Financing Heat Pump Market Adoption

Next Generation of Thermal Infrastructure
Online Teach-In

Cullen Kasunic, Head of Finance
The problem: US building energy infrastructure is outdated, unhealthy and in desperate need of upgrades.

High Energy Waste

HIGH ENERGY BILLS
Can cost 30% of total SME budget

DISCONNECTED, INEFFICIENT, DUMB BUILDINGS
50%+ energy waste.

Health Hazards

COVID-19 Spread
Building air + energy systems circulate COVID

LEAD, ASBESTOS, IAQ
Buildings circulate deadly toxins

7% US GHG Emissions

SME BUILDINGS
No Software. 80,000+ data points per energy system

EXPENSIVE AND COMPLEX
Can’t afford to retrofit buildings with smart electric equipment.
In order to upgrade a building, each building must organize a 6 to 12 Party transaction across 4 industries — it’s a mess.

Projects Are
Expensive
Manual
Fragmented
Interdisciplinary
Multi-Party
Transactions
greening buildings at every step of the building process...

Leveraging machine learning and IOT building monitoring to perform building assessments.

Zero-down financing so building owners can switch to heat pumps without upfront costs or budget increases.
How do we serve multi-family and affordable housing

- Analysis software custom designed for multi-family buildings
- Targeted marketing and messaging outreach
- Workforce development and training
  - With $70 million committed over the next 10 years, NYSERDA will work to change the landscape of New York’s workforce through clean energy workforce development and training.
- Community based marketing
  - Partnerships with JOENYC and RSA
  - These groups manage affordable housing units and work with building owners with rent regulated units
  - These partnerships allow BlocPower to generate leads and connect us with buildings in need of energy efficient retrofits
- Underwriting supports buildings of all types
  - Based on equity in building, and rents vs. expenses
Heat Pumps Bring Many Benefits

**END TENANT COMPLAINTS**

- All-in-one heating & cooling systems in each unit ensure tenants can control their comfort year-round.
- Airflow is steady and quiet as a whisper.
- Filters deliver healthy, purified air.
- Non-combustion heating means cleaner air and lower asthma rates for the entire community.

**CUT OPEX & ENERGY COSTS**

- Systems are famously efficient and low maintenance.
- Smart monitoring ensures reliable performance.
- Eliminate fuel bills, and lower maintenance costs.
- 15-year performance guarantee included with the BlocPower Lease.

**INCREASE YOUR BUILDING’S VALUE**

- Increased Net Operating Income (NOI) from energy efficiency.
- Building value will increase by 5-12%.
- Get a brand new modern heating & cooling system without putting any of your capital to work.
- No money down for heating & cooling frees up your cash for additional building improvements.
**Air Source Heat Pump (ASHP) Technology: What is it?**

ASHP technology operates through heat transfer, releasing heat outdoors during the summer and forcing heat indoors during the winter.
**Survey of Benefits to Stakeholders**

Over 20 possible benefits

**Property owners:**
- Energy Savings
- Avoided Capital Costs

**Tenants:**
- Comfort/Control

**Utility:**
- Peak gas reduction

**Society:**
- Economic Development
- GHG reductions

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<thead>
<tr>
<th>BENEFIT</th>
<th>Direct</th>
<th>Indirect</th>
<th>Property Owner</th>
<th>Tenant</th>
<th>Utility</th>
<th>Government &amp; Society</th>
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<td>Reduced Heating costs</td>
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<td>Reduced Cooling Costs</td>
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<td>Tenant Responsibility for Heating</td>
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<td>Low Income tenant responsibility for heat</td>
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<td>Increased temperature controls</td>
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<td>Comfort improvement</td>
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<td>Indoor air quality improvement</td>
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<td>Outdoor air quality improvement</td>
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<td>Building market value increases</td>
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<td>Reduction in GHG from less waste</td>
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<td>Reduction in GHG from cleaner fuel mix</td>
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<td>Short and long term job creation</td>
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<td>Address peak gas demand issues</td>
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<td>Further savings from tag-along EE projects</td>
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<td>Community Solar Contracts</td>
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<td>Preferential CS for Low Income tenants</td>
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<td>Ease of maintenance</td>
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<td>Maintenance Included *</td>
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<td>Energy comes from the grid</td>
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<td>Electricity demand response</td>
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Where should air source heat pumps be implemented?
Adoption Barriers

**Customer Inertia:**
Many buildings already have fossil fuel infrastructure installed, it’s what they know, and why change?

**Perceived Risk of “New” Tech**
There is inherent consumer suspicion of technology that they or their neighbors are not familiar with.

**Complexity**
Setting up a new style of system can lead to many questions, and what are the right answers?

**Cost**
Replacing any heating and cooling system costs money, and currently ASHP systems cost more (but save more).
Success of solar third party financing:

**Power Purchase Agreements (PPAs) & Leases**
PPAs: the customer pays per kWh of energy generated
Leases: the customer pays “rent” for the solar tech

**Innovative third party financing augments accessibility**
Reducing upfront costs of infrastructure installation and providing long term, low interest, or on-bill financing expands the viability of solar projects.

**Policy is becoming greener, faster than ever before**
States and cities are adopting more stringent green building and energy efficiency policies

• Nationwide, in 2017 **57%** of all installed non-residential capacity was third-party owned, topping the previous high of **43%** set in 2016.
### BlocPower Lease Payment Options

Flexible financing can reduce your air source heat pump up-front costs to zero dollars.

<table>
<thead>
<tr>
<th>Money Down Scenario</th>
<th>BlocPower Lease Monthly Payment*</th>
<th>Monthly Savings After Lease Payment</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Money Down</td>
<td>$5,330 / month</td>
<td>$415 / month</td>
</tr>
<tr>
<td>$183,618 Down</td>
<td>$3,531 / month</td>
<td>$2,214 / month</td>
</tr>
<tr>
<td>$944,700 Down</td>
<td>$0 / month</td>
<td>$5,744 / month</td>
</tr>
</tbody>
</table>

*Based on a 15-year term with 1% annual escalation

### The BlocPower Lease Benefits

- No Money Down. No Loan.
- No lien on home.
- Low, predictable monthly payments.
- 15-year performance guarantee.
- Regular maintenance included in lease.
Debt Financing
[$750-900k per bloc]

Equity Financing
[$100-250k per bloc]

Equity Return
$250k + 15%+

Investment
$250,000

Workforce Dev. Partner

Labor

Contractor Payments

Installer(s)

Contractor Services

Bloc #1
($1,000,000 Special Purpose Vehicle)

Energy services Agreement (ex: 8 yr term)

- Expected $200k annual savings
- $50k savings to client during loan (yr 1-4)
- $120k savings to client after loan (yr 5-8)

Our Lady Queen of Angels

Mt Carmel School

St. Athanasius

Set Apart the Evangelist

Sacred Heart

Red Rabbis
https://www.wrc.org/story/solar-industry-facts-and-figures
Targeting 50% cost reduction over 10 years

- Equip cost reductions
- Installation economies of scale
- Improvements in heat pump efficiency factors
Over $3.5B of support from NY State for Heat Pumps

<table>
<thead>
<tr>
<th>Program</th>
<th>Description</th>
<th>Incentive Levels</th>
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<tbody>
<tr>
<td>NYSERDA Flextech</td>
<td>The FlexTech program shares the cost to produce an objective, site-specific, and targeted study on how best to implement clean energy and/or energy efficiency technologies.</td>
<td>$1,500 to $10,000 per project</td>
</tr>
<tr>
<td>NYSERDA Multi-Family Performance Program</td>
<td>NYSERDA’s Multifamily Performance Program provides incentives from $700-$3,500 per unit for affordable multifamily property owners to help lower ongoing operating costs. A NYSERDA-qualified Provider will conduct an assessment of the property and create a customized plan to reach 15% or more in energy savings.</td>
<td>Up to $3,500 per apartment</td>
</tr>
<tr>
<td>NYS Clean Heating</td>
<td>The NYS Clean Heat Program aims to build market capacity to deliver building electrification solutions. The NYS Clean Heat Program is designed to provide customers, contractors, and other heat pump solution providers a consistent experience and business environment throughout New York State.</td>
<td>$4,000 to $6,000 per apartment</td>
</tr>
</tbody>
</table>
We agree...
The GeoMicroDistrict

A Novel Path to Building Electrification

Audrey Schulman & Zeyneb Magavi, Co-Exec. Directors
HEET

To cut carbon emissions NOW by driving systems change.
Pruning the Tree
One Method of Transition
Is there a faster way?
Service to Customer

Vertical Borehole Array

Thermal Loop

The GeoMicroDistrict
Shared Loop of Water

Uses wasted energy
Borehole Thermal Energy Storage

15°
Technical Feasibility per Street Segment

The ability to meet energy demand through boreholes in the street only

- Low Density Residential: 100%
- Medium Density Residential: 92%
- Medium Density Mixed-Use: 100%
- High Density Mixed-Use: 34%
The GeoGrid®
Other Methods of Thermal Management

Prewarmed Irrigation Water

Melted Snow on Sidewalks

Courtesy of The GreyEdge Group® & IGSHPA
BENEFITS of a GeoGrid

- SAFETY
- Cuts GHG 90% by 2050
- Resilient and reliable
- Provides cooling
- Flattens grid loads
- Cheap energy storage
- Equitable access

Courtesy of The GreyEdge Group ©
Colorado Mesa University

PE 20

GHG Emissions (CO2e/yr)

<table>
<thead>
<tr>
<th>GHG Source</th>
<th>Existing</th>
<th>GeoMicroDistrict in 2020</th>
<th>GeoMicroDistrict in 2050</th>
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<tbody>
<tr>
<td>DHW</td>
<td>125</td>
<td>100</td>
<td>0</td>
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<tr>
<td>Heating</td>
<td>75</td>
<td>50</td>
<td>25</td>
</tr>
<tr>
<td>Cooling</td>
<td>50</td>
<td>25</td>
<td>0</td>
</tr>
</tbody>
</table>

Courtes
Should utilities own the GeoGrid?
Gas System Enhancement Plan (GSEP)

Utility reported pipe replacement plans for next 5 years

- Boston Gas 43% leak-prone
- Boston $4.4M/mile in 2020
- 40-year amortization
- GWSA and Carbon Free Boston?!
GAS UTILITY VULNERABILITY

Modeled 2050 PG&E Gas Rates from Illustrative System Transition

<table>
<thead>
<tr>
<th>Solution</th>
<th>$/Therm</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Transition Strategy</td>
<td>$18.93</td>
</tr>
<tr>
<td>Solution 1</td>
<td>$17.28</td>
</tr>
<tr>
<td>Solution 2</td>
<td>$13.20</td>
</tr>
<tr>
<td>Solutions 1 &amp; 2</td>
<td>$11.02</td>
</tr>
<tr>
<td>Solutions 1, 2, &amp; 3</td>
<td>$4.49</td>
</tr>
<tr>
<td>Solutions 1, 2, 3, &amp; 4</td>
<td>$3.77</td>
</tr>
</tbody>
</table>

Source: E3, Gridworks 2020

GAS BANS
BENEFITS of Gas Utilities building the GeoGrid

- SAFETY
- Cuts GHG 90% by 2050
- Resilient and reliable
- Scalable & Adaptable
- Provides cooling
- Flattens grid loads
- Cheap energy storage
- Equitable & Low Cost
- Keeps gas workers jobs
- SPEED
Potential Pilots in MA

- Eversource Gas - requested 3 pilots
- Columbia Gas Settlement - likely $4 million pilot
- National Grid - announced rate based request in fall

Potential Pilots Outside of MA

- Mohawk (NGrid)
- Con Ed
- Xcel Energy
- Bridgeport, Conn.
HEET PILOT Central Research & Evaluation Team

- **MIT** Sloan School, System Dynamics
- **Harvard** T.H.Chan School of Public Health, C-CHANGE Institute
- **BuroHappold** Engineering
- Massachusetts **DEP** (Department of Environmental Protection)
- **Berkeley National Lab**, Earth and Environmental Science
- University of California, **Berkeley**, Civil & Environmental Engineering
- **National Renewable Energy Laboratories**
- Massachusetts **CEC** (Clean Energy Center)
A Gas to GeoGrid Plan?

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REFERENCES & RESOURCES

1. “GeoMicroDistrict Feasibility Study”, Buro Happold & HEET, 2019
2. Eversource Gas geothermal pilot ratecase DPU 19-120
3. AG Healey’s Petition to Consider the Future of Gas
4. Applied Economic Clinic policy brief
About Orca & GeoTility
Experience

- Installing Geothermal for 30+ Years
- Over 20,000 tons of systems installed
- Professional engineers on staff
- Canada’s largest geothermal contractor
- Largest comprehensive geothermal contractor on US west coast
- Over 4 million feet of pipe installed
- Operating geothermal utility services for over 15 years
- Utility customers in Canada, Washington State, Georgia & Maryland
- Experience in working with developers, builders and home owners
- Experience in the design of residential, commercial, industrial and district energy systems
Orca’s Utility Model

- Orca designs and installs ground heat exchanger
- Generally individual loops per system
- Orca owns exterior loop system only
- Monthly utility charge to customer
Are Renewable District Energy Systems Feasible?
Example Systems

- City of Richmond DEU
- Vancouver Athlete’s Village
- Microsoft Campus
- Osoyoos Indian Band
- Sun Rivers Community
- Toronto Deep Lake Water Cooling
Who Should Own Renewable District Energy Systems?
System Ownership

- Private utilities (i.e. Orca, Creative Energy, etc.)
- Investor owned utilities (i.e. FAES)
- Municipalities (i.e. Richmond, BC)
- Private corporations (i.e. Microsoft)
District vs. Non-District Systems
Need Project Specific Solutions

- System load profile is key
- Physical distance between buildings
- System size and build-out risk
- Example: Adams Crossing, Denver
Orca Projects
Wilden

- Over 400 homes on geothermal
- TerraSource provides geothermal utility services
- Located on bedrock
- Individual loops
Maple Lawn

- New homes for Bozzuto in Baltimore, Maryland
- Individual ground loops
- Vertically drilled boreholes
Charter School

- Charter school in Chattahoochee Georgia
- One geothermal heat pump per classroom
- Zero fossil fuel heating and cooling
Serenbe

- Townhouse development within Serenbe
- Water to air geothermal heat pumps
- Individual loops per home
Orca / TerraSource Communities

Wilden
Ponderosa
Pondview
Pineridge
Badger Mountain
Maple Lawn
Serenbe
Lakeview Village
Ledgeview
Latoria
Wembley
Northview
Apex
Limonas
Predator Ridge
Prospect at Black Mountain
Cadence
Bella Veduta
Las Ventanas
Conclusions
Keys to Success in Developing Renewable District Energy Systems

- Must develop project specific solutions
- System build-out timing and loads must be well understood
- Requires technically savvy design team
- Must match the technology to the project
- Need a utility partner to provide experience in utility operations and funding
- Ownership models will likely vary dramatically from project to project
- Designs will vary from project to project - not one size fits all
Utility-Owned Geothermal

Owen Brady-Traczyk
Manager, Future of Heat
A gas utility interested in geothermal?

Strong demand for natural gas over the past few decades, driven by convenience, social momentum, and low relative price, has created the need for significant gas resources in the Northeast.

- Limited pipeline infrastructure available to deliver supply
- State policy that requires reduction in emissions/fossil fuel consumption
- Desire from all stakeholders, including the gas industry, to improve efficiency and reduce GHG emissions
- Customers desire simplicity; one system that meet year-round needs
- Price tends to be the most important factor for customers
  - High electric rates in northeast have made the economics for electrification more challenging
  - Usually the purchase price of new equipment rather than the lifetime cost
Geothermal opportunity

Proven technology with industry-leading efficiency (300-600%)

Able to meet year-round, whole-home heating and cooling needs (at improved efficiency relative to window A/C)

Reduces net energy needs, which can help to manage system peaks

Intrinsic opportunity for energy exchange

Could be an alternative option for system expansion
REV Demo – Shared-loop in Riverhead, NY

- 10 homes connected to a 30-ton shared loop
- Operating since Dec 2017
- Customers have enjoyed the service and experienced benefits:
  - No smell from kerosene
  - Improved IAQ
  - Better temperature management
  - Quiet operation
- One property owner simplified installation for the pilot
- Scaling will require more complex installations (e.g. multiple properties)
NMPC Rate Case – Future of Heat Geothermal Proposal

- Installing 2,600 tons of capacity over 3 years
  - ~86 Riverhead projects
  - Exclusively shared-loop projects for this pilot
  - Exploring a mixture of projects for customers not connected to the gas system and customers who are being served by gas assets that will be replaced, including leak-prone pipe

- Installations will occur “in partnership with the competitive suppliers of geothermal heat pumps, with the Company owning the shared loop infrastructure and supplying thermal energy to connected customers under a long-term contract rate.”

- Customers will be charged a fixed monthly rate based on their connected capacity
  - Weighted average cost of a ton (‘WACOT’)
  - $22.69/ton/month
  - No subsidy from gas customers (share of general/overhead expenses)
Owen Brady-Traczyk
Manager, Future of Heat
Owen.brady@nationalgrid.com