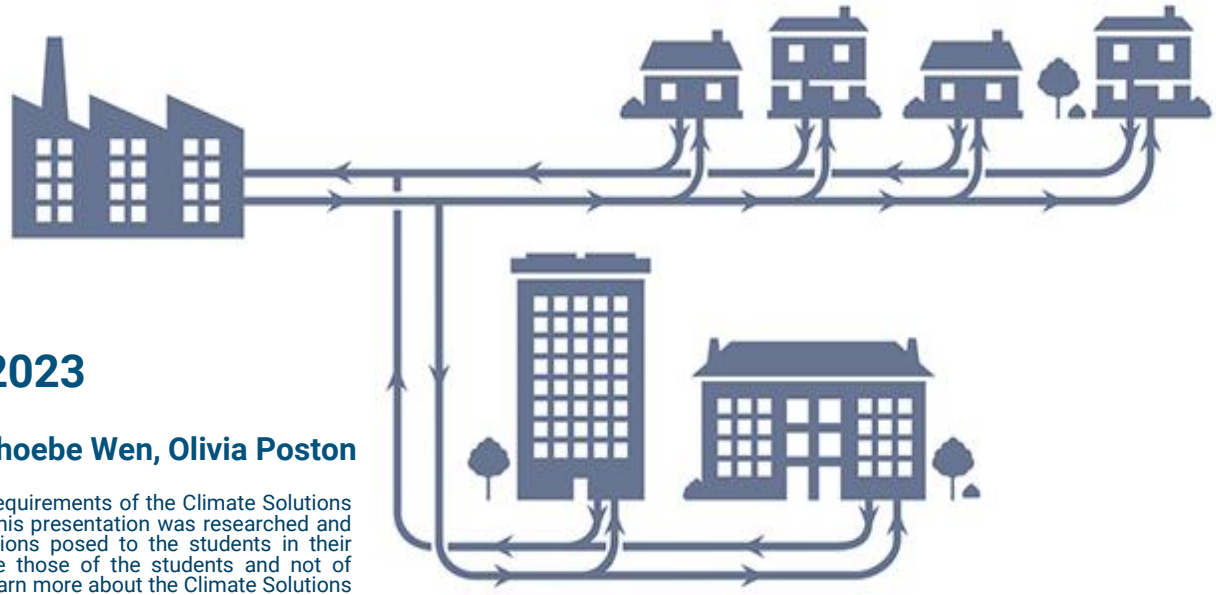
Shared Access to Net-Zero Energy Systems



Climate Solutions Living Lab 2023

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This presentation is student work product completed to fulfill requirements of the Climate Solutions Living Lab, a 12-week course offered at Harvard Law School. This presentation was researched and written under tight time constraints to answer specific questions posed to the students in their course assignment. Any opinions expressed in the report are those of the students and not of Harvard University or Harvard Law School. If you would like to learn more about the Climate Solutions Living Lab, please contact Aladdine Joroff at aladdine@gmail.com.

Overview

- Project background (Context & Assumptions)
- Connecting to Third-Party Properties
- Performance and Reliability
- Environmental Impacts and Credits
- Disruptions to the Shared Energy System
- Safeguards against ‘Green Gentrification’
- Technical Considerations and Third Party Eligibility
- Conclusion and Key considerations

Project Background

Project Background

Context

- An institution is exploring opportunities and obstacles to providing service from its geothermal energy system to third-party properties.

Simplifying Assumptions

- The institution is motivated
- Financing is secured
- Permitting is in place

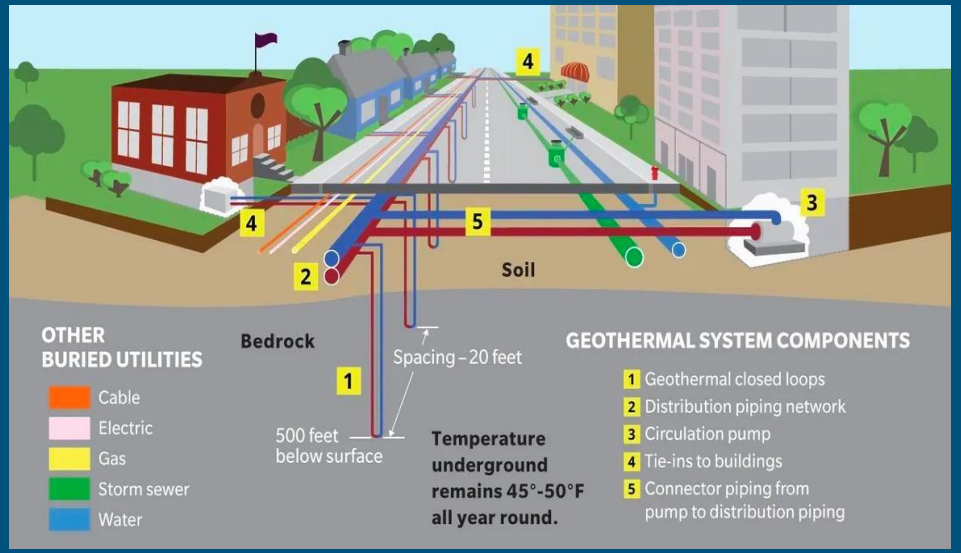
Connecting to Third-Party Properties

Connecting to third-party properties

1. Systems required
2. Ownership
3. Procurement
4. Payment Terms and Financing

Systems required

1. The grid
2. Heat exchanger
3. Sensors
4. Property’s distribution system



Source: Eversource

Terms: The Easy Ones

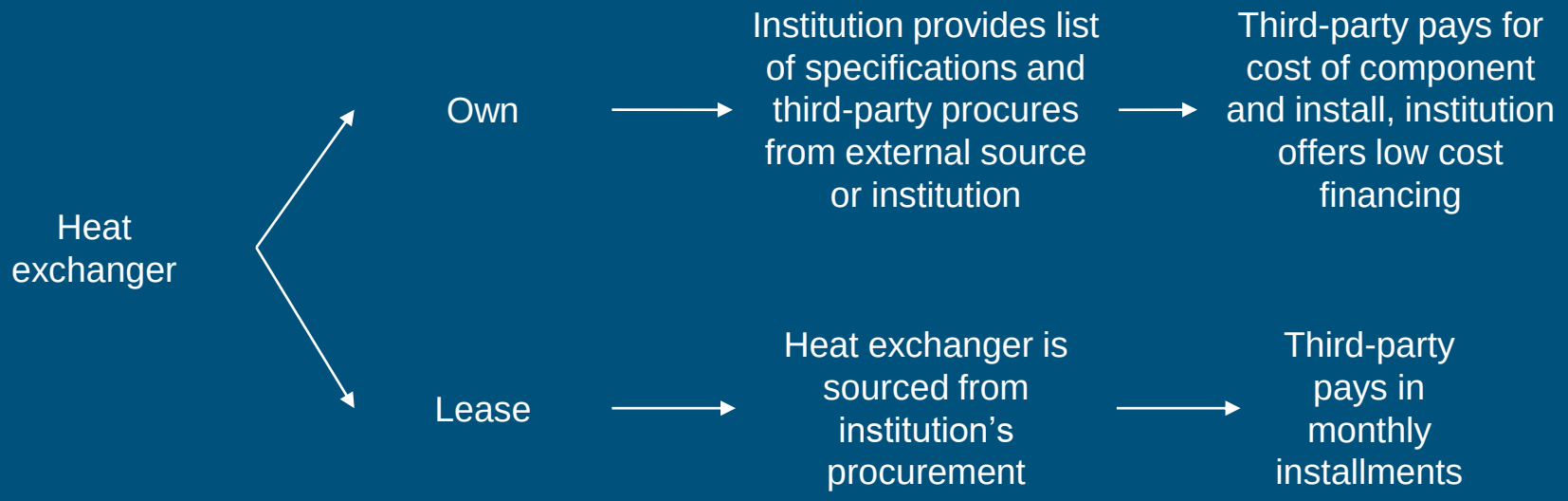
System	Ownership	Procurement	Payment & Financing

The grid → Institution → Institution → Institution

Sensors → Institution → Institution → Institution

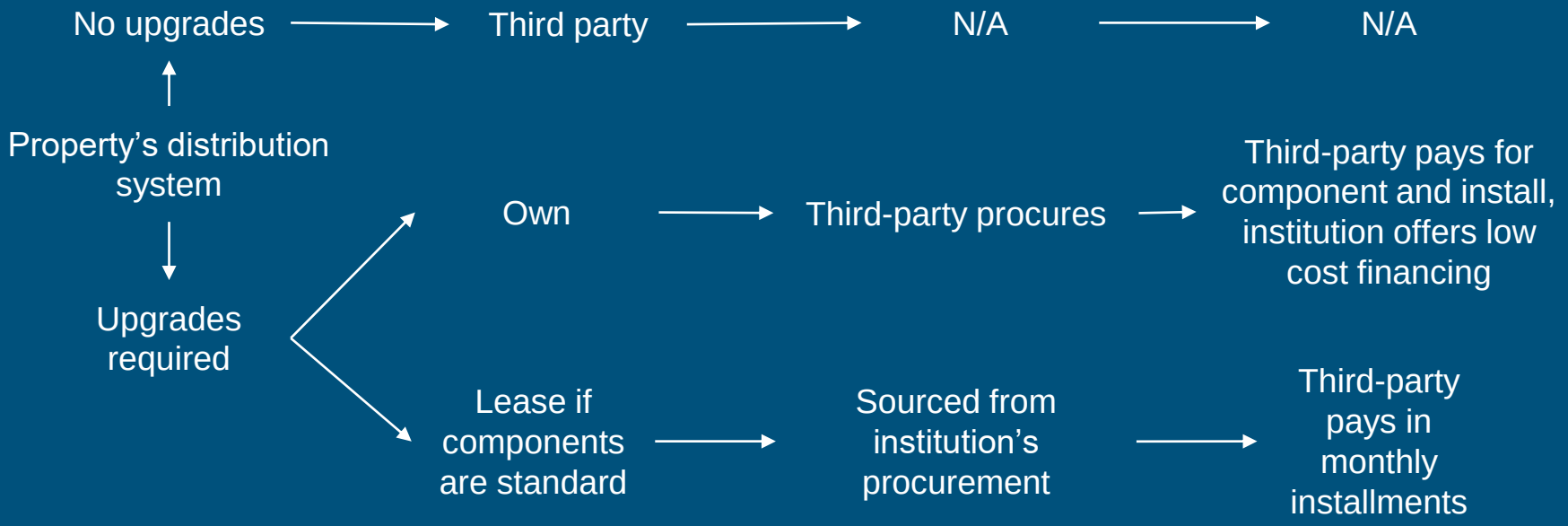
Terms: Heat Exchanger

System	Ownership	Procurement	Payment & Financing



Terms: Property's distribution system

System	Ownership	Procurement	Payment & Financing



Terms: Low cost financing

The institution can leverage its stature and balance sheet to access capital. We think it could do this in a few ways:

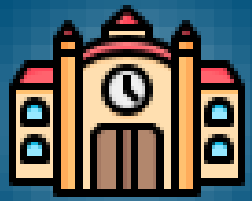
1. Raise a fund from its lenders to use as a source of capital for its own lending
2. Get an allocation of budget from the state or municipality it can use to lend
3. Partner with the state to inform third-parties of existing financing

Performance and Reliability

Day-to-Day Operations

Independent Experts

Local Government



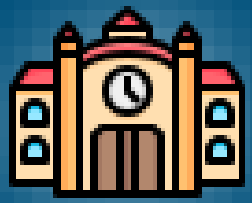
Institution

Management

Third Party properties

Normal Responsibility

Responsible For
Production



Institution

Energy

Responsible For

- Delivery
- Capacity Planning

Management

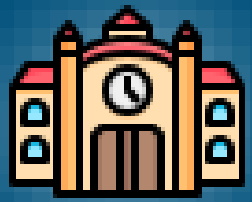
Energy

Third Party properties

Maintenance

Economy of Scale

Responsible For
Excess Production Capacity



Institution

Energy

Management

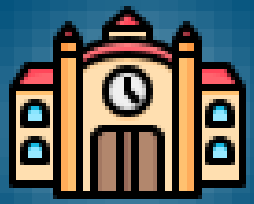
Energy

Third Party properties

Force Majeure

Energy

Good faith attempt to ensure production
Not obligated to share



Institution

Energy

Management

Energy

Third Party properties

Pricing and terms

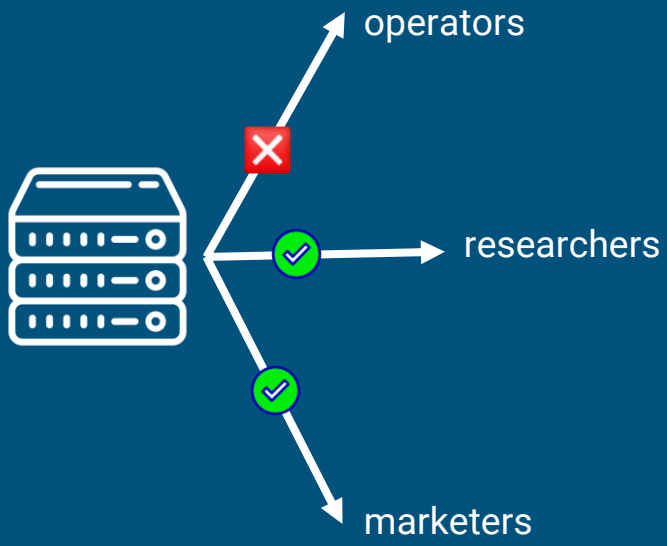
- Competitive against gas/oil
- Similar to other clean sources
- Cost effective
- Renegotiate if price is regulated

10 year minimum contract

- Termination for convenience - lump sum payment
- Termination for non-performance - cooperation in dispute
- Infrastructure

Data and Privacy

Can residents limit data sharing?



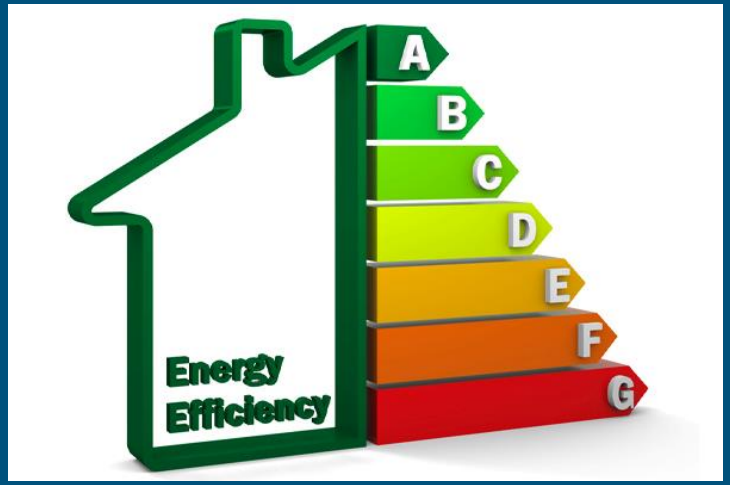
- Management responsible for safe data storage
- Data is only shared for specified purposes
- State-of-the-art anonymization if sharing publicly

Environmental Impacts and Credits

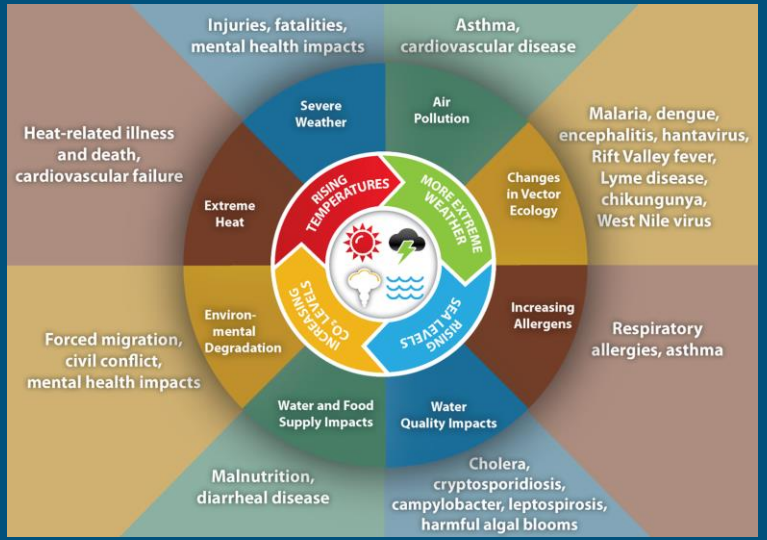
Environmental Impacts of Shared Geothermal Network

Benefits

1. Air quality improvement and climate change mitigation
    - Greater energy efficiency
    - Less air pollutants and greenhouse gases
        - Health benefits



https://www.townsendtotalenergy.com/electric-heat-pumps-costs



https://www.cdc.gov/climateandhealth/effects/default.htm

Environmental Impacts of Shared Geothermal Network

Benefits

2. Water resource saving

Compared with traditional systems:

- No need for cooling towers
- Treated wastewater utilization

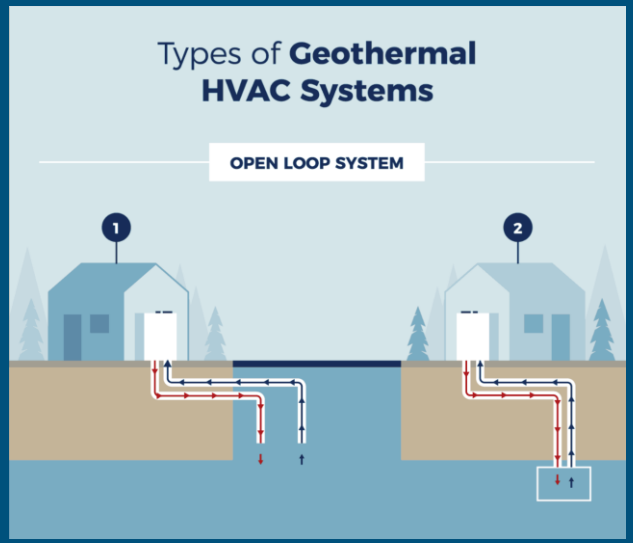
Compared with individual systems:

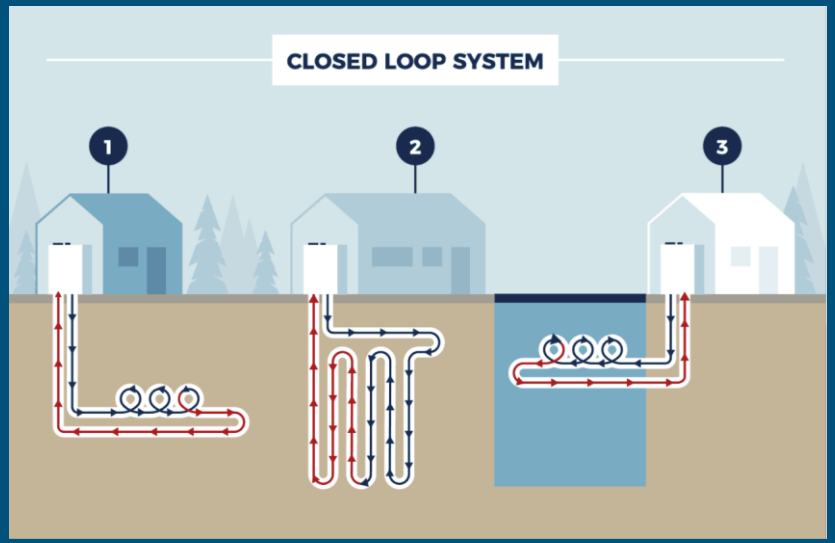
- Greater efficiency in water usage
- Reduced water resource associated with greater energy efficiency

https://www.santa-ana.org/water-conservation/

Potential Adverse Environmental Effects of Shared Geothermal Network

1. Influence the usage of potable water
   - Open loop-> Direct influences
   - Closed loop -> Indirect influences





https://www.furnacecompare.com/blog/resources/how-geothermal-hvac-works/

Potential Adverse Environmental Effects of Shared Geothermal Network

2. Ground disturbance
   - Soil compaction
   - Disruption of natural drainage patterns
   - Disturbance of biological habitats

https://www.trainanddevelop.ca/course-launch/newly-abcga-endorsed-ground-disturbance-201-course-from-astec-safety-ltd/

In order to maximize environmental benefits and minimize potential adverse environmental effects…

We think the institution could:

1. Utilize clean energy as back-up energy
2. Separate shared geothermal systems from the potable water supply
3. Consider environmental, health and safety (EHS) requirements

Environmental Credits

Additionality issue—Claims

- Check the eligibility of different credits

Verification and Certification issue–Counting

- Avoid double counting

Equity issue — Distribution

- Different scenarios
  - Direct ownership (full credits)
  - Shared ownership (percentage)
  - Third-party ownership (PPA)

https://www.kvue.com/article/news/investigations/defenders/carbon-market-climate-change-efforts/269-c9c0fcbe-b9c5-4952-a76a-aa288e37e9d0

Disruptions to the Shared Energy System

Disruptions to the Shared Energy System

- As geothermal wells are buried, there is little danger to the system from natural disasters
- Many disruptions will originate from ***a mechanical or communication disconnect***
  - *There is a greater risk of hackers: people who may pass firewalls and shut down communications*

Disruptions to the Shared Energy System

- Disruptions to geothermal wells stem from localized issues
  - *i.e. New England is known for fine, powdery snow in the winter*
- ***Powdery snow can clog the geothermal air filters more easily***
- Geothermal project installations will need to plan for climate and weather pattern related concerns

Safeguards against ‘Green Gentrification’

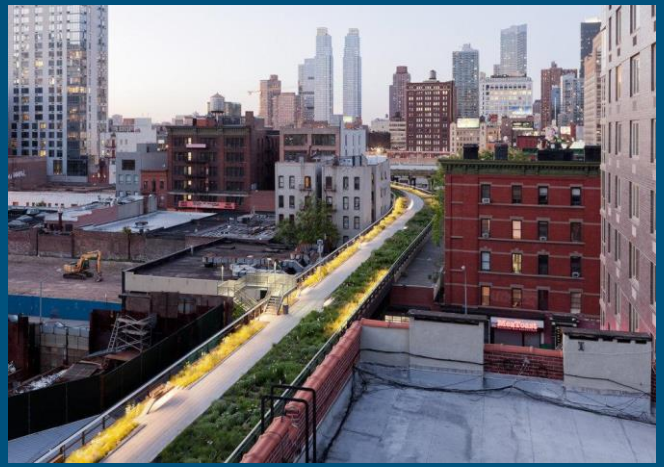
Safeguards against ‘Green Gentrification’

What is Green Gentrification?

- When planners install ‘green’ amenities with the intention of improving environmental conditions and aesthetics
- ***But overlook the increase in property values and displacement of low-income, often marginalized, community members***
- Examples include parks, gardens, trees, or installing clean energy sources
- The solution is not to do away with green amenities altogether, but ***plan to protect community members most vulnerable to displacement***

The High Line - *New York City, USA*

- A former railroad, the High Line is an elevated walking park. It is the reason for ***the 35% increase in adjacent housing and property values***
- Rapidly introducing attractive green spaces to areas that historically lack appropriate safeguarding resources creates this “green gentrification” effect



How to resist Green Gentrification

- Initial Rent Freeze Recommendation
  - *Recommend: third - party building owners enforce an initial five year rent freeze, where the rent price is not increased for residents or tenants.*
- Twenty - Five Year Rent Control Recommendation
  - *After five years, recommend: the institution enforces a contained rent price increase of no more than 5% every year over twenty years.*
  - *Any noncompliance to this agreement that results in raising property value or rental prices will result in financial penalties paid to the institution.*

Technical Considerations and Third Party Eligibility

Proximity to an energy system or producer

Proximity between the geothermal energy system and the off-taker influences the feasibility and cost of connection services for third parties.

Energy demand

- "Peaker"?
- Larger properties → high energy demands → larger capacity systems and additional equipment → impact the costs

Geotechnics and environment

The feasibility of connecting third-party properties to a geothermal energy system depends on geological, environmental, and infrastructural factors, which may necessitate additional mitigation measures or modifications.

Infrastructure and system considerations

Compliance, permitting, storage, and management for geothermal integration, and to maintain and service installed equipment for optimal performance.

Energy Efficiency and Weatherization

To be eligible for connection, third-party properties must maintain adequate insulation and energy efficiency, ensuring a net positive environmental impact through regular checkups and adherence to specific performance ratings.

Conclusion and Key Considerations

- Technical and system considerations must be met
  - If not, are the costs justified?
- Management and operations
  - Ensure performance and reliability standards are being met
  - Set up a separate entity running day-to-day operations
- Understand the environmental impacts and make good use of environmental credits
- Establish necessary safeguards for social and environmental impact
  - Impacts on gentrification
  - Risk minimization

Thank You