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Gas REV Geothermal Demonstration on Long Island



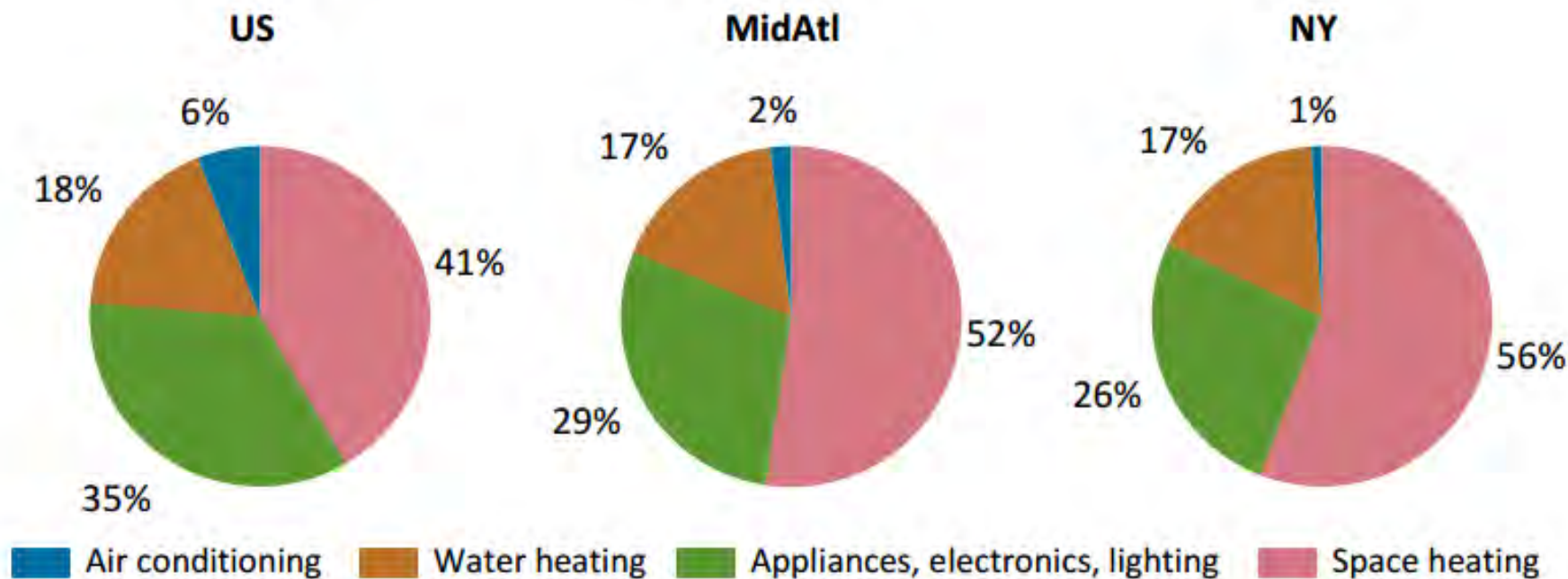
Chong Lin, National Grid
Dave Reardon, Miller Environmental Group
October 4, 2018



Heating and Cooling Energy Use

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■ Source: Residential Energy Consumption Survey EIA 2009.

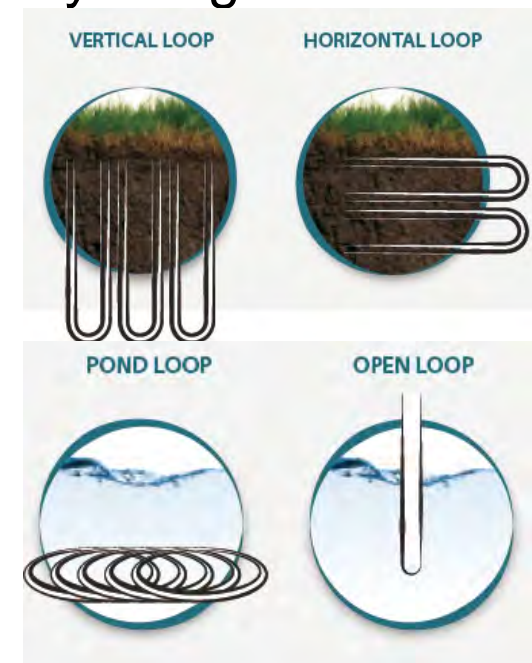
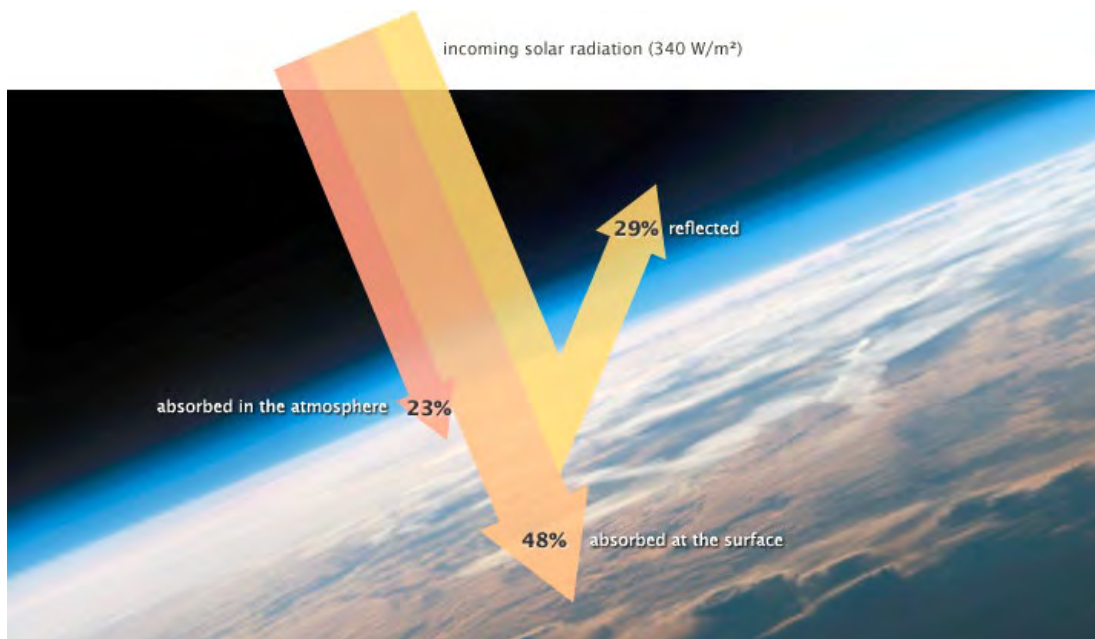
https://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/ny.pdf

What Is Geothermal

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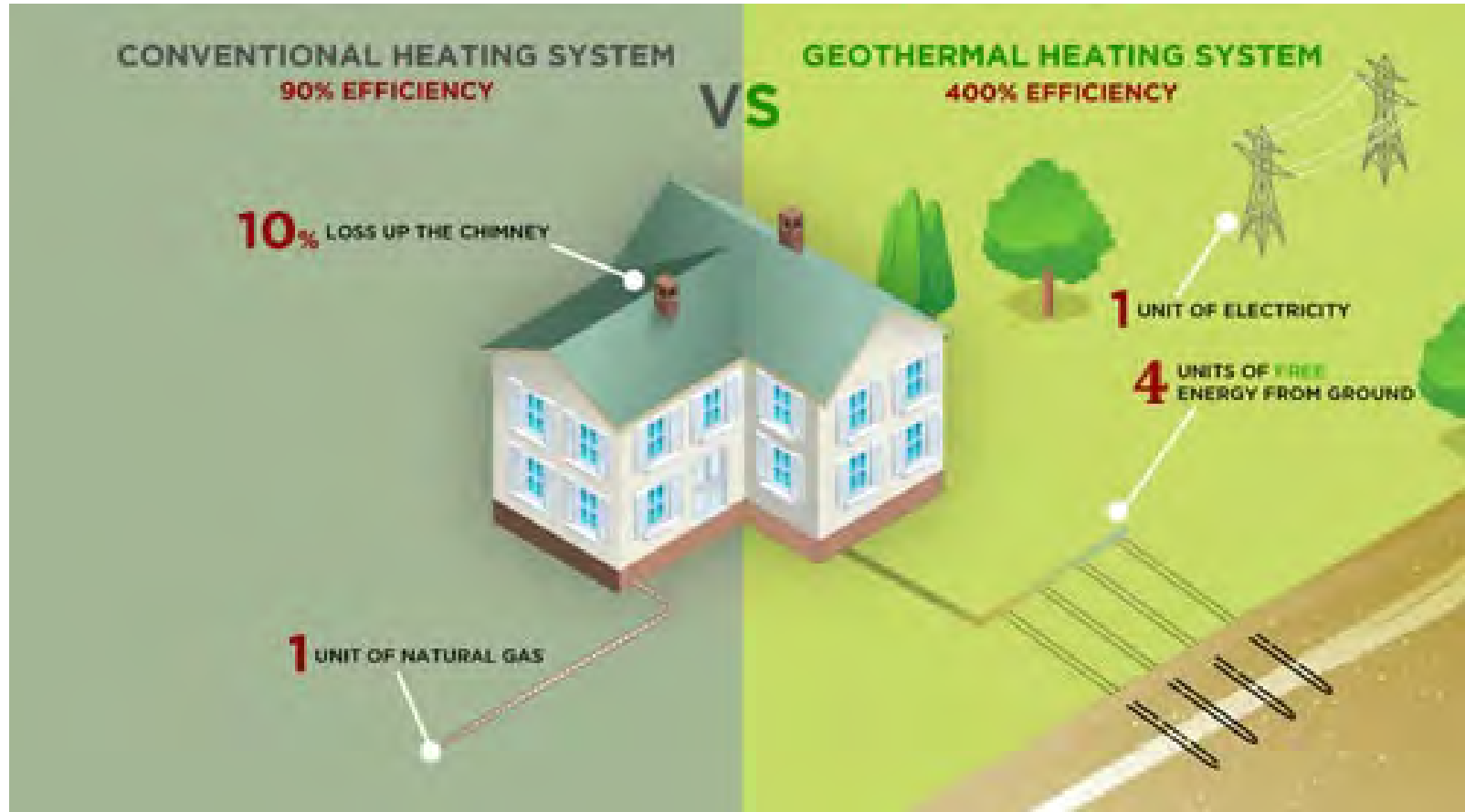
- 60 year-old Solar Technology
- Half of the energy from the sun absorbed by the ground



Geothermal is Very Efficient

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Retrofit Cost Comparison Example

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400% Efficient Geothermal

\$9,500 - 3 Ton Heat Pump
\$10,500 - 3 Closed Loops
\$1,000 - DHW Tank
\$10,000 - Labor
-\$9,300 - 30% Fed Tax Credit
-\$6,000 – Utility Rebate

\$15,700 – Total

Fuel Oil Furnace

\$4,000 – Furnace & Tank
\$3,000 – Furnace Labor
\$5,000 – Central Air Unit
\$4,000 – A/C Labor

\$16,000 – Total

95% Gas Furnace

\$3,500 – Furnace & Tank
\$3,000 – Furnace Labor
\$5,000 – Central Air Unit
\$4,000 – A/C Labor

\$15,500 – Total

*Geothermal System also supplies hot water

New Construction Cost Comparison Example

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400% Efficient Geothermal

\$9,500 – 3 Ton Heat Pump
\$10,500 – 3 Closed Loops
\$1,000 – DHW Tank
\$10,000 – Labor
\$5,000 – Duct Work
-\$10,800 – 30% Fed Tax Credit
-\$ 6,000 – Utility Rebate
\$19,200 – Total

Fuel Oil Furnace

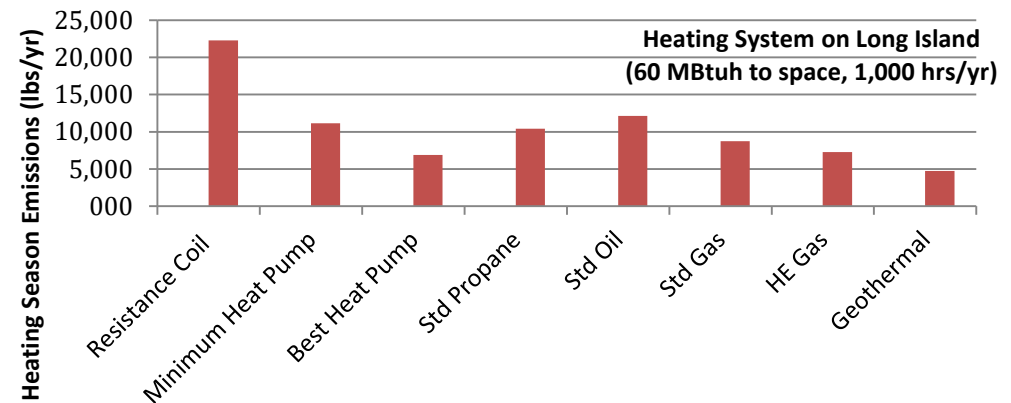
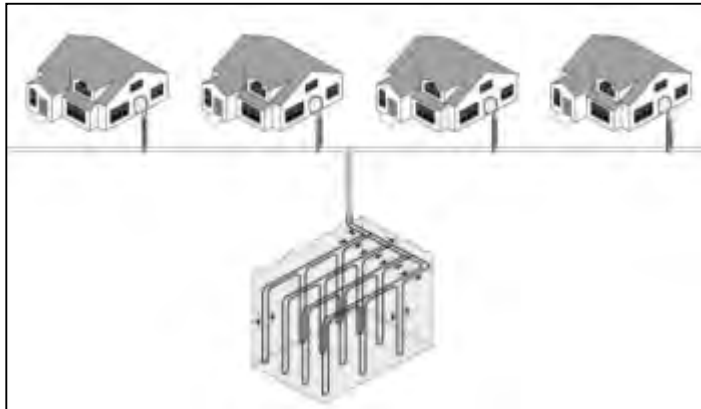
\$4,000 – Furnace & Tank
\$3,000 – Furnace Labor
\$5,000 – Central Air Unit
\$2,000 – A/C Labor
\$5,000 – Duct Work
\$2,500 – Fuel Oil DHW
\$21,500 – Total

95% Propane Furnace

\$3,500 – Furnace & Tank
\$3,000 – Furnace Labor
\$5,000 – Central Air Unit
\$2,000 – A/C Labor
\$5,000 – Duct Work
\$3,000 – Gas DHW
\$21,500 – Total

Project REV Goals

- A. Is GSHP cost effective for customers with no access to natural gas?
 - 3 Mil. NYS homes (0.5 Mil. On LI) do not have gas
- B. Does Utility ownership reduces barriers & enables scale?
 - Less than 1000 GSHP installs in NYS per year.
- C. Understand technical challenges, costs, and customer success factors
- D. Reduction of summer peak, winter base load, & utility benefits
- E. Evaluation, Measurement & Verification(EM&V)
 - I. Customer benefits
 - II. Technology performance efficiencies, shared-loop benefits



Ribbon Cutting Video

- <https://www.youtube.com/watch?v=W74xbFB0XVw>

Video can be embedded but requires booting.

Video can be stored on a drive with reference to the drive which will not require booting but will need to have both files stored on a flash drive. - preferred

Access to Clean Energy

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New York	Total Count
Residential	374,284
Multifamily	1,652
Commercial	20,016
Total	395,952

- 3 million NYS residents do not have immediate access to natural gas.
- Nearly 400,000 will likely to never connect to natural gas
- Rely on high carbon fuels



Ground Source Heat Pumps

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■ Enertech Hydron Module

- 2 speed compressor
- Packaged: EER 31.3, COP 5.1
- Split system: EER 25.3, COP 4.2

■ Water Furnace 7 Series

- Variable speed compressor
- Desuperheater for water heating
- Highest efficiency: EER 37, COP 5.7

■ Energy Efficiency upgrades

- Insulation with close cell spray foam
- Building envelop and duct air sealing



1. Digital Control Box
2. Ultra-Quiet Two-Stage or Variable Speed Compressor
3. Foam Insulated Pipes
4. Variable Speed ECM Blower Fan
5. High Efficiency Geothermal MERV Filters (Front) and Air Coil (Rear)
6. Air Discharge

Shared Geothermal System

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- 10 manufactured homes: 1 to 40 years & 1008Sf. to 1566Sf. area
- High efficiency GSHP units, replacing Propane / Kerosene
- Shared geo heat exchanger, no central pumps

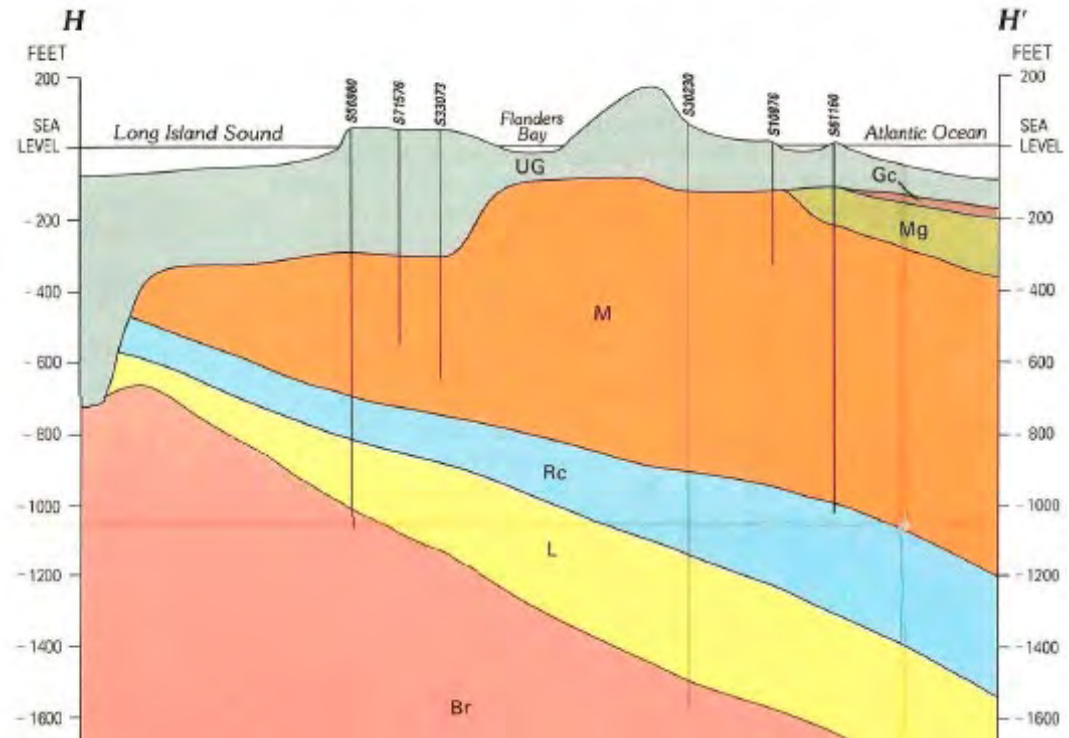


Lesson Learned Respecting the Environment

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- Ideal ground properties
- 20 vertical boreholes
- Maximum depth 225 feet
- Avoid entering the Magothy Aquifer
- 1.25 inch High Density Polyethylene (HDPE) Pipes



Ground Property	Unit	Value	Comment
Deep Earth Temperature	° F	55	Ideal
Thermal Conductivity	BTU/hr-ft-° F	1.63	Very Good
Thermal Diffusivity	f ² /Day	1.21	Very Good

Lessons Learned Customer Acquisition



- Consumer knowledge and confidence is limited
- Energy Audits are important when managing installation cost
 - Reduce total heating and cooling load
 - Correctly sized equipment and loop
 - Specify proper control

Lessons Learned Market Potential

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- Less than 1000 GSHP installs a year compared to 250,000 standard HVAC
- Workforce development needed
- Lack of volume, increases overall cost

Lessons Learned Design and Installation



- Confirmed underground heat exchanger system can account for 50-60% of the project cost
- Knowledge of local geology is required
- Identical construction material and trade techniques used

Lessons Learned Interconnection

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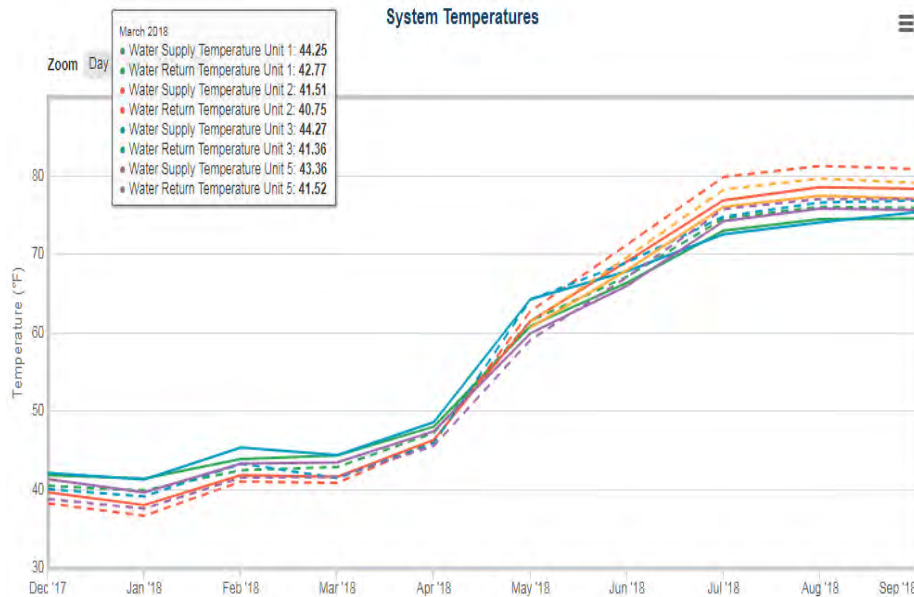


- Shared geothermal system can provides drilling cost efficiencies
- Retrofits can incur additional costs and can be challenged by existing conditions
- GSHPs have lower supply air temperatures which makes energy retrofits a necessity

Lessons Learned EM&V

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- GSHPs yielded a COP range of 2.2-3.5, including extended periods of 15 F below design temperature
- one operated with minimum reliance on auxiliary heat
- Customer education and follow-ups are required
- GSHP's provide real time performance data

Lessons Learned – Big Picture

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- Technology has proven efficiencies
- Underground infrastructure is akin to our gas business
- Customer upfront costs are a significant barrier to adoption
- The industry wishes for utility involvement to elevate today's rate of install from 1000/yr to 11,000/yr



Potential Geothermal Business Models

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Thank You

