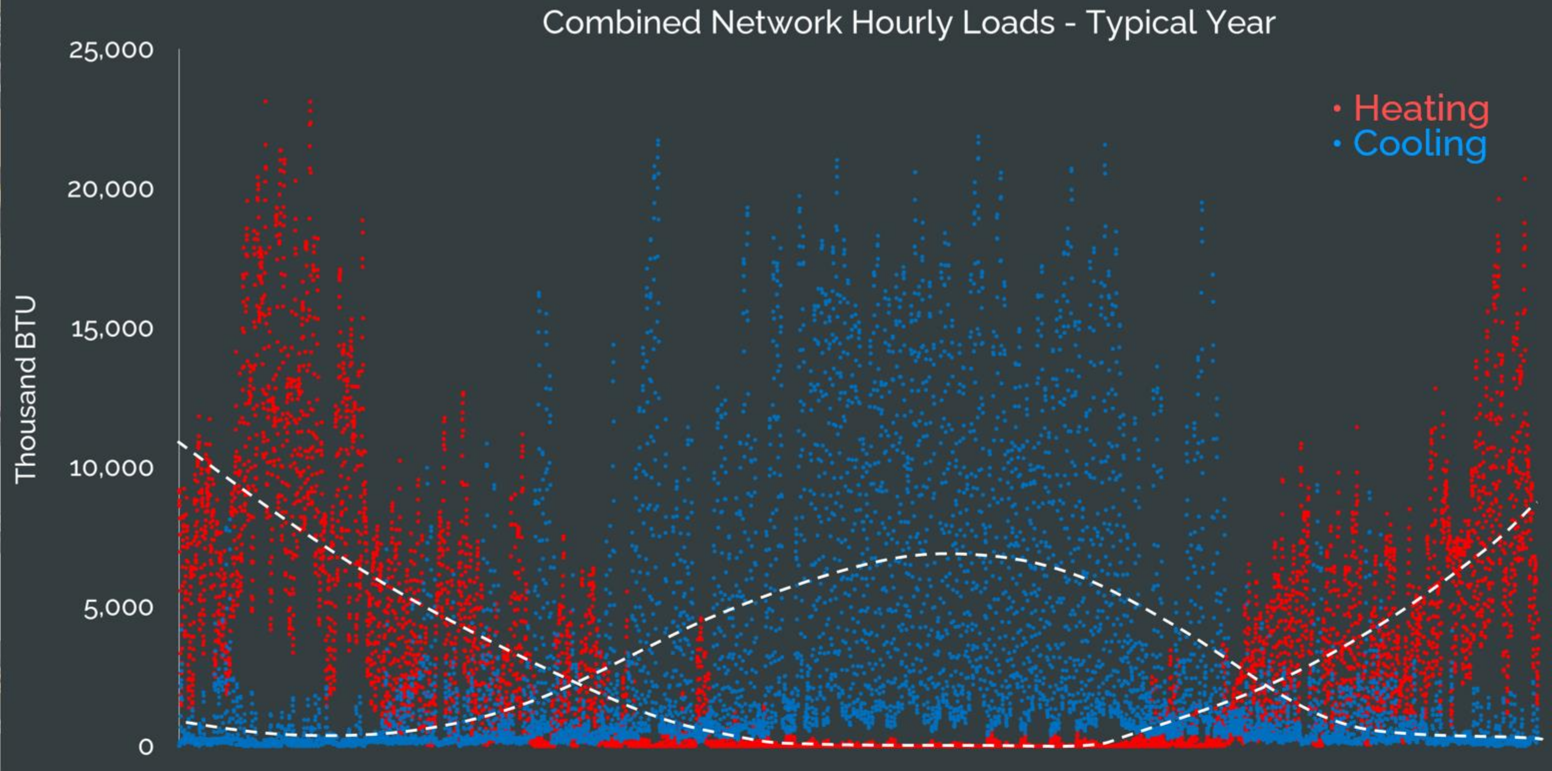
E+NG, DAC

SITE EVALUATION

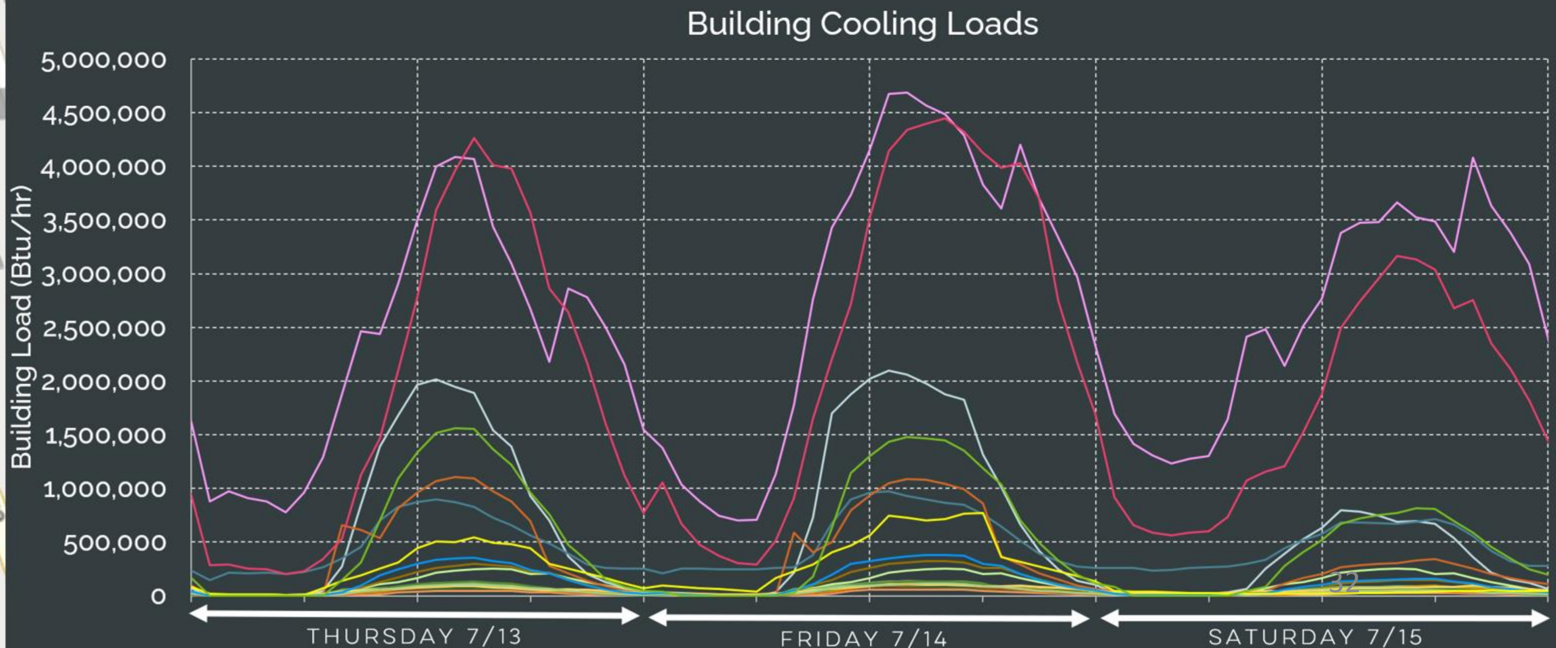
Customer Acquisition Risk	All critical buildings have expressed interest in participating in pilot project	10
Load Diversity	Site has predominantly heating dominant buildings, anchor site load profiles are difficult to define	3
Thermal Resources	Site has access to large open fields near anchor site, geology suitable for vertical bores	10
Building Diversity	Site has 5 major building types (recreation center, midrise apartments, commercial, residential, library)	6
Ease of Conversion	Site has existing capability (library, Project YOU), other building equipment is unknown but assumed to be typical	7
Conversion Risk	Site has 10+ major energy consumers, anchor site funding and timeline in question	8
Replicable	Recreation centers near midrise apartments are common, anchor site building load may not be	7
Expandable	Site has high potential for future expansion, nearby ice rink north of site as future anchor building	9







Combined Network Hourly Loads - Typical Year



Building Cooling Loads

THANK YOU

Site Selection for Geothermal Networks

Presented by:
Mitch DeWein
Associate Vice President
Energy & Renewables Team Leader
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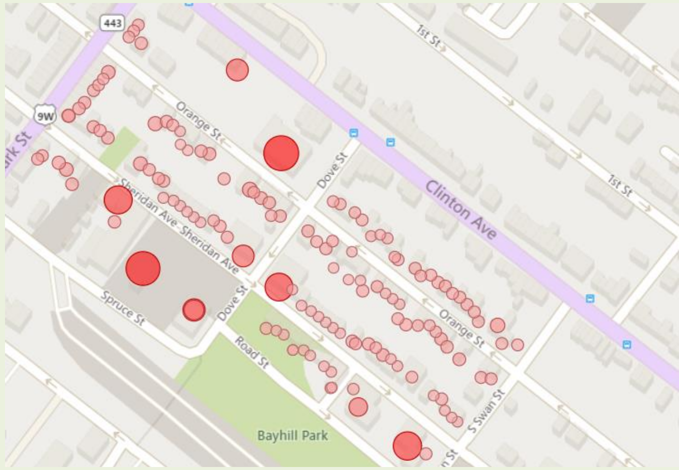
2023 NY-GEO Conference

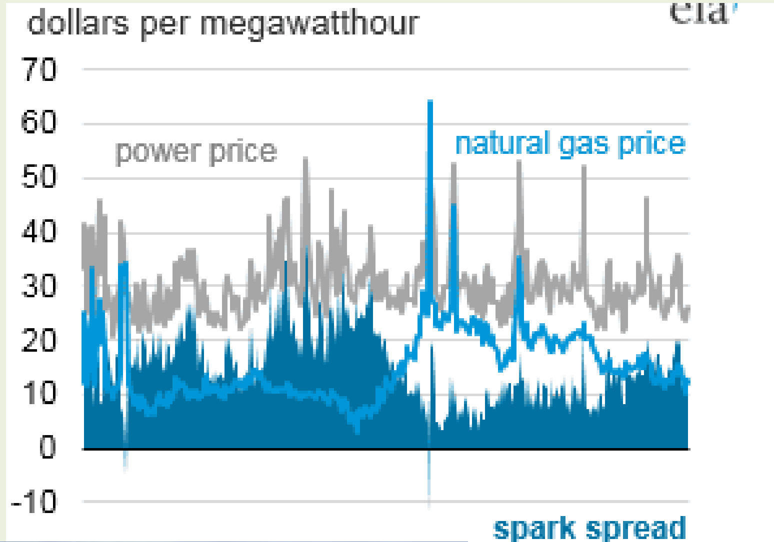
Typical Site Selection Criteria (Geo)



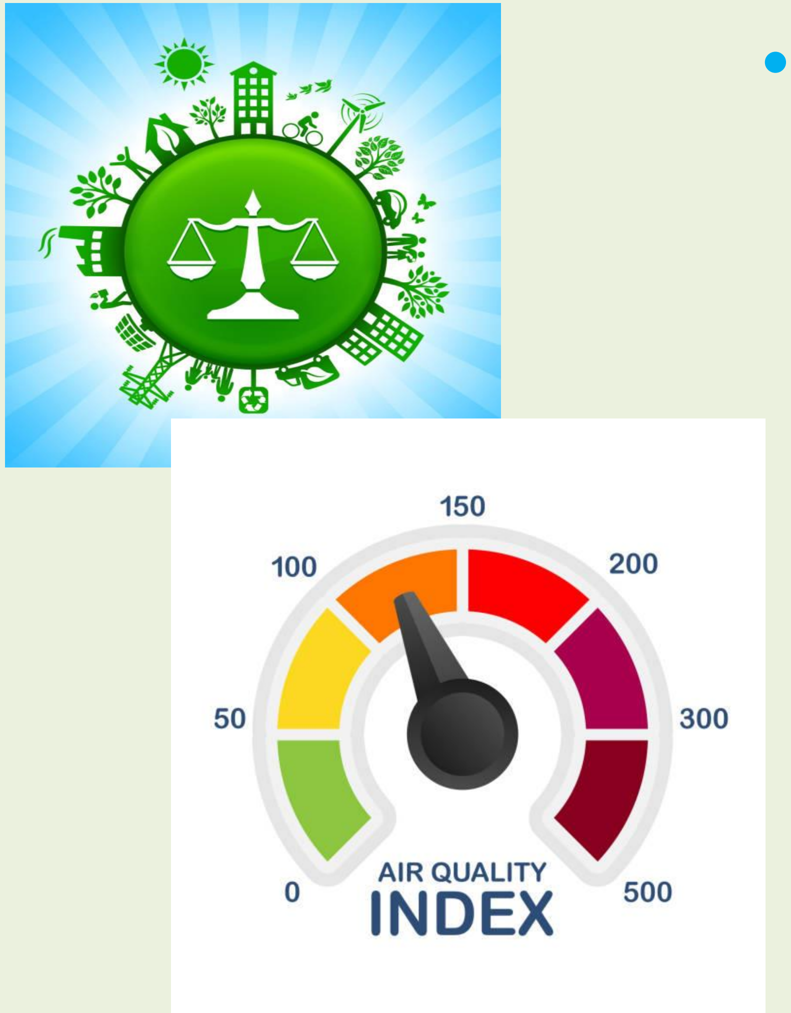
- Motivated Customer Base (anchors)
- Available Geothermal Locations
- Geo Resource Coincidence Location
- Source/Sink Diversity
  - Geo
  - Water/Wastewater
  - Surface Water
  - Thermal loads (Ice Rinks, Data Centers, etc)
- Load Diversity
- Line/Load Density

Financial Project Selection Factors

- Delivered Fuels
  - Fuel Oil
  - Propane
- High Gas/Low Electric Costs
- Avoided Carbon Tax $$ (LL97)
- Upcoming Capital Upgrade Needs
  - Failing HVAC Systems
  - Need to add Cooling
  - New building construction



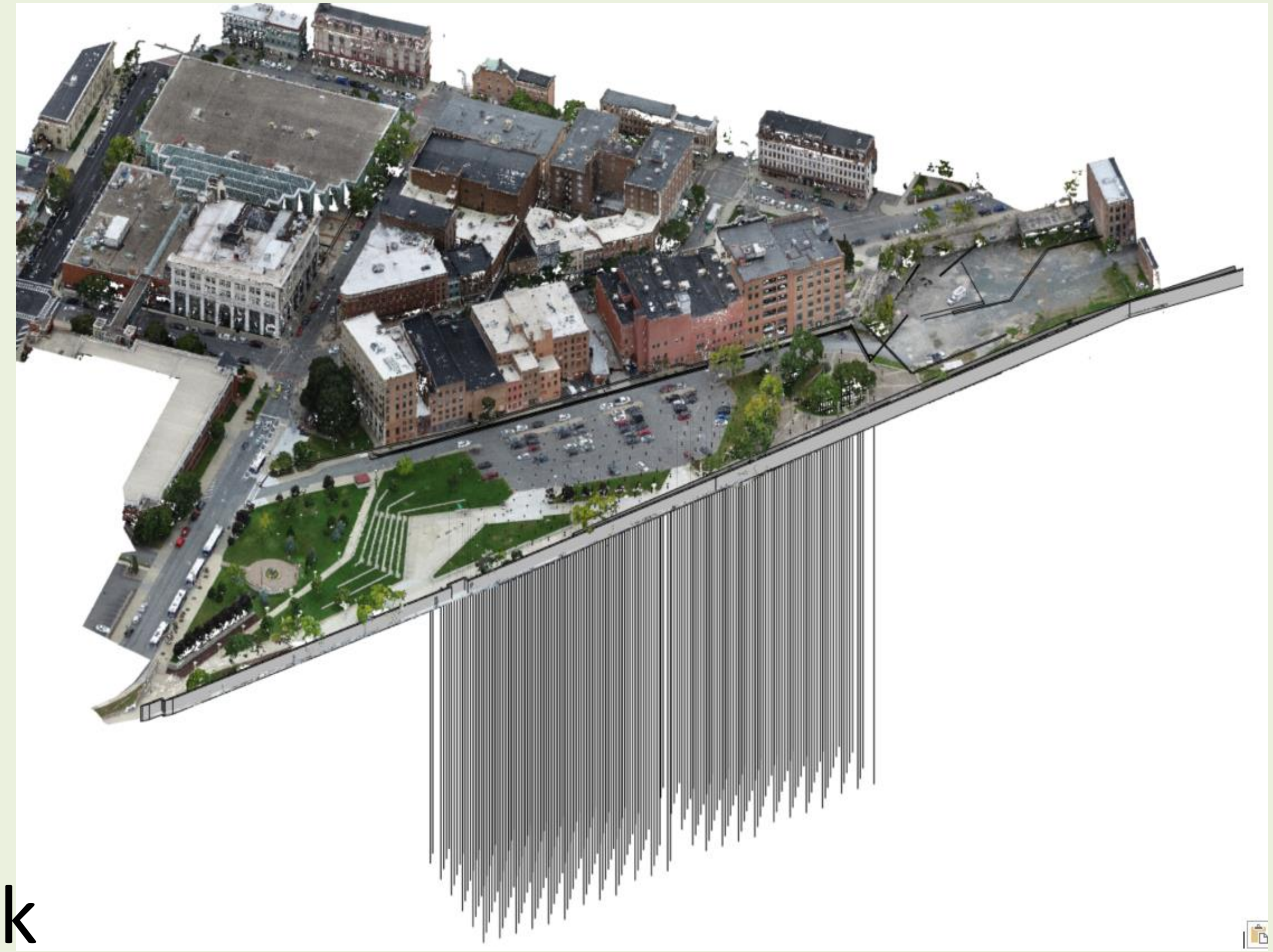
Disadvantaged Community Benefits



- Municipal Ownership
  - – Revenue returned to community
    - Tax reduction
    - Community improvement
    - Future district energy expansion
  - – Reduced utility rates
  - – Improved local air quality
  - – Potential job creation
  - – Job Transition (ex. Delivered Fuels Providers)

Case Study – City of Troy

- Partial Municipal Ownership
- Project Supporting DAC
- Geothermal Base (~200 wells)
- Load Diversity
  - Existing HP Buildings
  - New Build/Renovation
  - Existing Multifamily/Office/Entertainment
- Supplement Surface Water/Black Water HEX



Case Study – Village of Saranac Lake

- Delivered Fuels
  - Fuel Oil
  - Propane
- Job Transition Opportunity
- No Gas Available
- Planned Municipal Ownership
- Customer Upgrades
- Diverse Source & Loads
- Submitting to EPA Grants

Thank you!

Presented by:

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Website: https://www.chacompanies.com/

Geothermal Network
Site Selection

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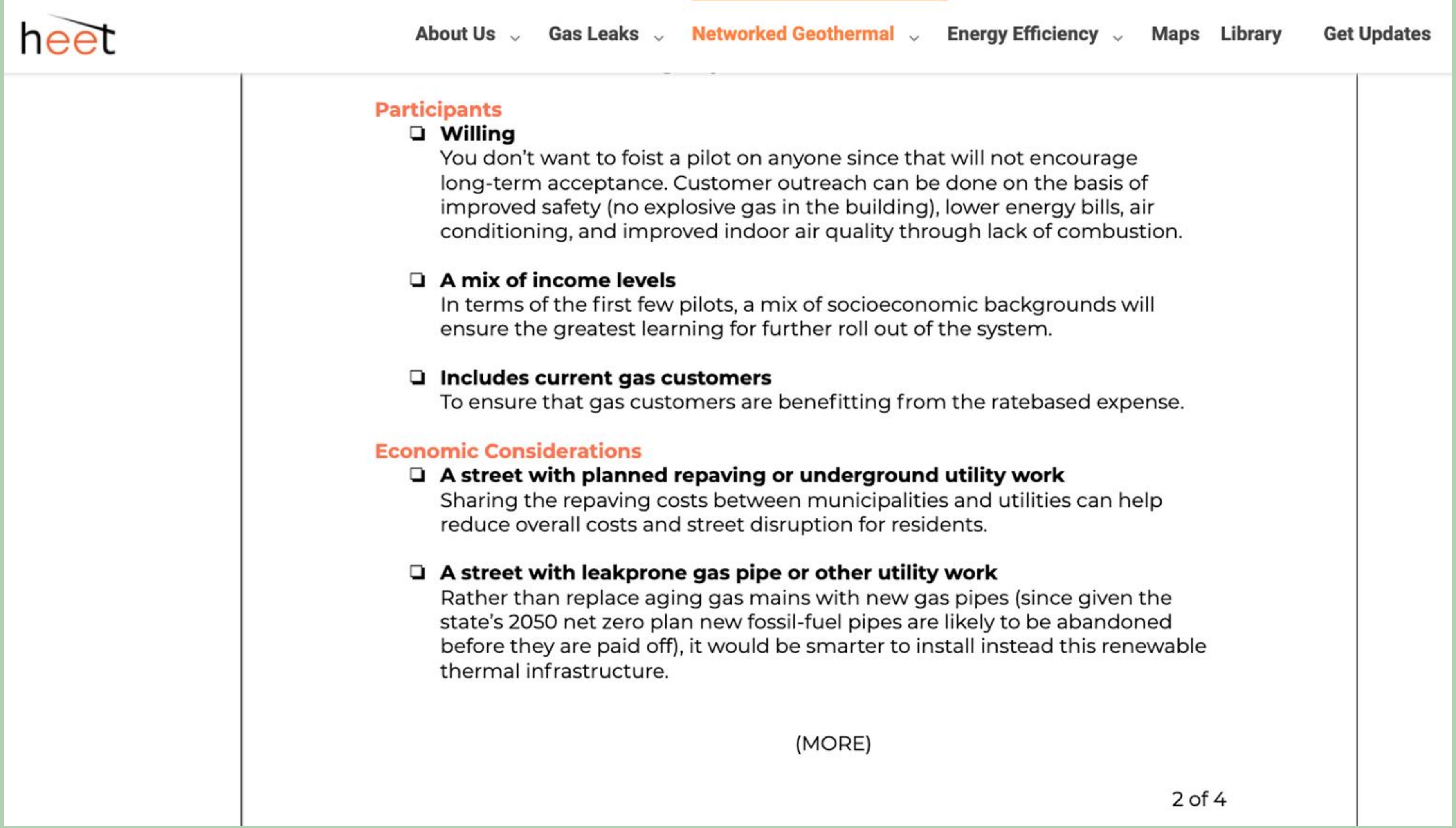
Stakeholder Developed Site Selection Checklist Online



Participants

- ☐ **Willing**
  You don’t want to foist a pilot on anyone since that will not encourage long-term acceptance. Customer outreach can be done on the basis of improved safety (no explosive gas in the building), lower energy bills, air conditioning, and improved indoor air quality through lack of combustion.

- ☐ **A mix of income levels**
  In terms of the first few pilots, a mix of socioeconomic backgrounds will ensure the greatest learning for further roll out of the system.

- ☐ **Includes current gas customers**
  To ensure that gas customers are benefitting from the ratebased expense.

Economic Considerations

- ☐ **A street with planned repaving or underground utility work**
  Sharing the repaving costs between municipalities and utilities can help reduce overall costs and street disruption for residents.

- ☐ **A street with leakprone gas pipe or other utility work**
  Rather than replace aging gas mains with new gas pipes (since given the state’s 2050 net zero plan new fossil-fuel pipes are likely to be abandoned before they are paid off), it would be smarter to install instead this renewable thermal infrastructure.

(MORE)

2 of 4

Stakeholder Engagement in Site Selection

The 63 participants present included utility executives, regulators, labor and workforce representatives, community organizations, advocates, geothermal designers and installers, and heat pump installers and manufacturers.

Questions?

Geothermal networks: What makes a good geothermal network?
Where should we start and why?

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