



heet

Efficient Equitable Electrification of Heat



Putnam
Foundation



Winslow
Foundation



Values for Gas to Geo System Transition

- **All stakeholders at the table:** community, workforce, gas utilities, EJ, environmentalists, legislators, regulators, academics, industry, and businesses
- **Communities benefit** from our work and the process includes impacted community stakeholders
- **Equitable and affordable** systemic transition
- **Workforce transition** includes fair labor standards, prevailing wages, and training
- **Systemic thinking** (gas/electric/water/community/geography) and design for optimizing benefits
- **Strategic TENS placement:** leak prone pipe, gas constraints, will lead to gas decommissioning, environmental justice communities, old buildings, replace oil & propane, etc
- **Economically viable business models** for all locations and communities
- **Opportunistic design** that uses the resources of the location
- **Data standardization and transparency** to facilitate learning across projects and to promote system scaling

HEET Research

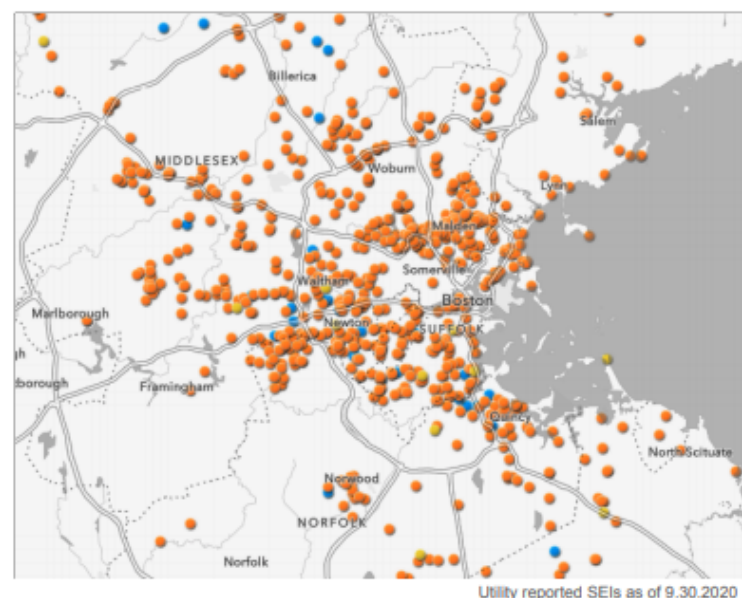


Significant Environmental Impact (SEI) Natural Gas Leaks

Shared Action Plan Year 1 (2019/2020)

Utilities Enacting the Leak Extent Method

April 27th 2021



Environmental Science & Technology
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Policy Analysis

1 Repair Failures Call for New Policies to Tackle Leaky Natural Gas Distribution Systems

2 Morgan R. Edwards,* Amanda Giang, Gregg P. Macey, Zeyneb Magavi, Dominic Nicholas, Robert Ackley, and Audrey Schulman

Cite This: <https://doi.org/10.1021/acs.est.0c07531> Read Online

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Environmental Science & Technology
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Article

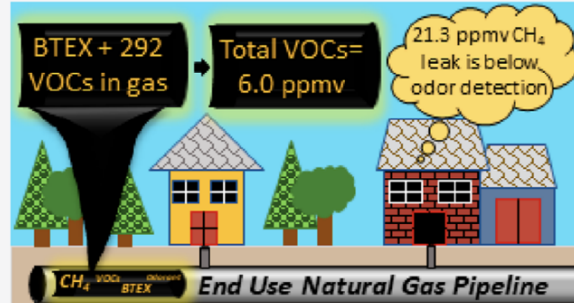
1 Home is Where the Pipeline Ends: Characterization of Volatile Organic Compounds Present in Natural Gas at the Point of the Residential End User

2 Drew R. Michanowicz,*^{1,2} Archana Dayalu,³ Curtis L. Nordgaard, Jonathan J. Buonocore, Molly W. Fairchild, Robert Ackley, Jessica E. Schiff, Abbie Liu, Nathan G. Phillips, Audrey Schulman, Zeyneb Magavi, and John D. Spengler

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ABSTRACT: The presence of volatile organic compounds (VOCs) in unprocessed natural gas (NG) is well documented; however, the degree to which VOCs are present in NG at the point of end use is largely uncharacterized. We collected 234 whole-NG samples across 69 unique residential locations across the Greater Boston metropolitan area, Massachusetts. NG samples were measured for methane (CH₄), ethane (C₂H₆), and nonmethane VOC (NMVOC) content (including tentatively identified 296 unique NMVOC constituents in 17 end-use NG, of which 21 (or approximately 7%) were designated as hazardous air pollutants. Benzene (bootstrapped mean = 164 ppbv; SD = 16; 95% CI: 134–196) was detected in 95% of samples along with hexane (98% detection), toluene (94%), heptane (94%), and cyclohexane (89%), contributing to a mean total VOCs = 6.0 ppmv. A 21.3 ppmv CH₄ leak is below odor detection.




Energy Policy

Volume 162, March 2022, 112778



An environmental justice analysis of distribution-level natural gas leaks in Massachusetts, USA

Marcos Luna ^a✉, Dominic Nicholas ^b✉

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<https://doi.org/10.1016/j.enpol.2022.112778>

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Research

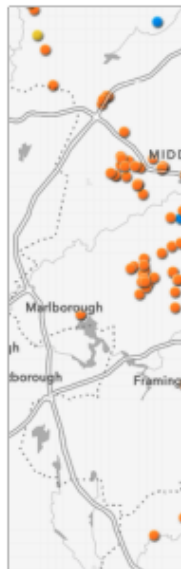
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Significant Environmental Impact (SEI)
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Shared Action Plan Year 1 (2019/2020)

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Failure Rate %

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ELSEVIER

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End Use Natural Gas Pipeline

GEO MICRO DISTRICT

Feasibility Study

heet HEET 2219-1551

LEARNING FROM THE GROUND UP

GeoMicroDistrict Pilot: Installation, Evaluation and Research

Audrey Schulman, Business Manager
Zeyneb Magavi, Principal Investigator

HEET is an award-winning Massachusetts nonprofit that developed the GeoMicroDistrict concept and that aims to achieve two goals over the three-year project period:

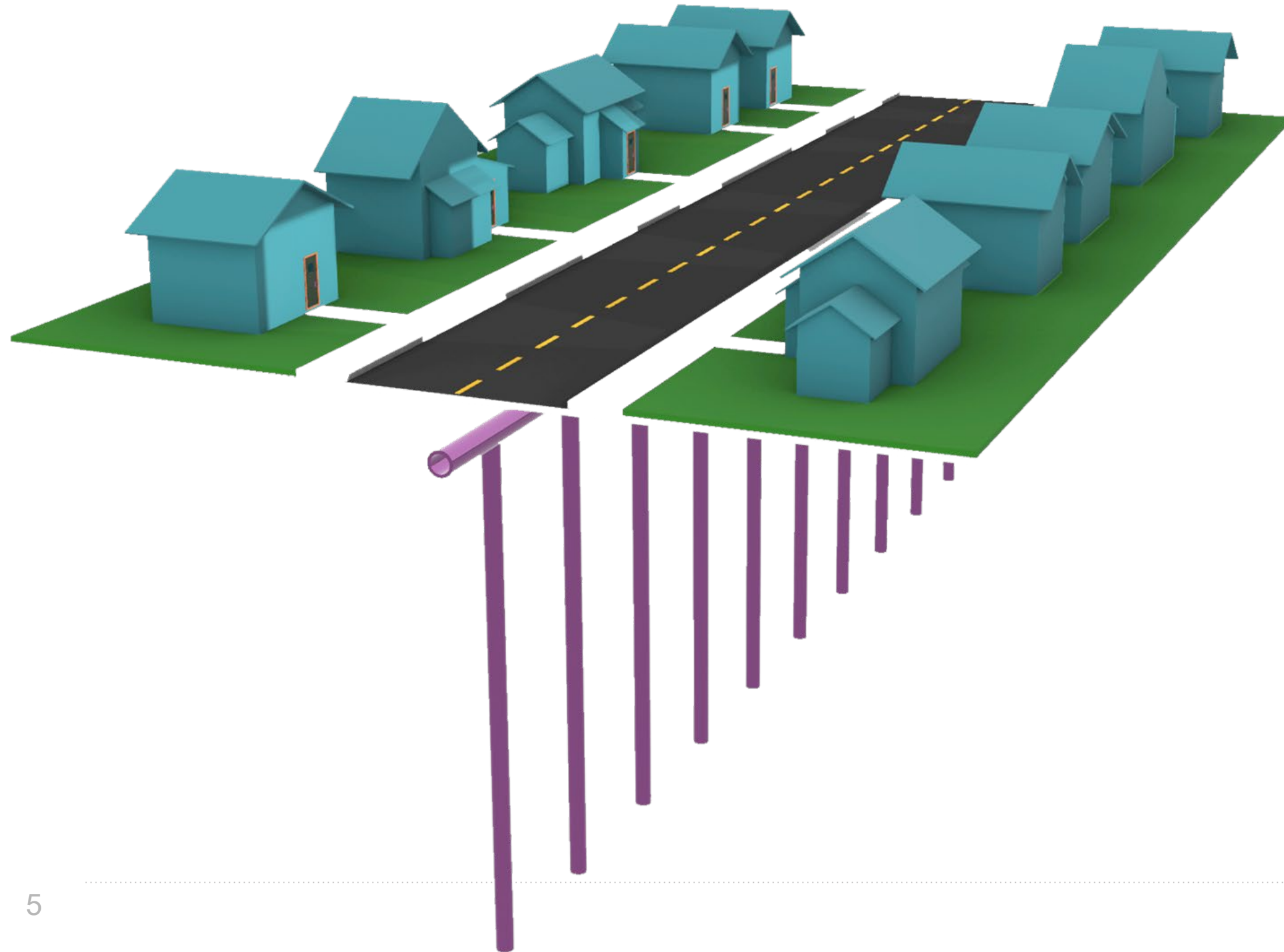
1. Evaluate the pilot GeoMicroDistrict capacity a) meet annual heating and cooling demands for an approximately 100,000 sf dense, mixed-energy-use street segment b) minimize energy use and costs through optimization and management of bidirectional borehole thermal energy storage c) positively interact with the electric grid to increase resilience and reduce overall cost.
2. Establish a standard method of GeoMicroDistrict research and evaluation to inform policy makers and utilities of significant engineering and economic considerations and impacts of GeoMicroDistricts. By driving down costs and risks, the aim is to develop a business case for utilities to install networked geothermal systems, driving rapid market transformation.

GeoMicroDistricts use bidirectional borehole thermal energy storage (BTES) as the prime source of thermal energy for buildings. A subsurface ambient temperature water loop, maintained at 40–80°F across seasons, delivers that temperature through service lines to buildings. The use of an ambient-loop

The GeoMicroDistrict®

Networked Geothermal

Ground source heat pumps

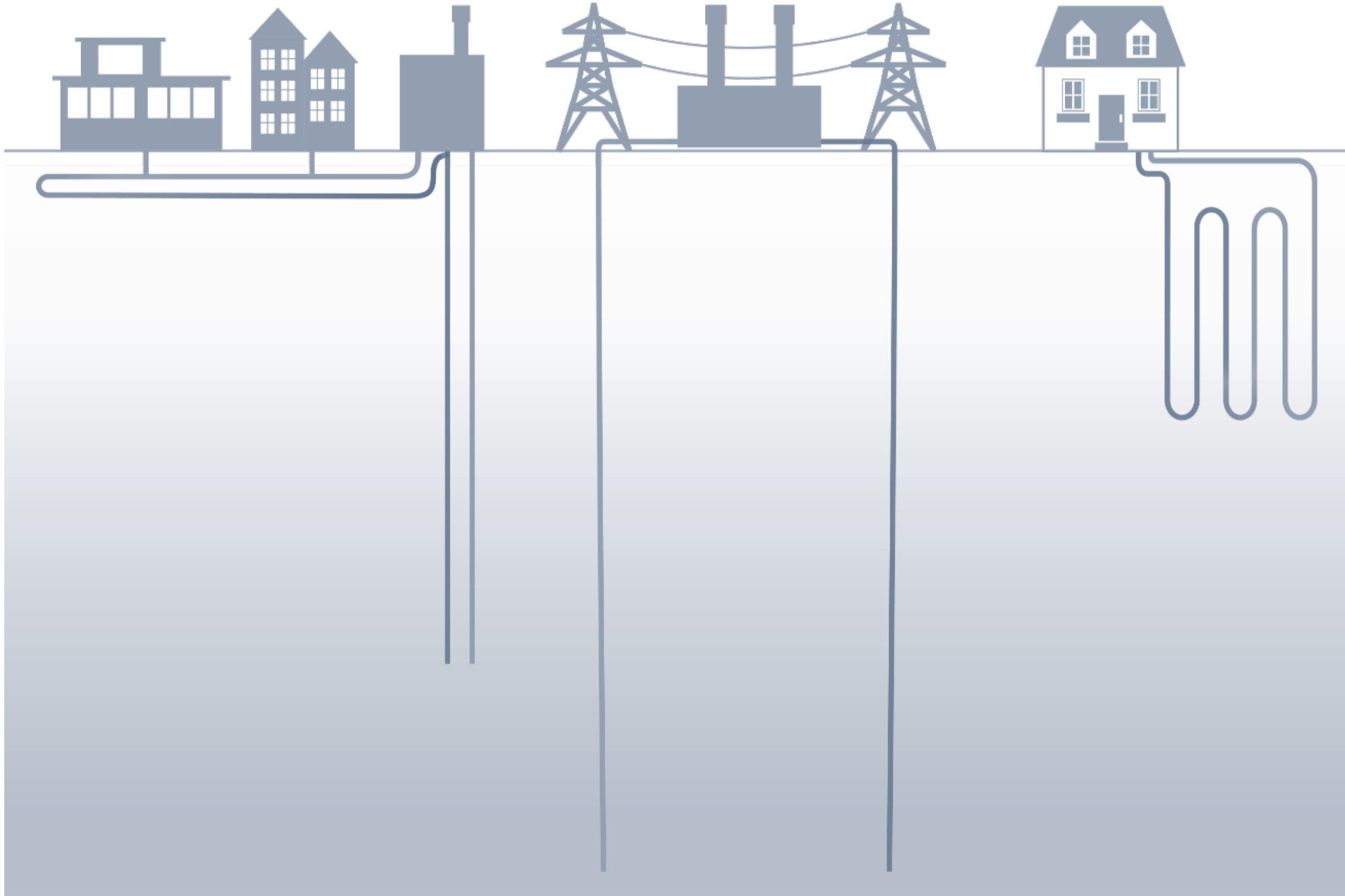


- Closed loop
- Water
- A few 100' deep
- Heat pumps in buildings

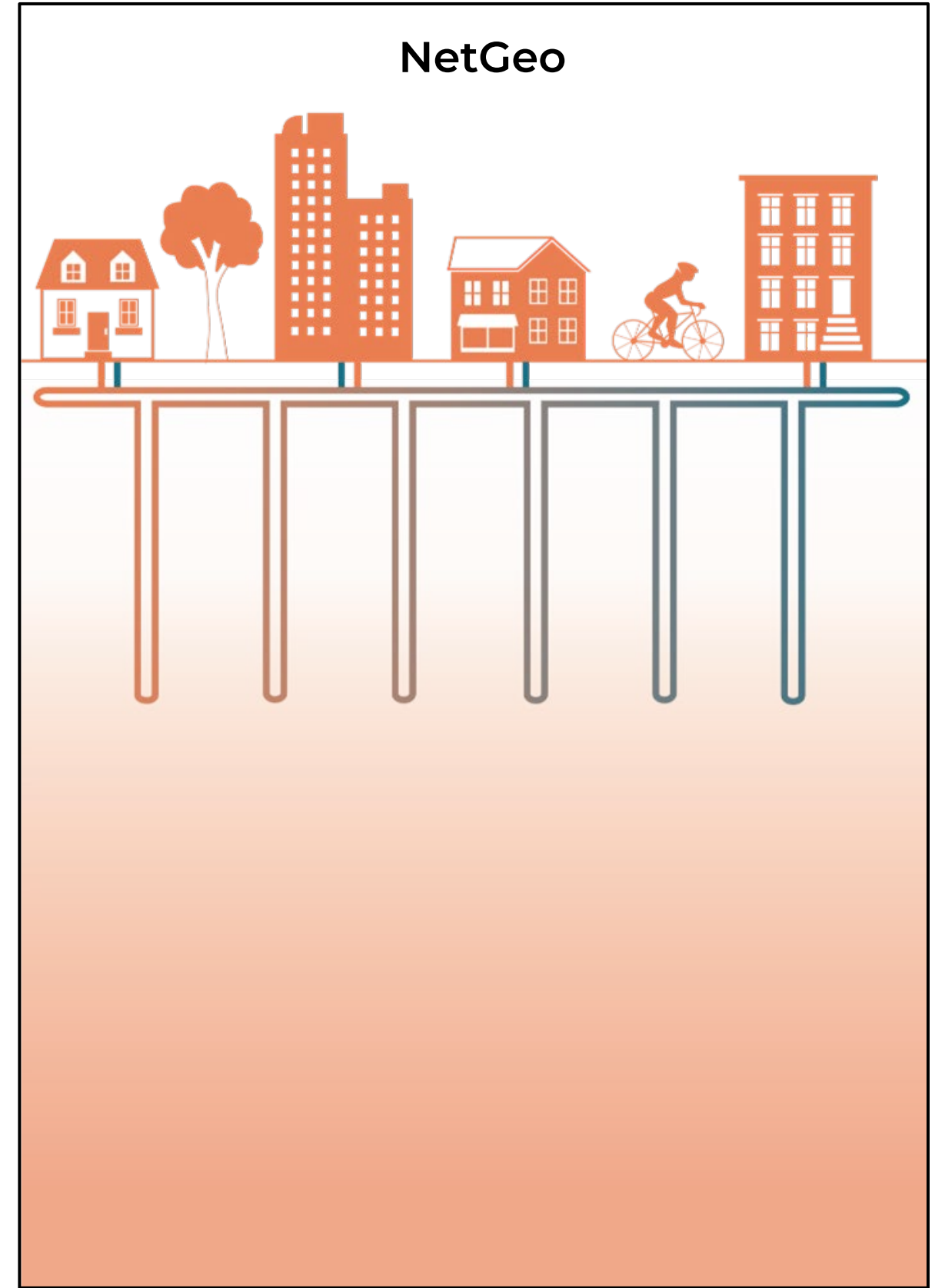
Geo District

Geo Power

Geo Building

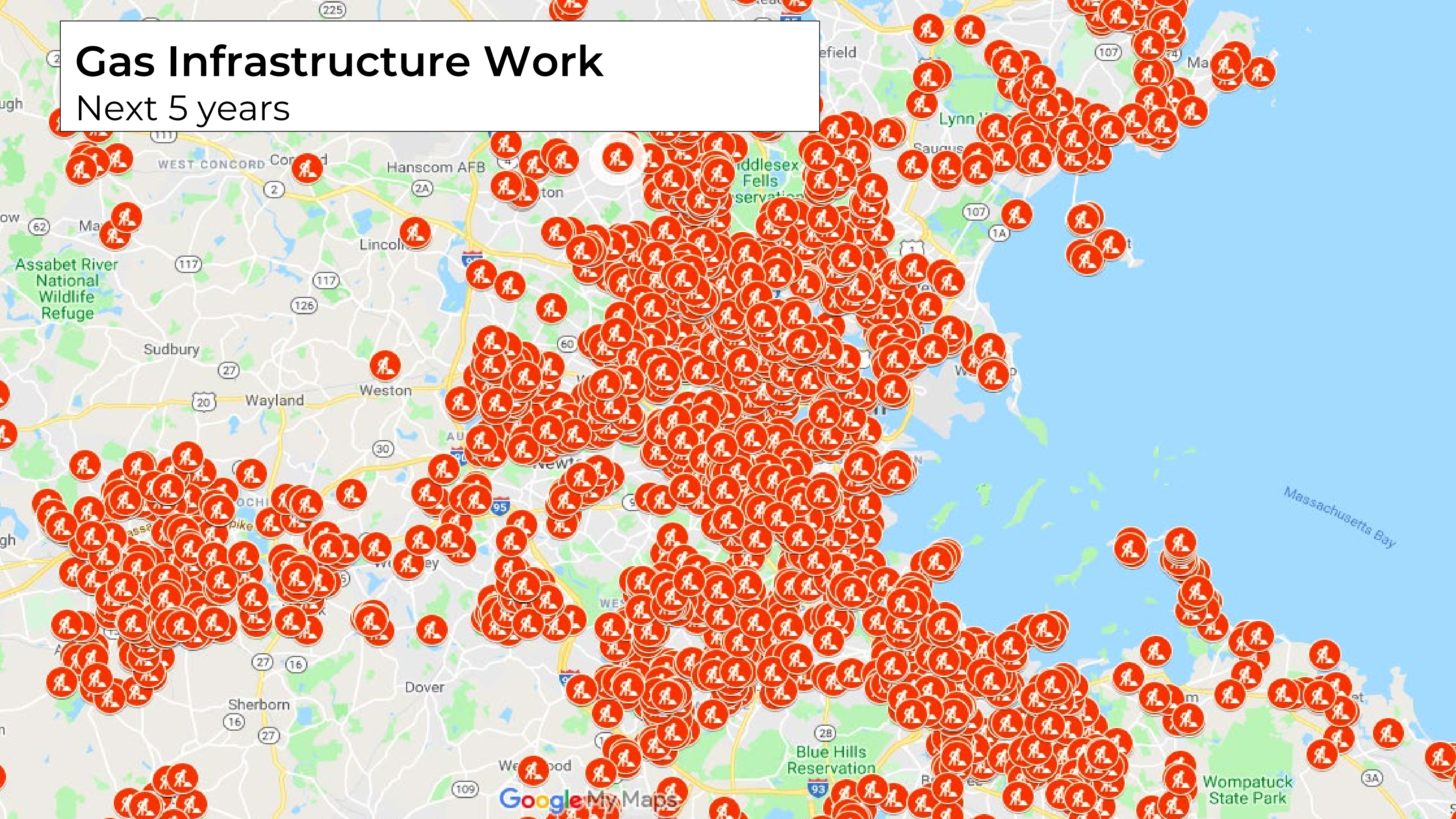


NetGeo



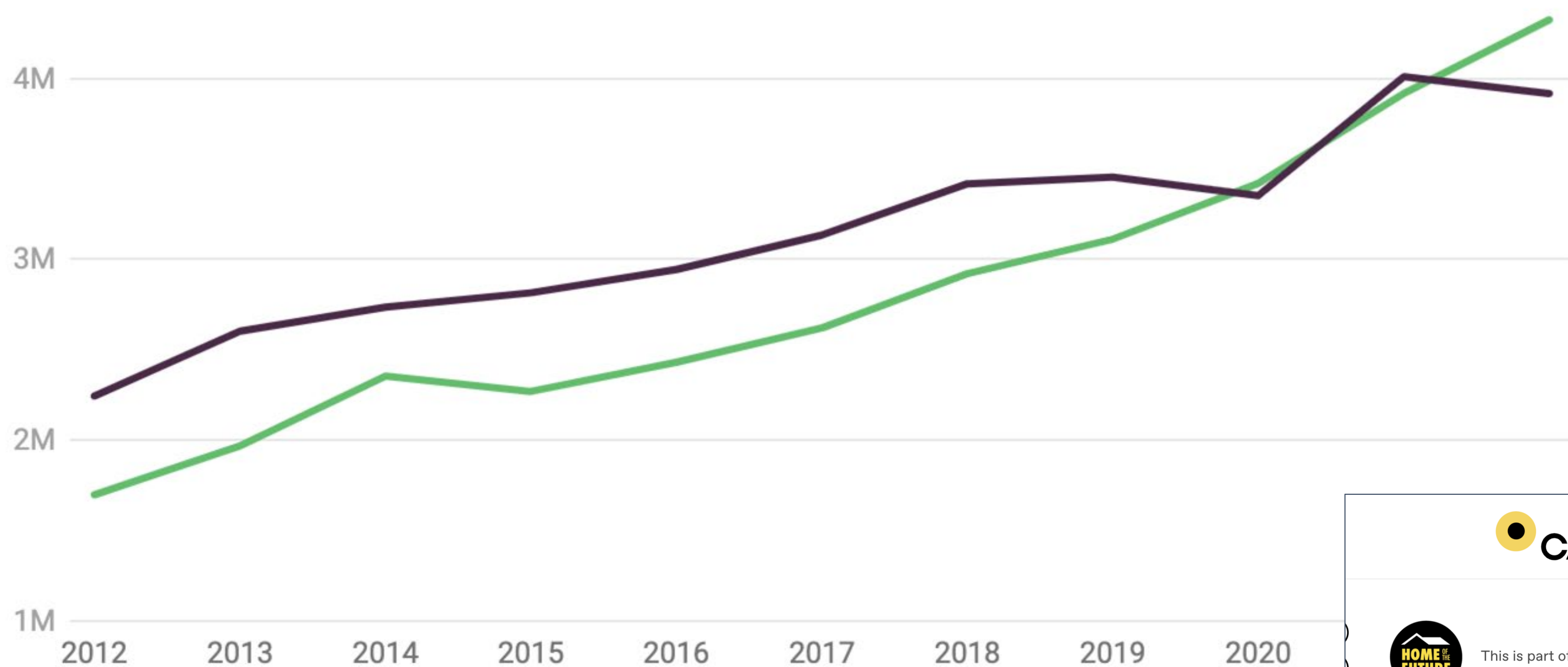
Gas Infrastructure Work

Next 5 years



Heat pump sales in U.S. surged past gas furnaces in 2022

Heat pump sales Gas furnace sales



2022 figures include sales data for Jan–Nov and projected sales for Dec.

Chart: Canary Media • Source: [Air-Conditioning, Heating, and Refrigeration Institute](#) • [Embed](#) • [Download image](#)

 CANARY MEDIA

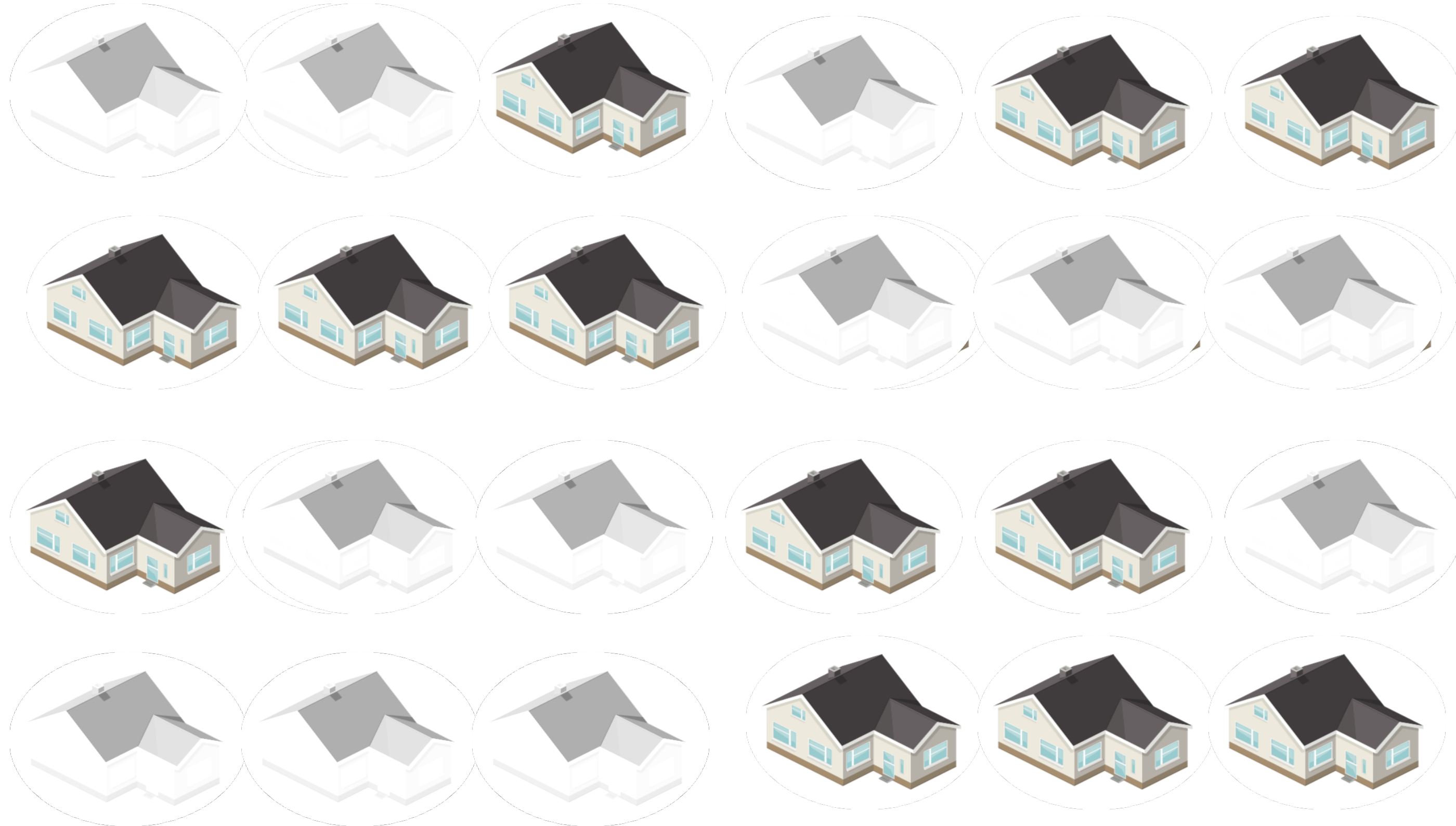


This is part of our special series "Home of the Future." [Read more.](#)

Chart: Americans bought more heat pumps than gas furnaces last year

Even before Inflation Reduction Act incentives kicked in, Americans bought more heat pumps than ever before last year — well over 4 million.

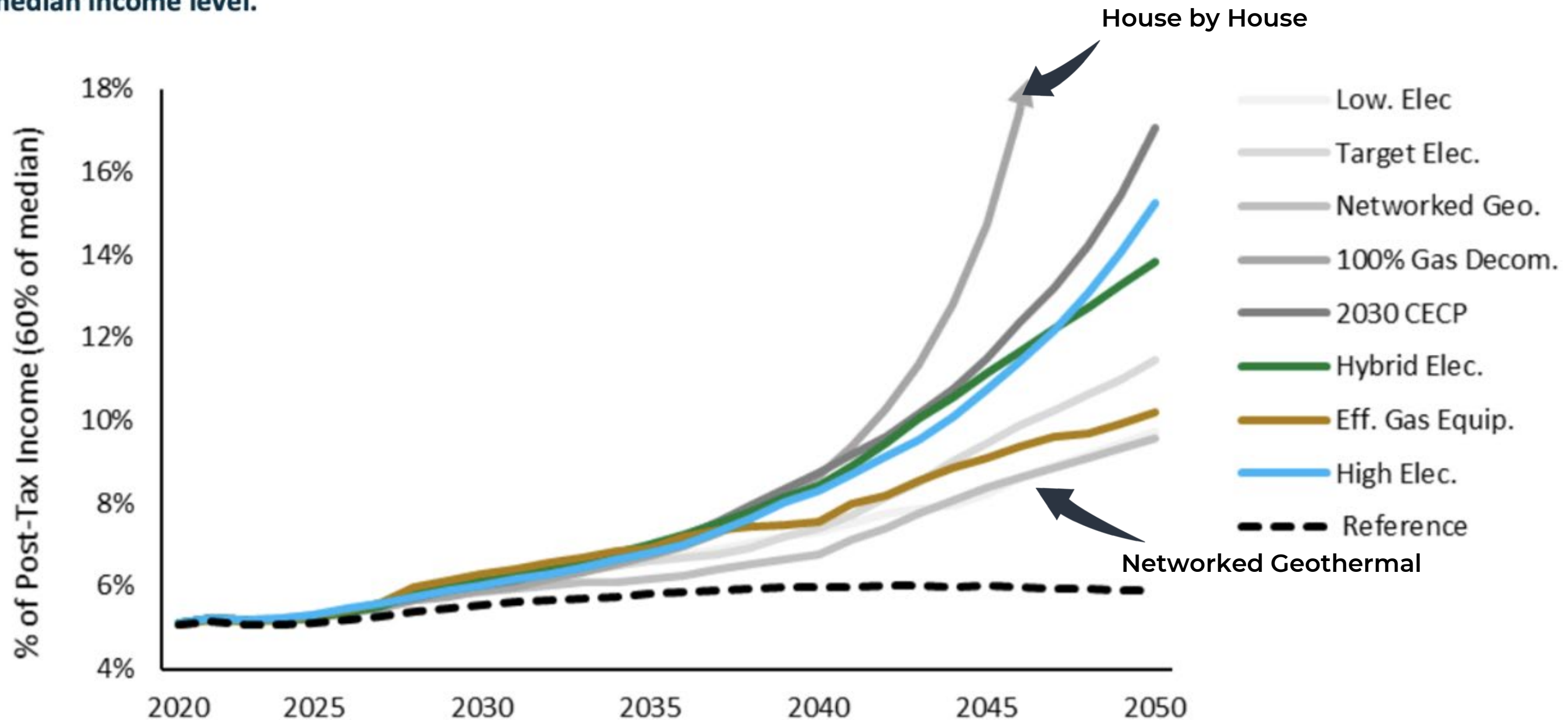
As Customers Leave, Gas Bills Increase



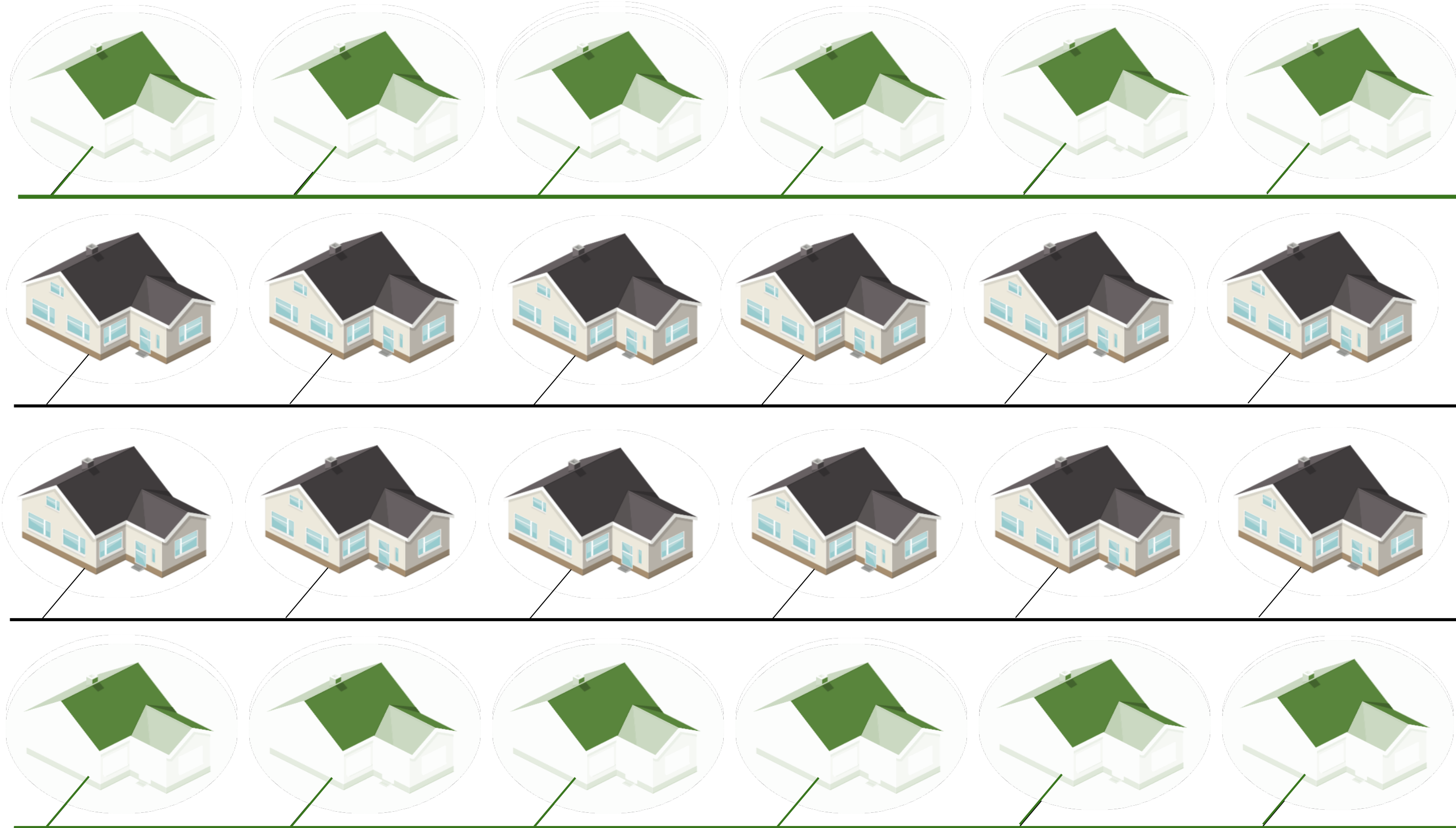
Low-income Energy Burden During Decarbonization

MA Future of Gas docket

Figure 38. Non-migrating customer energy burden for low-income customers (% of annual income spent on gas and electricity). A low-income customer is defined as a customer with a household income that does not exceed 60% of the state median income level.



Merged Gas/Geo Rate Base, Customer Bills Stay Low



So far...

1. Eversource Gas

Framingham, MA

Installation began

1. National Grid

Lowell, MA

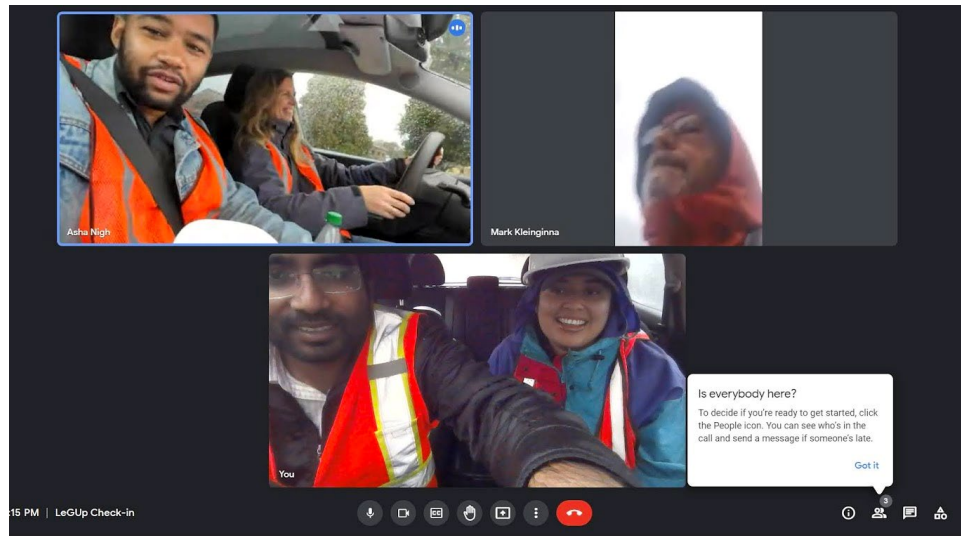
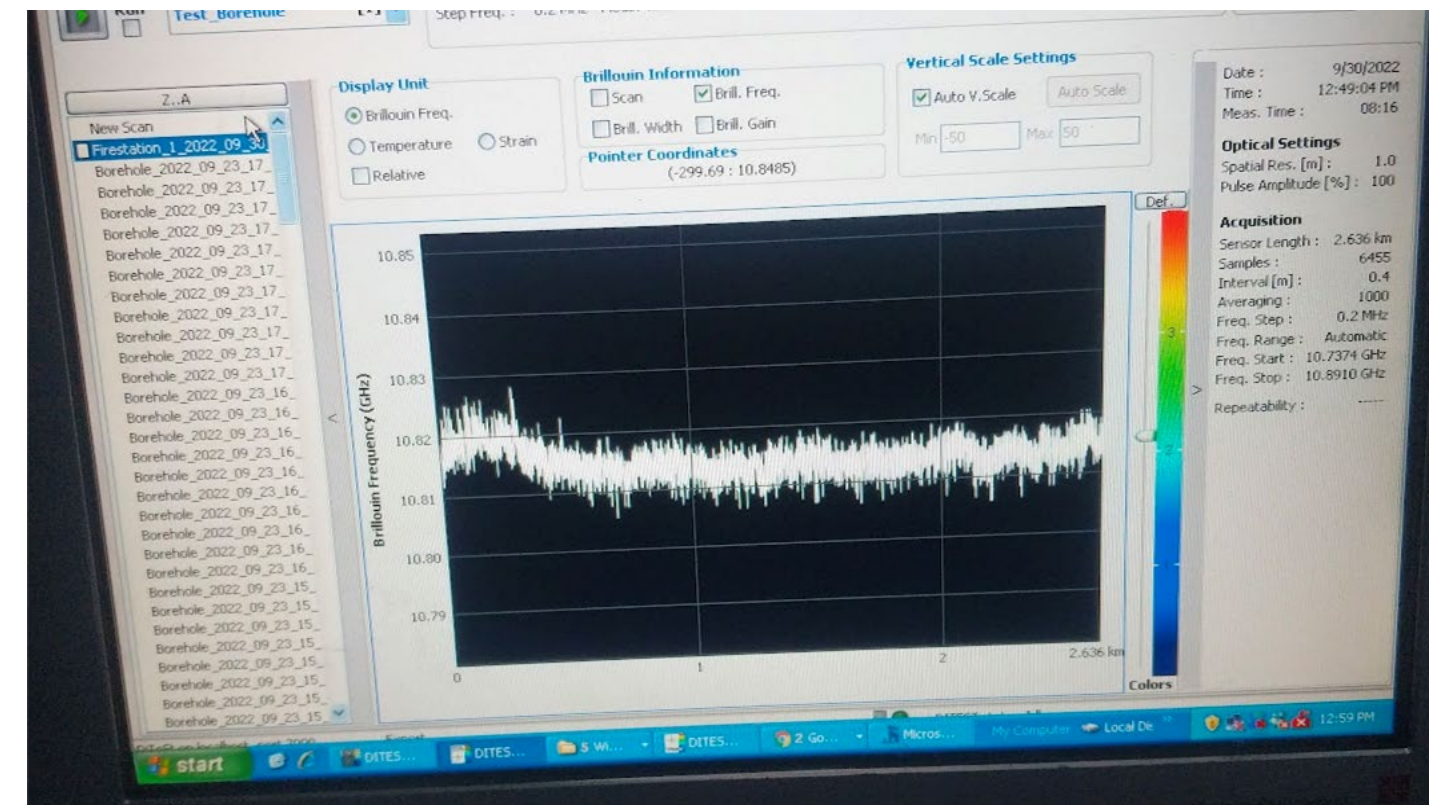
Design in progress



Installation



Data Collection



Gas Workers Can Transition

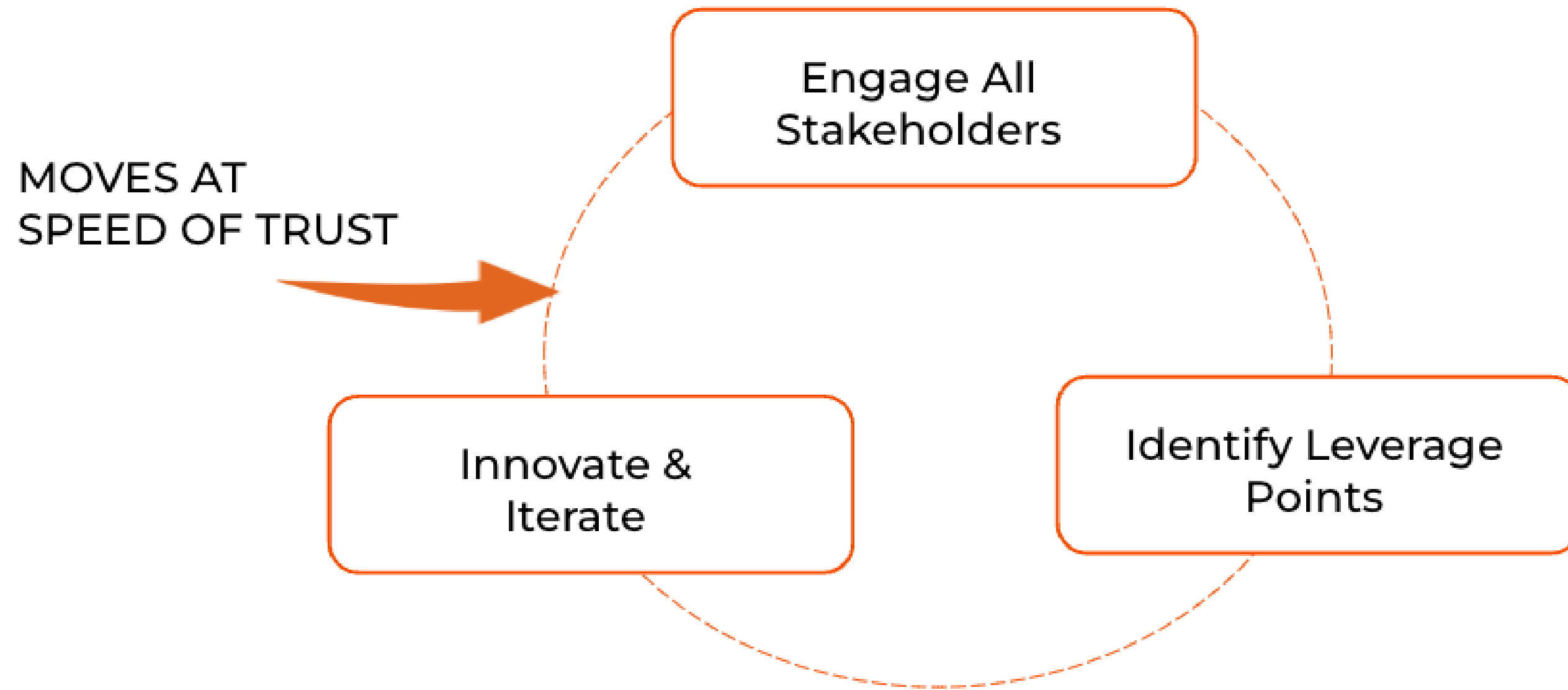
Gas Pipes



Water Pipes



Strategy



GOAL: Equitable nationwide deployment and true climate change mitigation

HEET.org