Eversource Geothermal Pilot Project

Clean Heat – The Potential of Networked Geothermal

Agenda

- Geothermal Background
- Project Proposal and Approval
- Objectives
- Site Selection
- Engineering Design Work
- Construction
- Monitoring and Evaluation
- Pathway Forward

Our Commitment to Carbon Neutrality

Eversource has been recognized as one of the most sustainable energy companies in the nation. We are committed to leading the way in environmental, social and governance performance, demonstrated in part by our ambitious Carbon Neutrality goal.

CLIMATE LEADERSHIP

Eversource aims to be carbon neutral by 2030 by reducing our carbon footprint from corporate operations and increasing resiliency to climate change impacts.

CLEAN ENERGY

We are committed to bringing more clean and affordable energy to the region.

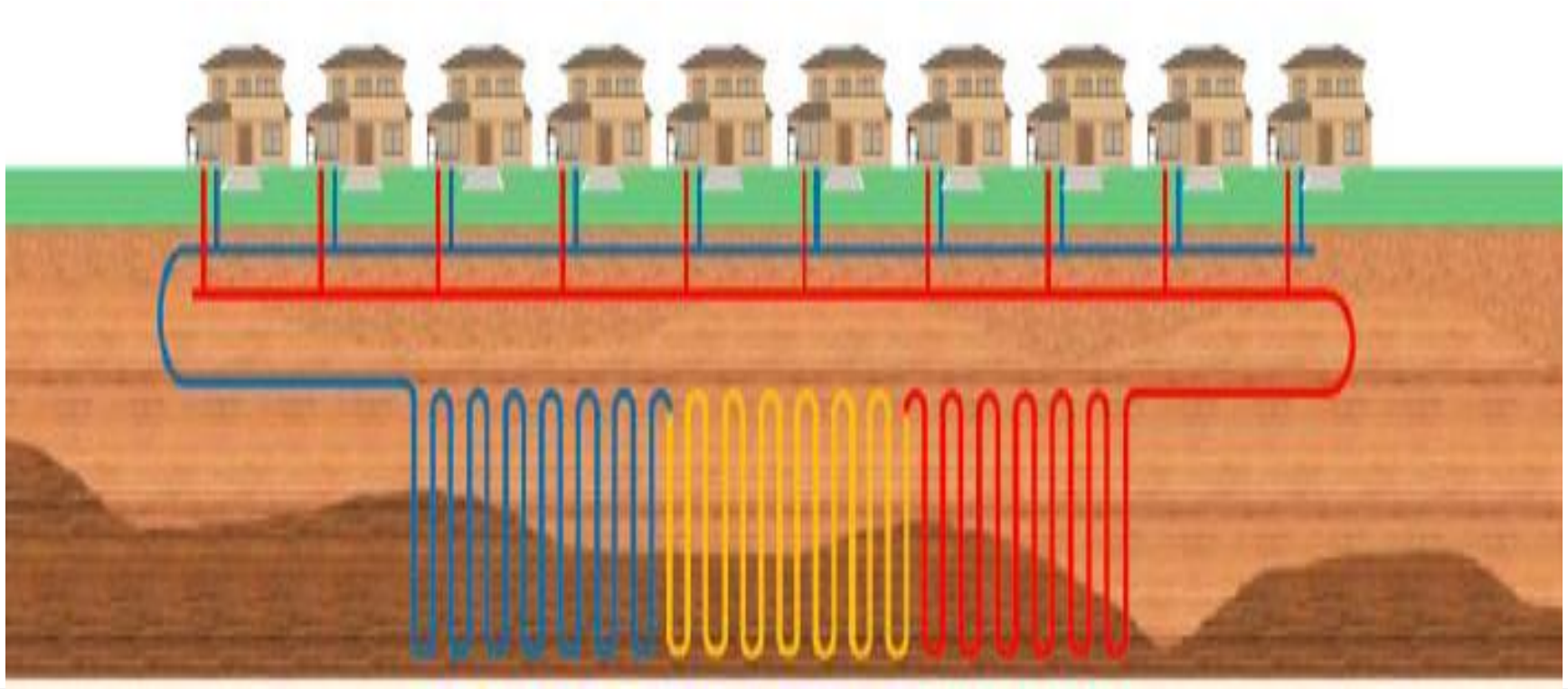
ACCOUNTABILITY

We meet and, in many cases, exceed all environmental laws and regulatory commitments and requirements.

STEWARDSHIP

We take great care to promote conservation and protection of wildlife, natural and cultural resources.

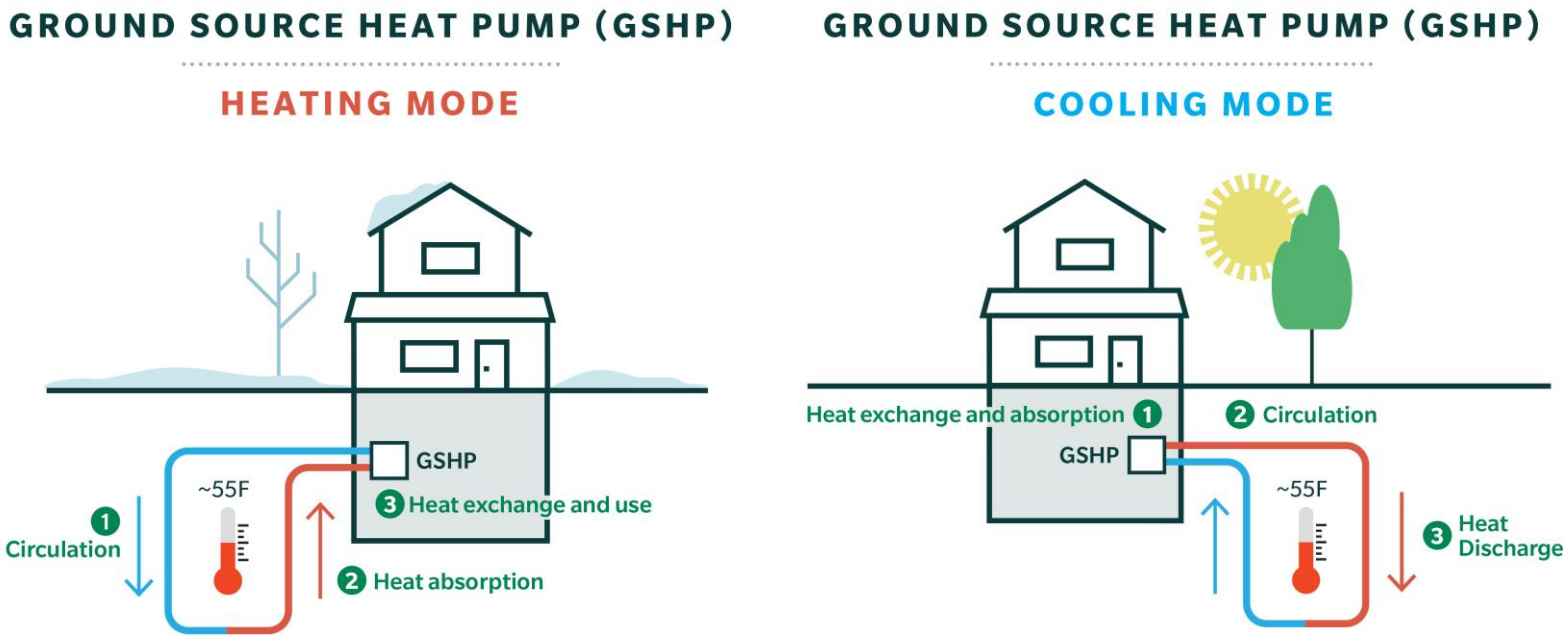
What is Networked Geothermal?



Example of a Closed Loop, Vertical System

- Ground source heat pump **(GSHP)** system is a heating and cooling solution for customers
- Use the **relatively stable temperature of the ground** to provide heating and cooling
- **Very efficient systems**, with Coefficients of Performance (COP) of 300-600%

Is Geothermal New Technology?



"Archaeological evidence shows that the first human use of geothermal resources in North America occurred more than 10,000 years ago with the settlement of Paleo-Indians at hot springs."
Source: energy.gov

Geothermal Networks

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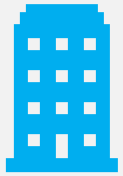
Program Structure

The demonstration project initially sought to test the viability of geothermal networks in three different scenarios. Ultimately the mixed use scenario was approved by the DPU



MULTI-FAMILY

# of HVAC Units: 30
Tons Per Unit: 2
Overall Tons: 60
Well Capacity: 75 Tons
Estimated Budget: $2.2M

MIXED USE/DENSE URBAN

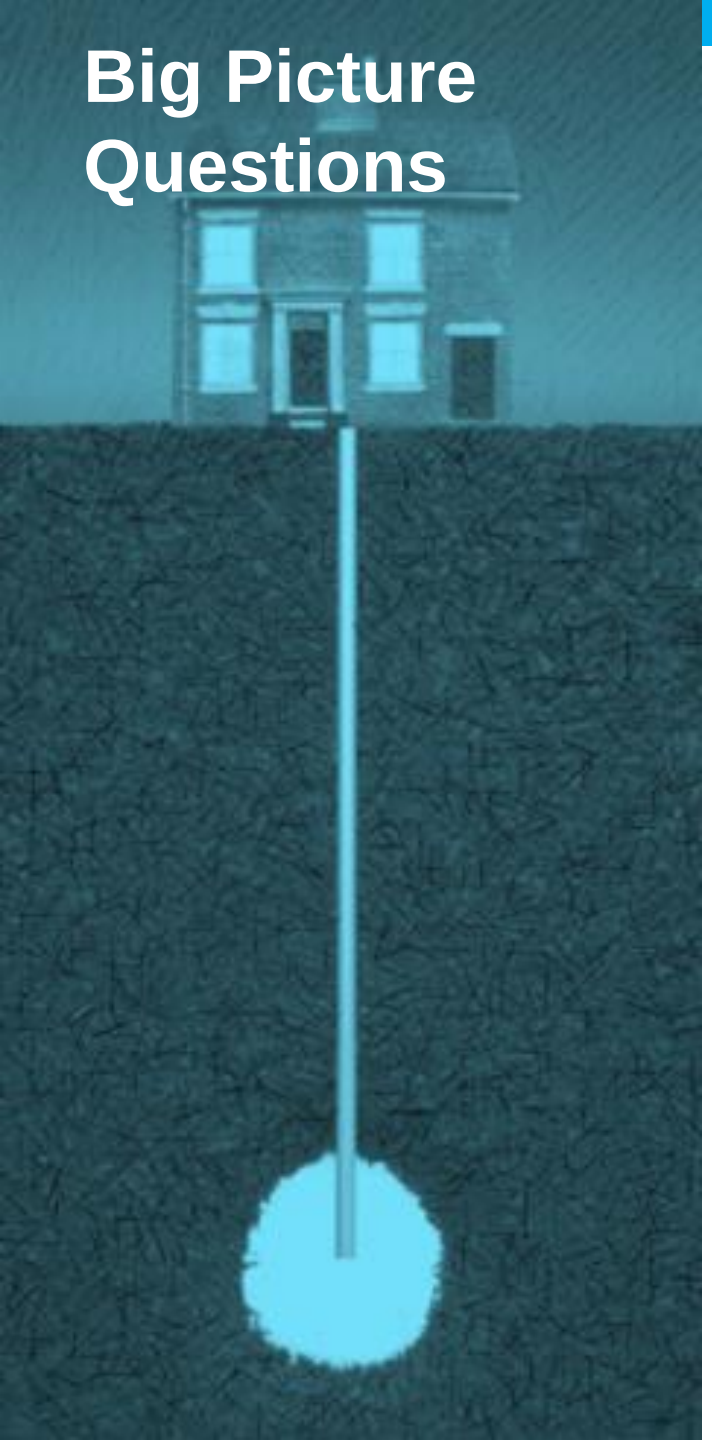
# of HVAC Units: 100
Tons Per Unit: 3
Overall Tons: 300
Well Capacity: 375 Tons
Estimated Budget: $10.2M

RESIDENTIAL NEIGHBORHOOD

# of HVAC Units: 10
Tons Per Unit: 3
Overall Tons:30
Well Capacity: 37.5 Tons
Estimated Budget: $1.2M

Budget estimates are inclusive of: Construction costs, staff costs, O&M, energy, water/glycol, performance monitoring

Big Picture Questions



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

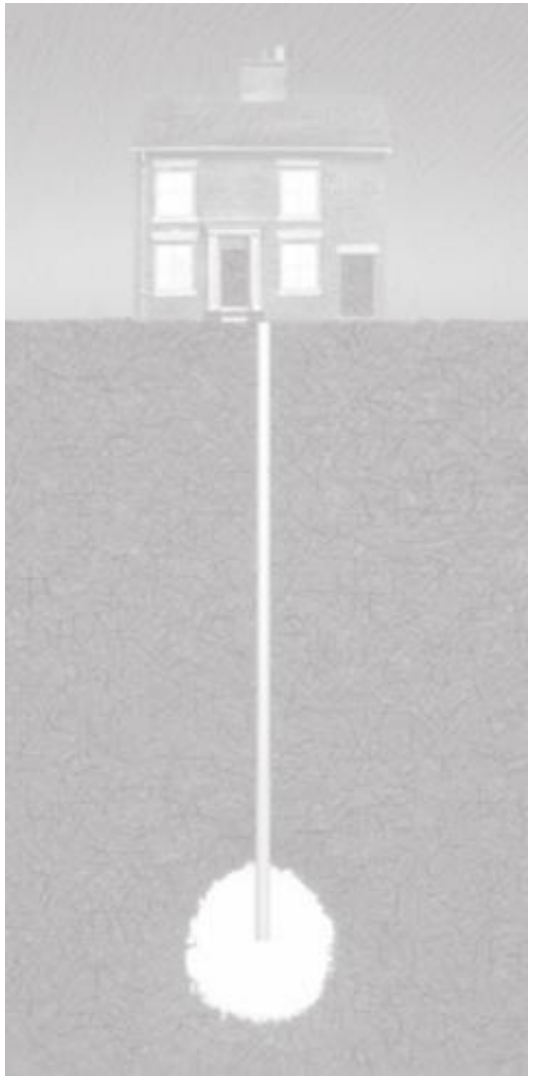
Data Points to Collect

Questions	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
Carbon reductions	• Emission reductions • System performance
Technology performance	• System performance • Changes in customer energy consumption
Cost savings	• Changes in customer heating and cooling costs

The pilot project is an opportunity to answer key technical and financial questions that would enable the Company to decide whether to roll out a larger offering

Similarities Between Geothermal and Natural Gas Business

From a big picture perspective, geothermal and natural gas businesses share many common aspects



- Capital Intensive
- Buried/Underground Infrastructure
- Long Lived Assets
- Regulated Service
- Monitoring System Conditions
- Similar Customer Barriers
- Similar Point of Common Coupling

Existing Gas Business Model Addresses Common GSHP Concerns

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Existing gas business model and operations may be conducive to building, owning, and operating ground source heat pump networks

COMMON OBSTACLES TO GSHPS	EXISTING GAS BUSINESS OPERATIONS
Large upfront capital costs	Utility makes investment in capital projects and rate bases those assets across customers
Reluctance to spend money on infrastructure when customer might be in space for limited time period	Utility amortizes long lived assets over many years
Maintaining infrastructure outside of the customer's structure	Utility owns, operates, and maintains infrastructure in public/private ROWs

Benefits for Different Stakeholders

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Utility

- Provide customers an additional choice/alternative for heating
- Possible new business line
- Capitalize on existing gas company core competencies
- Flatter load profiles, higher utilization of infrastructure

Customer

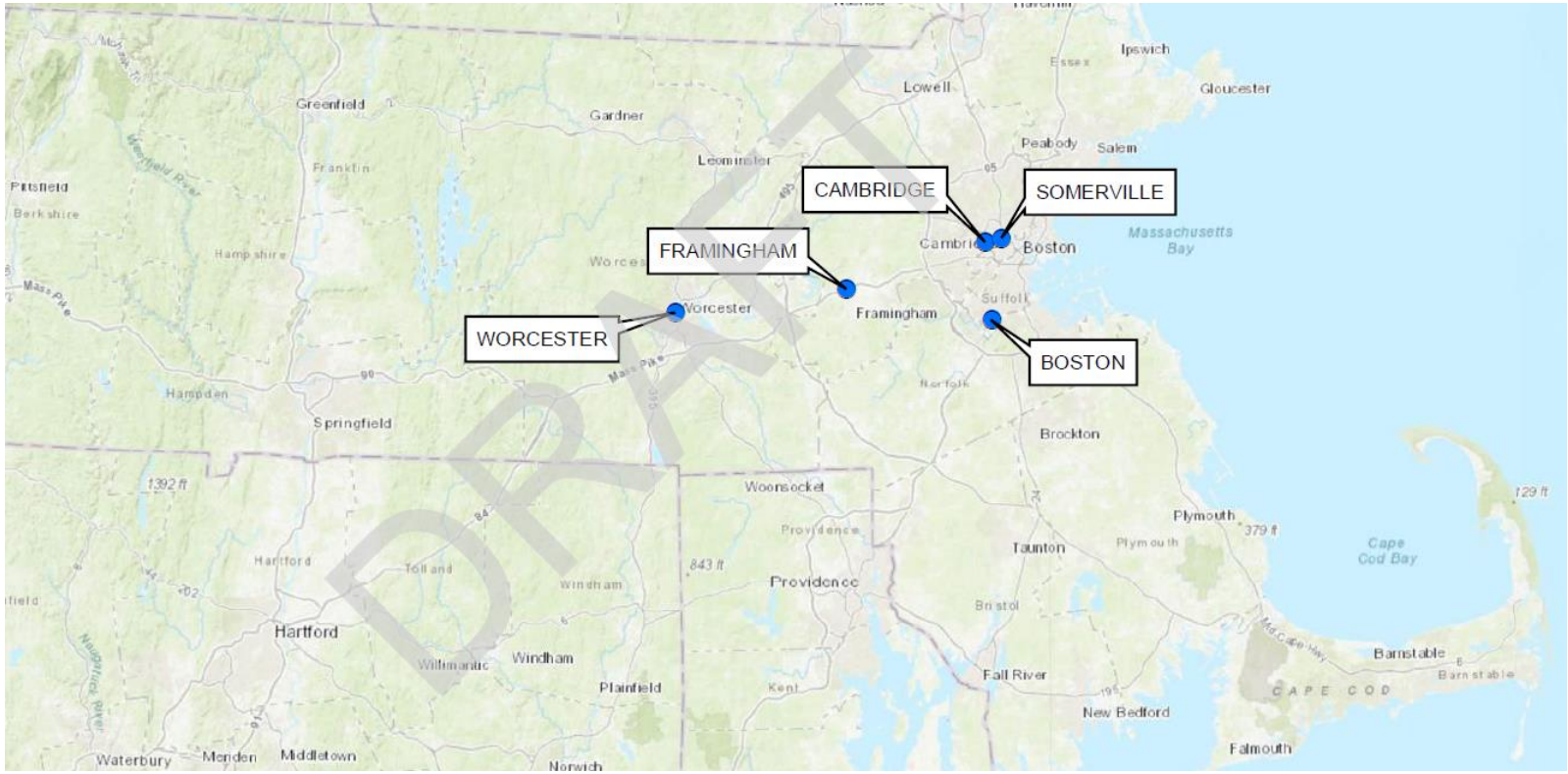
- Provide low-cost heating where gas is not available
- Cleaner, safer, quieter, reliable system
- Provides both heating and cooling
- GSHP equipment is located inside the building so there is an ease of repair/maintenance and no aesthetic impacts

State

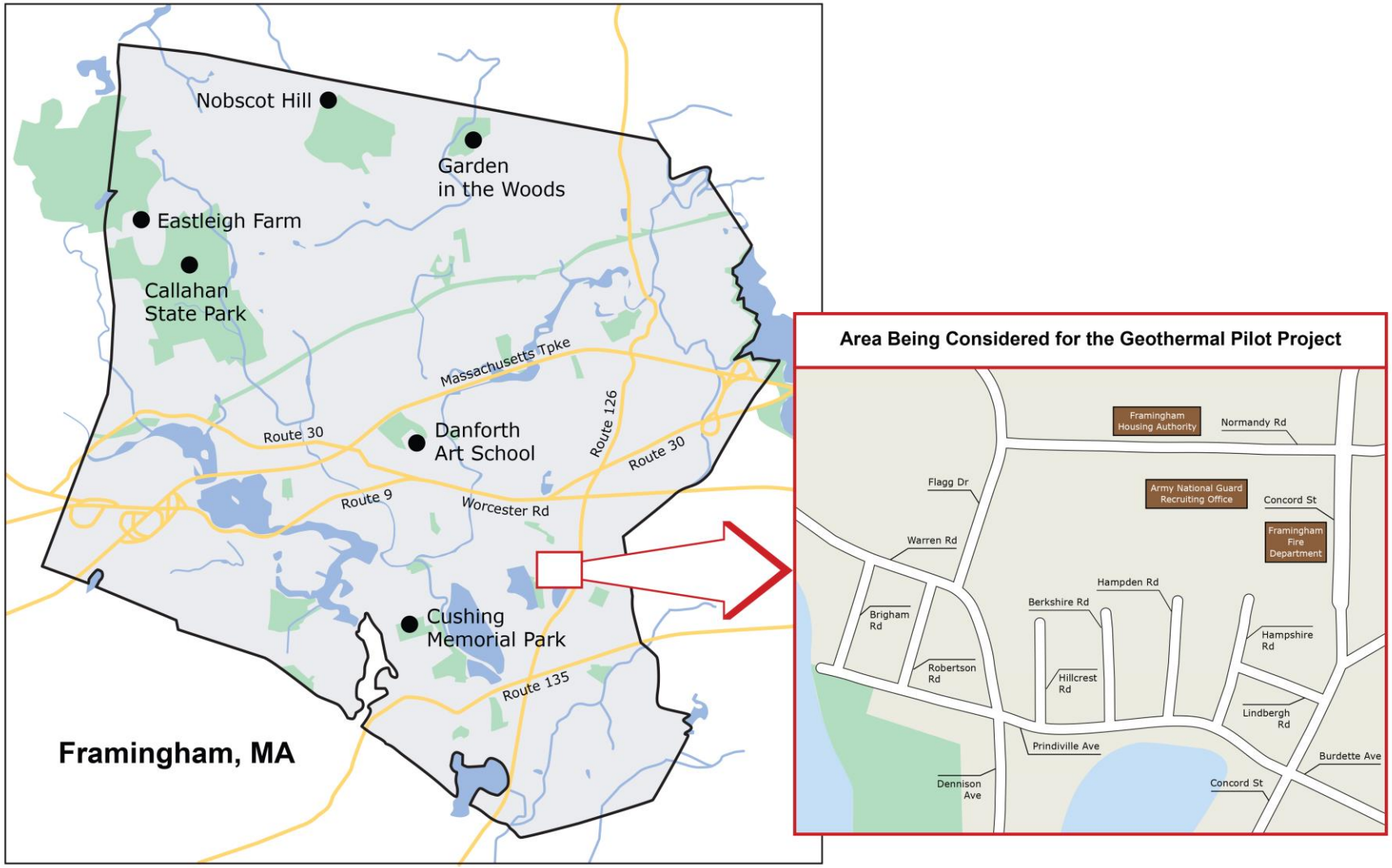
- Provides state with another way to meet to climate goals
- Estimated 60%+ reduction in carbon emissions from combined heating and cooling for an average residence by installing GSHP

Site Selection Process

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



Framingham Neighborhood Selected



Customer Outreach

- Entire area was canvassed for customer willingness to participate
- Overwhelmingly positive response from customers that we were able to speak to
- Customer outreach done in coordination with the City of Framingham
- Sales and Technical representatives worked together to address customer questions

Project Timeline

End of 2021 – Eversource will select the pilot site

Spring of 2022 – Construction is scheduled to begin

Timing of construction and installation activities will be site-specific.

Three years – The pilot program duration

Community Meeting

Once a pilot area is selected, Eversource will host a community meeting with residents and building owners. We want you to understand the project and will respond to your concerns or questions. Eversource will reach out to customers with meeting details after the pilot area is selected.

Post-Pilot Project

After the pilot project, Eversource or the customer may decide to stop using geothermal energy. Eversource will design and install the geothermal network system to minimize the cost and disturbance that come with stopping the program. The customer may choose to return to the original heating system (at no cost), shift to either an all-electric air source heat pump system (50% of the cost will be covered by Eversource), or continue with geothermal via an individual ground source heat pump. If the customer continues with their own geothermal, they will be responsible for the cost of installing a private vertical ground loop on the property.

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GEOTHERMAL PILOT PROGRAM

As the largest utility provider in New England, Eversource is committed to using energy sources and technologies that reduce/eliminate emissions, are low maintenance, cost-effective, and reliable, while also being environmentally sustainable well into the future. Eversource is investing in one such promising technology: a geothermal network pilot.

The pilot program eligibility and community selection process criteria are described in the frequently asked questions (FAQs) and on the Eversource pilot program website.

Scan this QR code with your smart phone camera for a direct link to the pilot program website.

www.eversource.com/content/ema-c/business/save-money-energy/explore-alternatives/geothermal-pilot-program

We're building a green community.

Join us!

Be a part of this innovative, community-minded, environmentally friendly pilot project that is happening in your neighborhood. As the largest utility provider in New England, Eversource has the responsibility to provide energy using the best methods possible for customers and the environment.

Eversource is working with the Massachusetts Department of Public Utilities to build a **geothermal** project that is the first of its kind in New England using networked geothermal technology. You'll be a part of a group sharing geothermal wells in your community.

Learn more about this three-year pilot that uses geothermal technology, which works by transferring heat to and from underground wells into your home using heat pumps. A geothermal system, on average, is up to 400% efficient and is the most environmentally friendly way to **heat and cool** your home.

Benefits to Those Who Participate in the Program

No direct cost to you:

- Geothermal heating and cooling equipment installed in your home that will provide both heating and central air conditioning ($30,000 value)
- New ductwork installed, if needed, in your home ($15,000 value)
- Energy-efficiency measures such as insulation and air sealing for your home (up to a $4,000 value in addition to existing Mass Save® incentives)
- Energy savings up to 40% on heating your home
- Full restoration of the affected areas of your lawn, if needed, after geothermal line from the street is installed
- System looks like a conventional heating system and is installed where your existing system is located
- System is quiet and long-lasting

Reduce your carbon emissions.

Because geothermal heat pumps don't require combustion of fossil fuels or fuel storage, installing geothermal is the single biggest way a homeowner can reduce their carbon (CO_2) emissions. According to the U.S. Environmental Protection Agency (EPA), geothermal heat pumps are the most energy efficient, environmentally clean, and cost-effective systems for heating and cooling buildings.

Comfort now, value later.

With this system, you'll have consistent heating and cooling, regardless of the season. A geothermal system is very energy-efficient because it uses the earth's stable temperature. According to the EPA, for every unit of electricity used in operating the system, the geothermal heat pump can deliver as much as four times the energy. That's 400% efficient! Geothermal heat pumps can achieve this efficiency because they don't create heat — they just transfer it, making it the most energy efficient home heating and cooling system on Earth.

And energy efficiency measures implemented with this program may increase the value of your home.

Can't wait to hear more?

Contact Marisol Burgos at **860-665-6255**. Call today!

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Customer Agreement

- Based on gas service agreement terms but adjusted for Geothermal Pilot
- Approved by Massachusetts D.P.U in Jan 2022
- Installation terms and responsibilities described
- Length of service defined as the pilot duration
- Basic service charge included as per D.P.U order
- Termination options identified as per D.P.U guidance

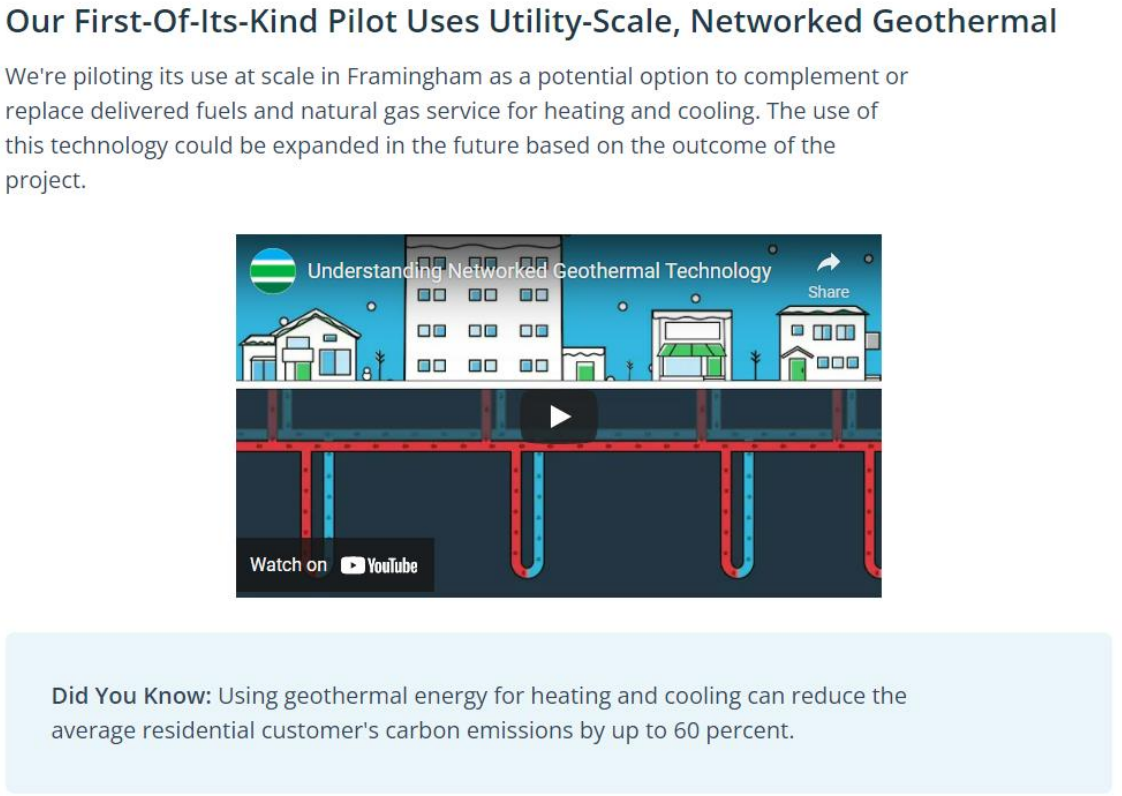
GEOTHERMAL ENERGY SERVICE DEMONSTRATION PILOT

SERVICE AGREEMENT

THIS GEOTHERMAL DEMONSTRATION PROGRAM SERVICE AGREEMENT ("Agreement") is entered into as of the ____ day of _____, 2021 ("Effective Date"), by and between NSTAR GAS COMPANY d/b/a Eversource Energy, a Massachusetts corporation and gas company, with an address at 247 Station Drive, Westwood, Massachusetts 02090 ("Company") and _____, _____, with an address at _____, Massachusetts _____ ("Customer"). The Company and Customer are each referred to herein singularly as a "Party" and collectively as "Parties".

Stakeholder Engagement

- A Geothermal section of the Eversource Website was developed
  https://www.eversource.com/geothermal
- A Geothermal specific email address was created for inbound communications and questions
- Interested parties were added to a geothermal mailing list for project updates
- Eversource presence at public events such as Earth Day and other community initiatives
- Regular updates are held with the AG, DOER, and groups such as HEET



*Snapshot from Geothermal website with informational video

Site Selection Finalization

- Site screenings 1 and 2 completed
- Multiple configurations in the selected neighborhood considered
- All configurations in final neighborhood had similar scores in screening 2
- Anchor loads (commercial customers) were established first and loops developed around them
- Input from the city was also considered for specific layouts

FRAMINGHAM 1B SITE PLAN

FRAMINGHAM 4A.1 SITE PLAN

FRAMINGHAM 5B SITE PLAN

*Potential loop configurations that were considered

Primary Loop Layout Design

- Current primary layout option
- Single pipe design displayed (two pipe option available)
- Planned ~300 ton system
- ~30 Residential Homes, 5 Commercial Buildings, 10 Apartment Buildings
- Main borefield with smaller satellite fields
- Design is dependent on customer willingness to participate
- Alternate route has been established as a backup option

Loop Design Considerations

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- Loop designs were considered with a number of criteria in mind:
  - One Pipe vs Two
  - Pumping Energy
  - Overall Efficiency
  - Temperature Variation
  - Ease of Expansion
  - Cost and Construction Scope

Option	Advantages	Disadvantages
Two-pipe	▲ Consistent, predictable water temperatures to each building ▲ Works well with large, centralized bore field which avoids downtime and simplifies water / cuttings management ▲ Centralize location of thermal balancing with boilers / dry coolers	▼ Larger Central Pumping Requirements that account for service line heat exchanger pressure drop ▼ More challenging with setbacks to other buried utilities in ROW ▼ Less expandable to neighboring thermal networks ▼ Less opportunity for redundancy and resiliency with central ground loop location
One-pipe	▲ More expandable to neighboring networks in almost all directions ▲ More opportunity for redundancy and resiliency with distributed thermal recharge ▲ Less distribution piping between buildings / in the street with less space required within ROWs ▲ Lower first cost for lateral piping & installation ▲ Lower central pumping energy resulting in lower flow rates and smaller pipe sizes for distribution piping ▲ Connection on either side of the street without crossovers ▲ Can incorporate various types of thermal sources and sinks specific to the site (surface water, wastewater/sewer, horizontal ground loops, etc.) ▲ Requires distributed recharge	▼ Requires distributed recharge to have equitable entering water temperature (EWT) ▼ Requires service line pumps, buildings, and recharge field ▼ Vertical heat exchanger drilling will impact more customers ▼ Can result in greater number of access points (man-hole covers, etc.) or would require building access to service in-line pumps

Project Timeline

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End of 2021 — Eversource selected the pilot site

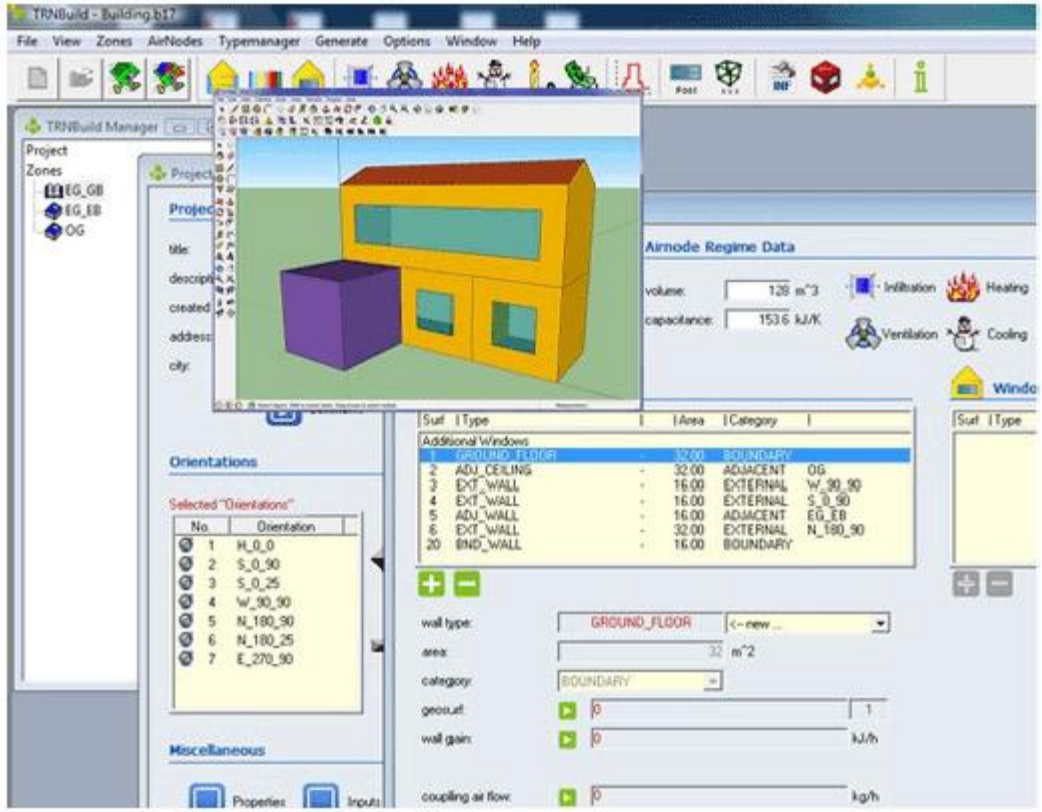
Mid-to-late 2022 — Construction is scheduled to begin

Timing of construction and installation activities
Will be site-specific. (Approximately one year.)

Three years — Total pilot program duration (two heating and cooling seasons)

Engineering Design Workstream

- Ongoing procurement process for Engineering Design firm
- Design will involve several work areas:
  - Building Site Visits
  - Thermal Modeling
  - Pump House Design
  - Borefield Sizing
  - Instrumentation and Monitoring Elements
  - Drawing Preparation
  - Permitting Support
  - Initial Construction Support



Construction Workstreams

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Vertical Loops

- Borehole Drilling
- Central Pump House
- Control and Monitoring

Horizontal Loop

- Main Installation
- Service Installations
- Heat Exchanger Installation

Customer Installations

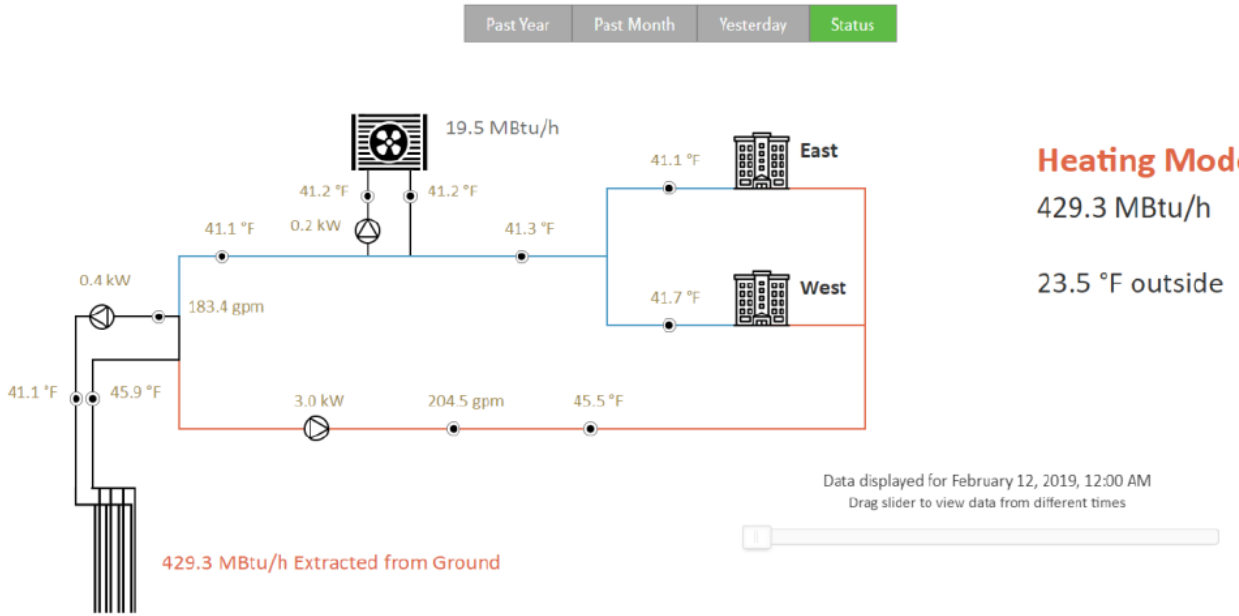
- Weatherization
- Ducting and Electrical
- Heat Pump Installation

Construction Budget Considerations

- Budget was established in the initial filing and based on established industry metrics for cost per ton
- Market conditions at the time of the filing (2020) were used
- Quarterly updates on progress and budget adjustments are made to the Massachusetts D.P.U
- Industry metrics were compared to existing cost metrics for installing gas infrastructure (mains and services)

Operation and Monitoring

- 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



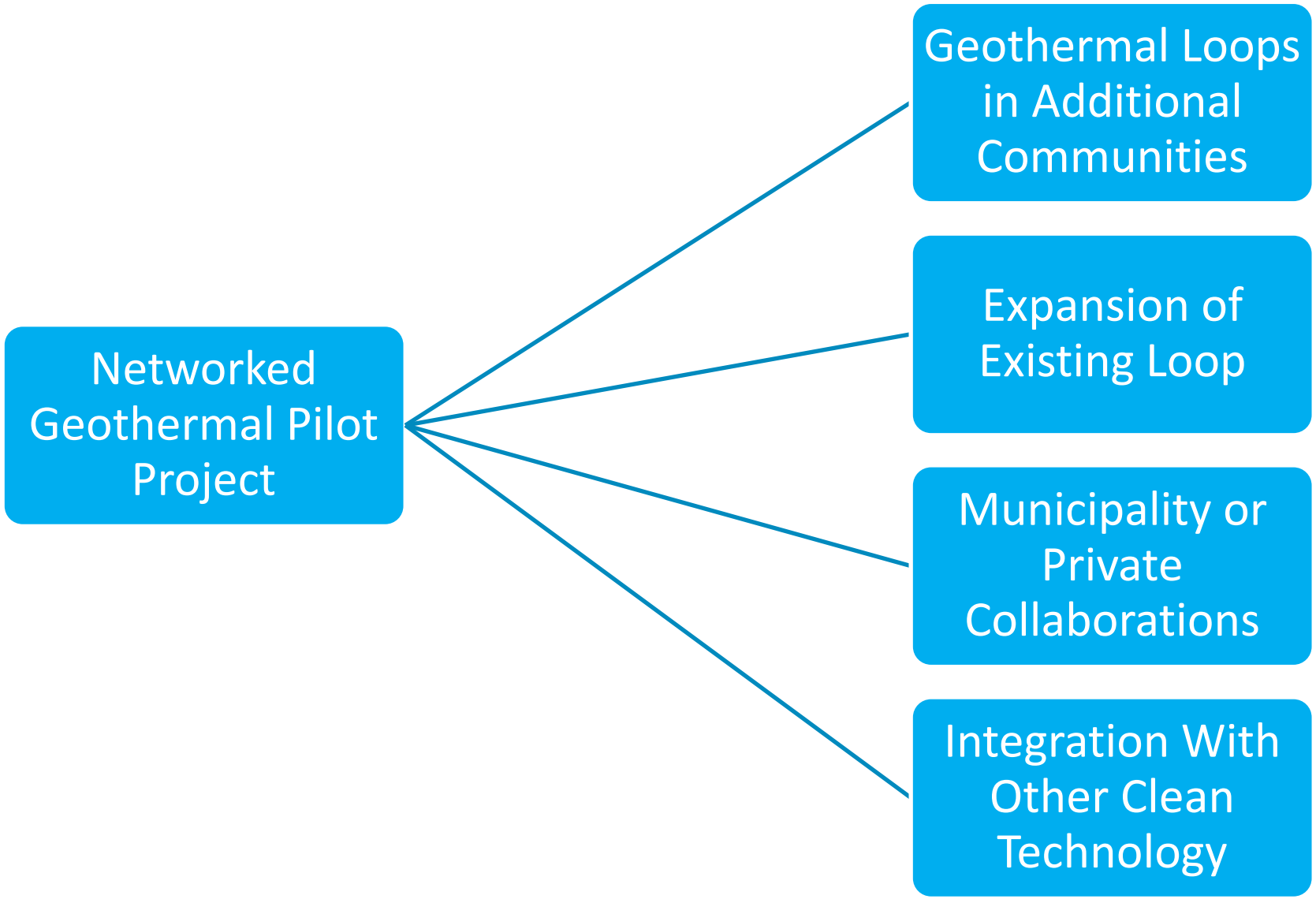
Third Party Evaluation

- An outside evaluation firm has been brought on to assist with measuring the pilot projects performance
- Technical performance, financial impacts, and customer satisfaction will all be monitored throughout the project
- A report will be created as part of the process to capture the key takeaways and learnings from the pilot project

Potential Challenges

- Learning curve associated with drilling (not typically a utility activity)
- Current size of the geothermal industry
  - Geothermal firms have traditionally been smaller businesses
  - Work capacity may be limited for a larger program implementation
- Ongoing supply chain environment
  - Quickly rising prices
  - Equipment availability
- Widespread customer adoption
  - Maintaining customer choice
  - Potential for new business opportunities
- Regulatory environment for future installations
  - No established rate mechanism
  - No established safety regulations

Future Opportunities



Discussion & Questions