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

<table>
<thead>
<tr>
<th>System</th>
<th>Ownership</th>
<th>Procurement</th>
<th>Payment &amp; Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>The grid</td>
<td>Institution</td>
<td>Institution</td>
<td>Institution</td>
</tr>
<tr>
<td>Sensors</td>
<td>Institution</td>
<td>Institution</td>
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</table>
### Terms: Heat Exchanger

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<th>Payment &amp; Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat exchanger</td>
<td>Own</td>
<td>Institution provides list of specifications and third-party procures from external source or institution</td>
<td>Third-party pays for cost of component and install, institution offers low cost financing</td>
</tr>
<tr>
<td>Heat exchanger</td>
<td>Lease</td>
<td>Heat exchanger is sourced from institution’s procurement</td>
<td>Third-party pays in monthly installments</td>
</tr>
</tbody>
</table>
## Terms: Property’s distribution system

<table>
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<th>System</th>
<th>Ownership</th>
<th>Procurement</th>
<th>Payment &amp; Financing</th>
</tr>
</thead>
<tbody>
<tr>
<td>No upgrades</td>
<td>Third party</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Property’s distribution system</td>
<td>Own</td>
<td>Third-party procures</td>
<td>Third-party pays for component and install, institution offers low cost financing</td>
</tr>
<tr>
<td>Upgrades required</td>
<td>Lease if components are standard</td>
<td>Sourced from institution’s procurement</td>
<td>Third-party pays in monthly installments</td>
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</table>
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

Institution

Management

Independent Experts

Local Government

Third Party properties
Normal Responsibility

- Institution
  - Responsible For Production

- Management
  - Responsible For
    - Delivery
    - Capacity Planning

- Third Party properties
Maintenance

Responsible For Excess Production Capacity

Economy of Scale

Institution → Energy → Management → Energy → Third Party properties
Force Majeure

Institution

Energy

Good faith attempt to ensure production
Not obligated to share

Management

Third Party properties

Energy

Energy

Energy
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?

- Operators
- Researchers
- Marketers

- 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

[Diagram showing types of geothermal HVAC systems]

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

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-c9c0fcbbe-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

<table>
<thead>
<tr>
<th>Proximity to an energy system or producer</th>
<th>Energy demand</th>
<th>Geotechnics and environment</th>
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</table>
| Proximity between the geothermal energy system and the off-taker influences the feasibility and cost of connection services for third parties. | - “Peaker”?  
- Larger properties → high energy demands → larger capacity systems and additional equipment → impact the costs | 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