Geothermal Energy Networks:

Transforming our Thermal Energy System

January 30-31, 2024

Source: public domain

MIT Environmental Solutions Initiative (ESI)

- **The ESI Education Program** aims to collaborate with MIT and the **broader community** to assess, innovate, and expand climate education across **disciplinary** and **institutional** contexts.

- This workshop stems from other collaborations with **HEET** & **ESI**:
  - **New Course:** Massive Open Online & In-Person **(Department of Urban Studies and Planning)**
  - **K-12** Curriculum on Geothermal Energy Networks **(Open Learning)**

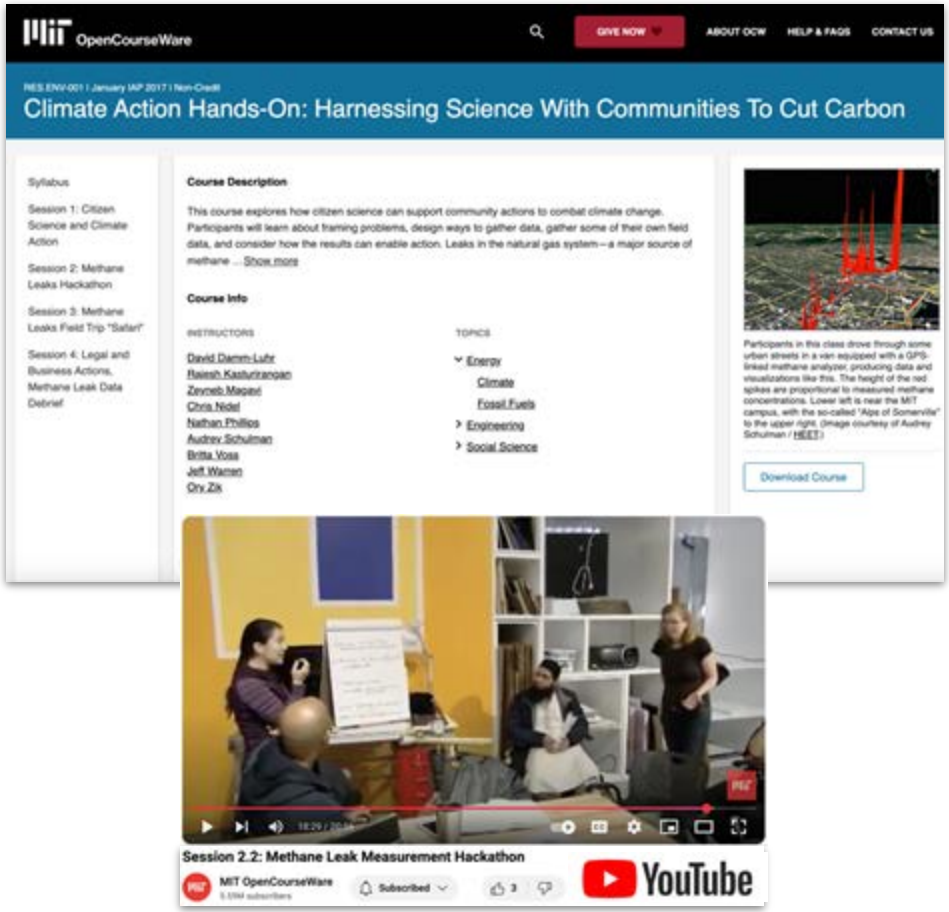
DAY OF CLIMATE

MIT OpenCourseWare

- Empowering **learners & educators** with free open-licensed materials

- Global **open knowledge ecosystem**: open education+science+data+tools

- OCW's reach & impact (2024 stats)
  - Website: 15M unique visits, 7.5M learners
  - YouTube: 5.5M subscribers, 47M views
  - 70% from outside the US



HEET team here to help over the two days:

Zeyneb Magavi
Executive Director

Isabel Varela
Science Director

Kari Bender
Assistant to ED

Eric Juma
Technology

Angie Alberto Escobar
Community Gas-To-Geo

Molly Fairchild
Healthy Homes

Rachel Wheeler
Logistics

Andrew Iliff
Policy Director

Mike Ring
Funding

Tony Berry
Communications Director

Stacy Kinnaly
Project Director

Rebecca Brenneis
Scientist

Course Overview

Day 1


Framing the Challenge


People Landscape for GENs


Policy Landscape for GENs


Scaling GENs

Day 2


Design Principles of GENs


Construction of GENs


GENs Research and Impact


GENs Case Studies

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Guest Lecturers

Day 1

Zeyneb Magavi, HEET
Jason Jay, MIT
Christoph Reinhart, MIT
Jonathan Buonocore, BUSPH

Nathan Phillips, Boston University
Chris Rabe, MIT
Kelsey Wirth, Mothers Out Front

Lorig Charkoudian, MD State Delegate
Ryan Murphy, Climate Jobs
Ania Camargo, BDC
James Van Nostrand, Chair of DPU MA

Sanjeev Kumar, European Geothermal Council
Nikki Bruno, Eversource Energy
Don Lessard, MIT Emeritus
Hela Cheikhrouhou, IFC, World Bank Group

Day 2

Connor Dacquay, GeoFease
Nick Fry, Jacobs
Brian Urlaub, Salas O'Brien

Garen Ewbank, GreyEdge Group
Mark Metzner, Endurant Energy
Brock Yordy, Geothermal Drilling Association
Eric Bosworth, Eversource Energy

Xiaobing Liu, ORNL
Isabel Varela, HEET
Juliet Simpson, NREL

Cary Smith, Sound Geothermal Corporation
Mark Metzner, Endurant Energy
Jay Egg, EggGeo
Susan Murcott, MIT

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Housekeeping

This course is being recorded for sharing freely with the world through MIT OpenCourseWare

Each session has brief presentations
Q&A at the end of each session - please participate !

First time offering this course
Evolving content - please provide ideas and feedback !

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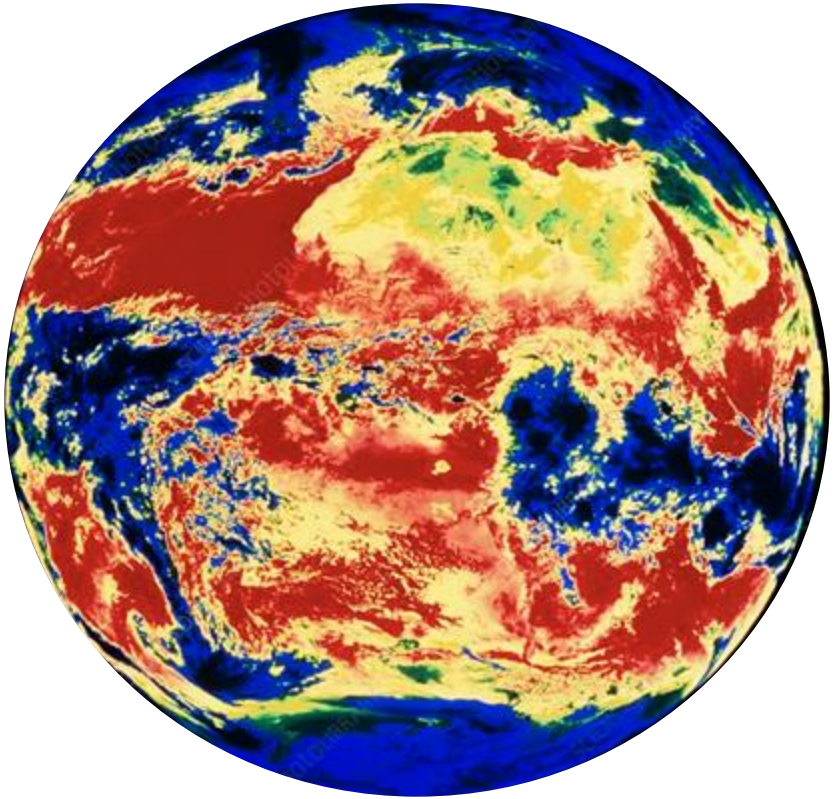
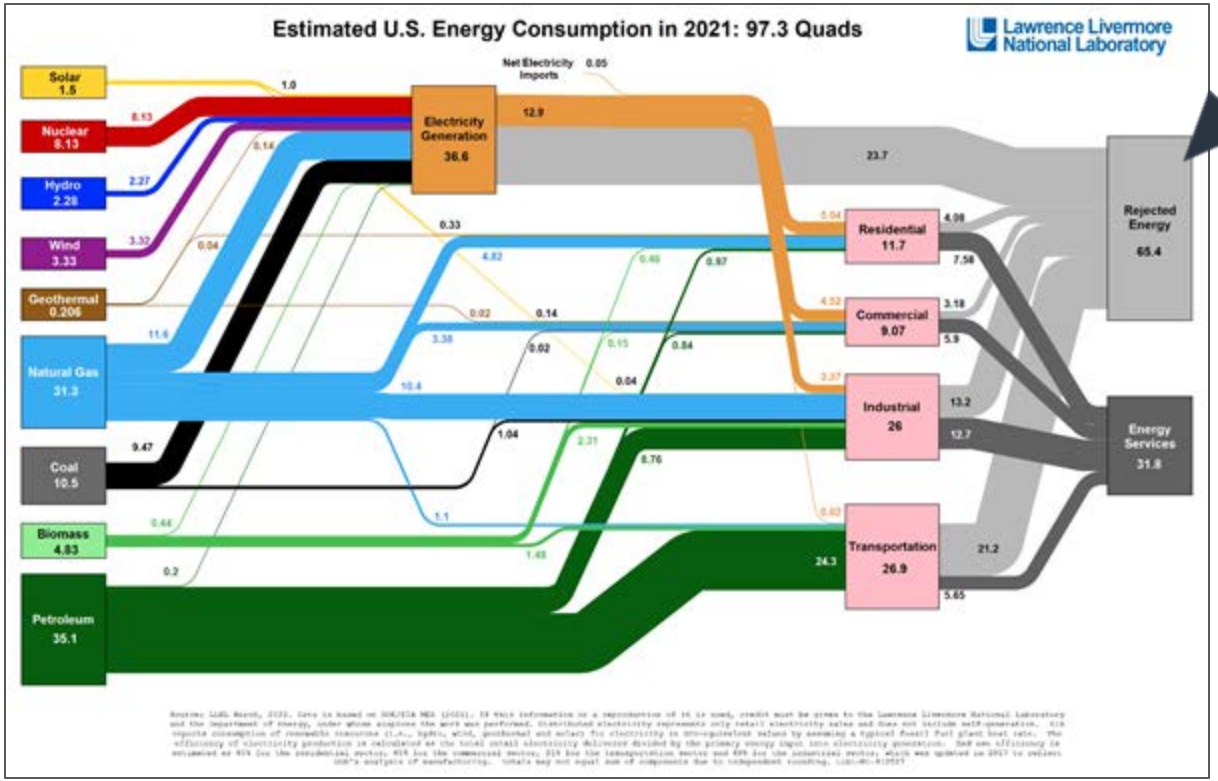
#ThinkThermalTogether



THINK THERMAL ?

“The technical potential of geothermal would be more than enough to meet all heat demand in Africa, China, Europe, Southeast Asia, and the United States.”

- IEA December 2024



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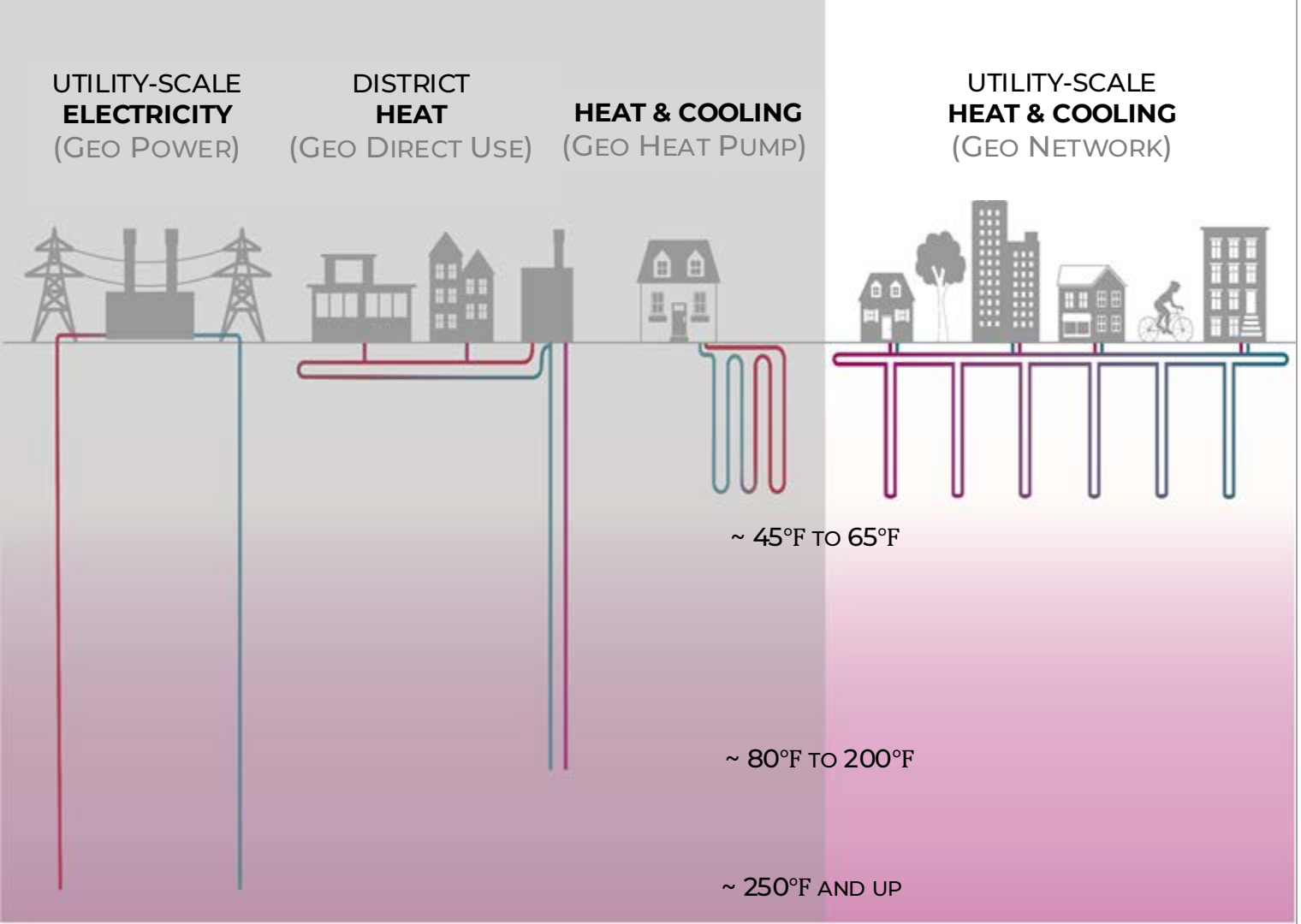
The majority of the energy we use is wasted, much of it is

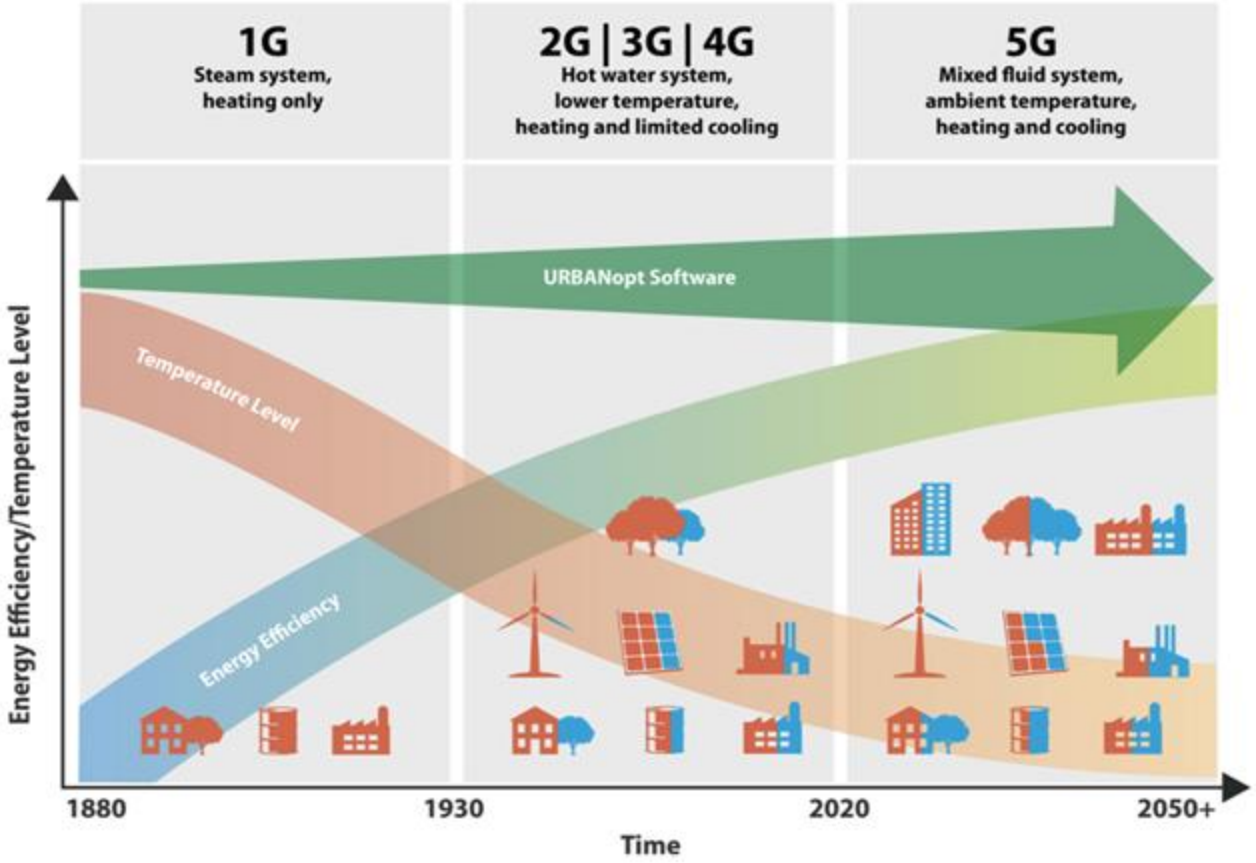
Thermal energy.



GEOTHERMAL ?

All Geothermal Technologies provide STABLE non-intermittent energy

- Shallow or Deep
- Ambient or Hot
- Everywhere or Not



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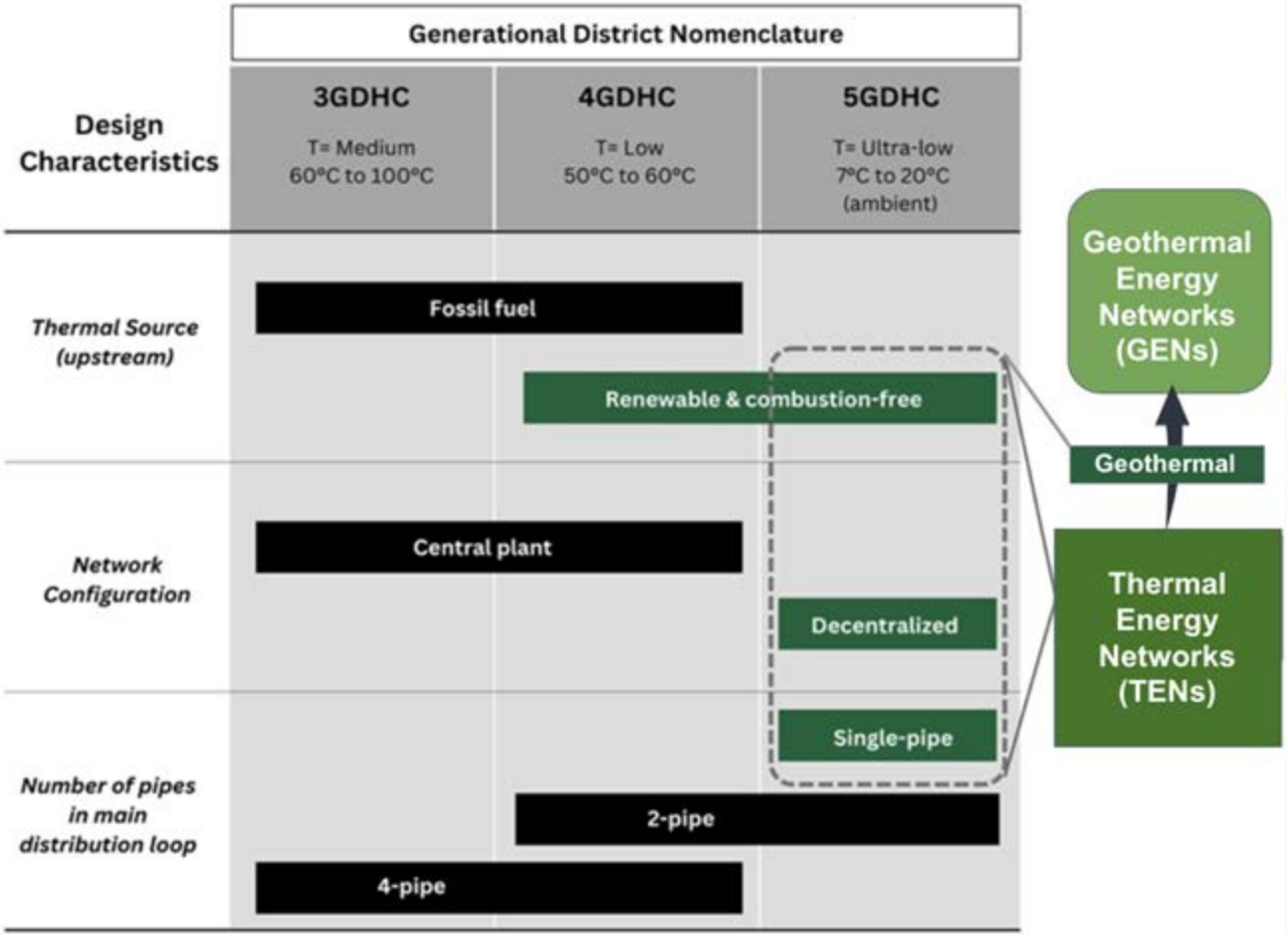
DISTRICT ?

A simplified diagram of district energy from NREL (U.S. National Renewable Energy Labs)



ENERGY NETWORK ?

Geothermal Energy Networks (GENs)

are a subset of

Thermal Energy Networks (TENs)

which are a subset of

5G Districts.

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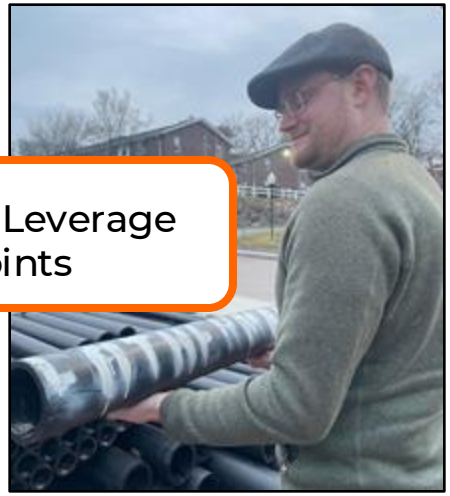
Engage All Stakeholders

MOVES AT SPEED OF TRUST

Identify Leverage Points

Innovate & Iterate



HEET's Approach to Designing & Driving Systems Change

Used to develop Geothermal Energy Networks & the Gas to Geo Pathway

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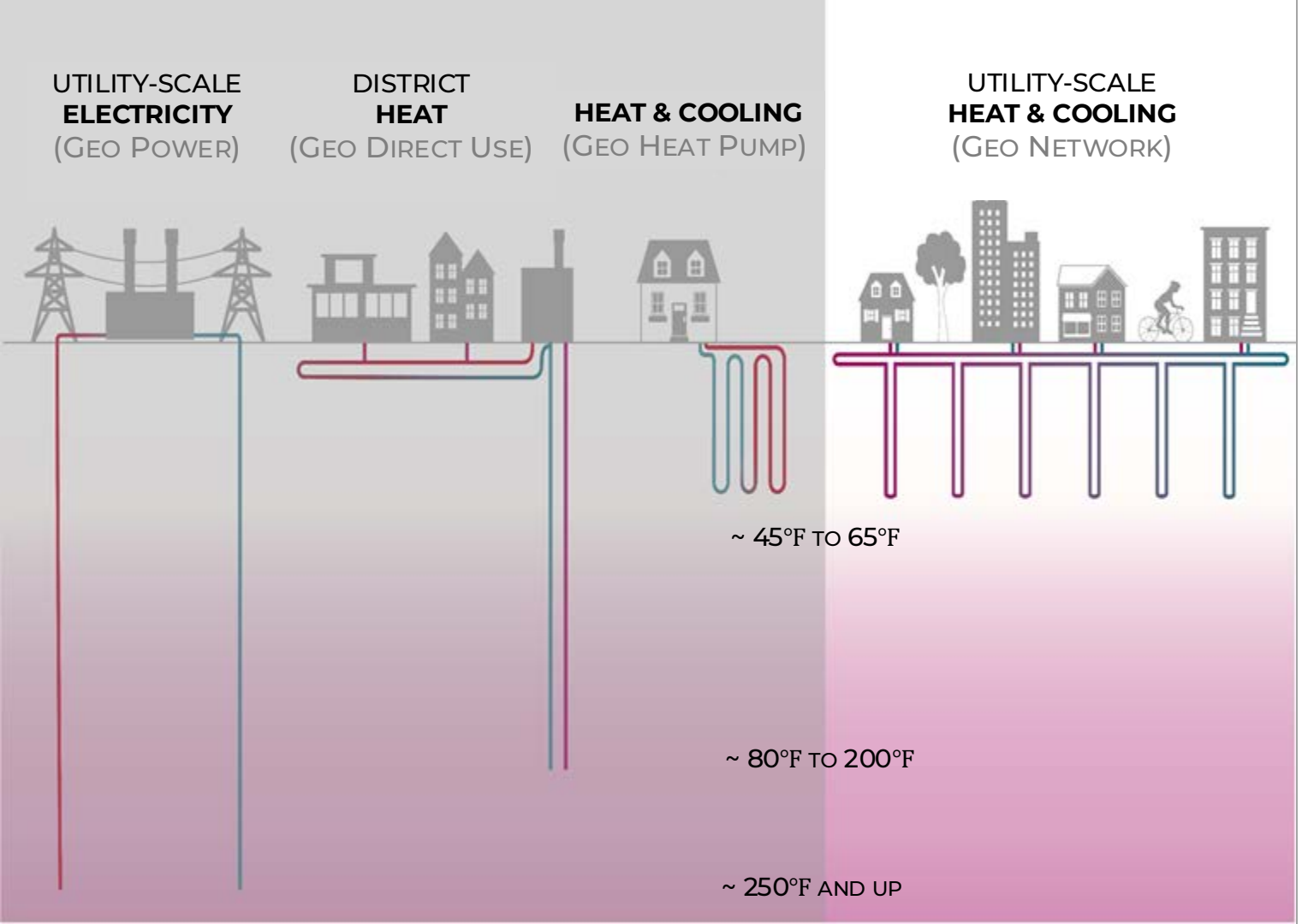

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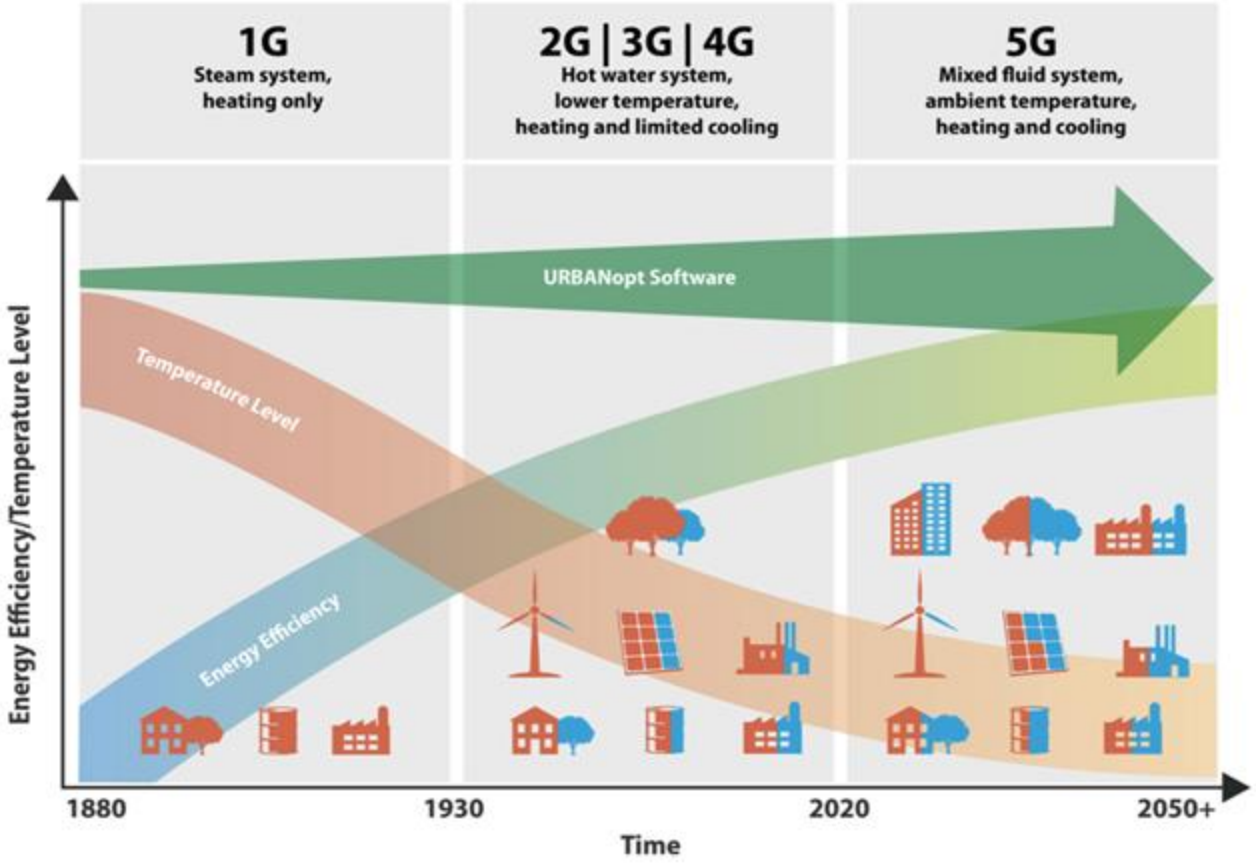

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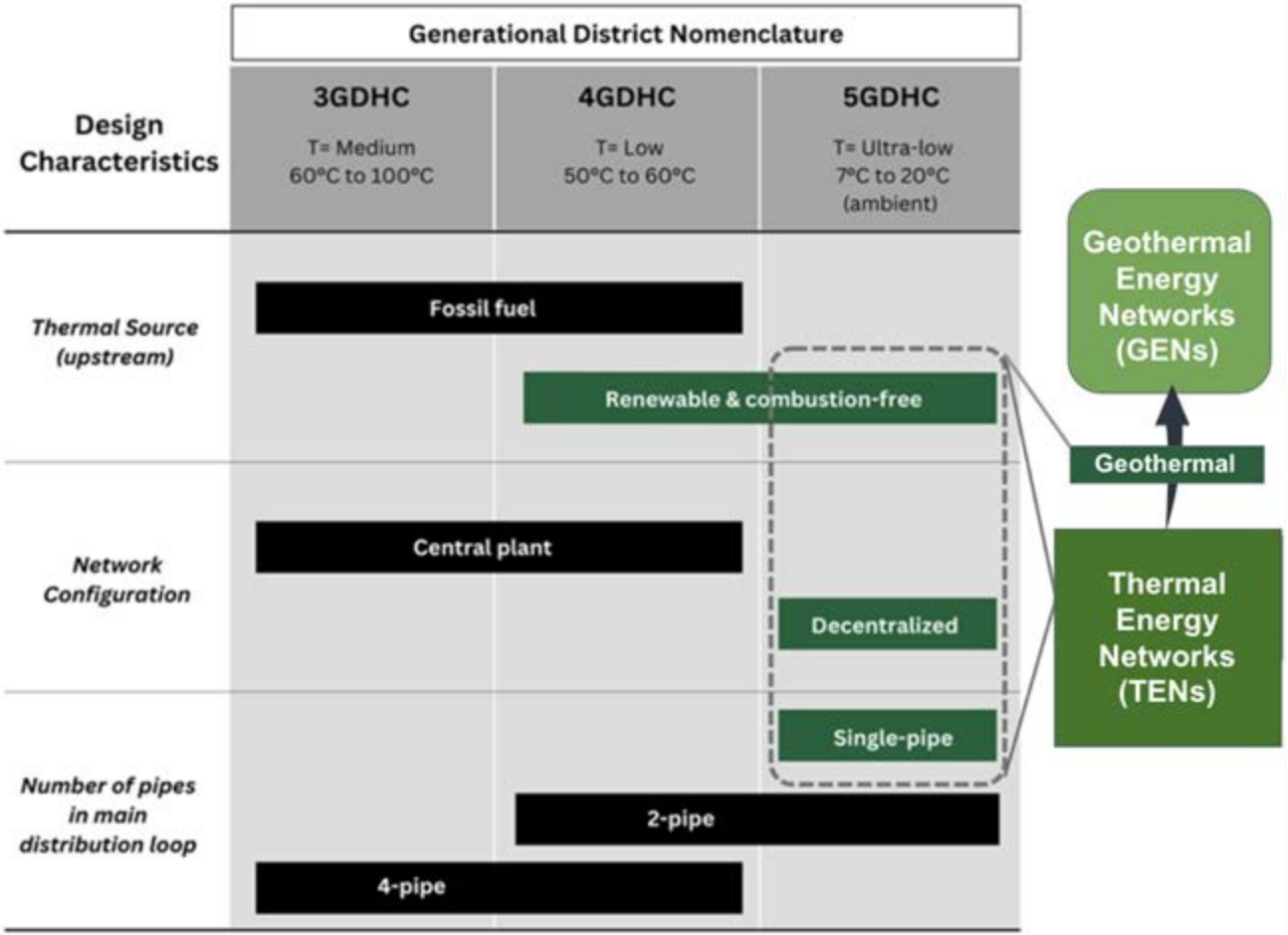

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Thermal Energy Networks (TENs)

which are a subset of

5G Districts.

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Slido Quiz !

Session 1: Framing the Challenge

Moderator: Zeyneb Magavi, HEET

- A Systems View of the Energy Transition and Role of Methane Emissions, Jason Jay, MIT
- Carbon Reduction Pathways for Building Stocks, Christoph Reinhart, MIT
- Climate, Energy and Health Nexus for GENs, Jonathan Buonocore, BUSPH

SLIDO: What challenge are YOU trying to solve ?

Coffee Break

Session 2: People Landscape for GENs

Moderator: Ania Camargo, Building Decarbonization Coalition

- An Ecological View of the Energy Transition, Nathan Phillips, Boston University
- How GENs Can Meet Environmental Justice Priorities, Chris Rabe, MIT
- GENs Origins from Moms Searching to Protect Their Children's Future, Kelsey Wirth, Mothers Out Front

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SLIDO: Brainstorm the key stakeholders

Lunch Break

Session 3: Policy Landscape for GENs

Moderator: Andrew Iliff, HEET

- Policy Case Study on the WARMTH Act, Lorig Charkoudian, Maryland State Delegate
- How Thermal Energy Networks (TENs) & GENs Can Meet Workforce Needs, Ryan Murphy, Climate Jobs
- The Rapidly Evolving Policy Landscape for GENs & TENs, Ania Camargo , Building Decarbonization Coalition
- The Potential Role of GENs in the MA Natural Gas Transition, James Van Nostrand, Chair of Department of Public Utilities Massachusetts

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SLIDO: What is the largest policy challenge you see?

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Coffee Break

Session 4: Scaling GENs

Moderator: Zeyneb Magavi, HEET

- The Growth of GENs in Europe, Sanjeev Kumar, European Geothermal Energy Council
- Utility Perspective on Scaling GENs, Nikki Bruno, Eversource Energy
- Business Models for Deploying GENs, Don Lessard, MIT (emeritus)
- Expanding GENs at a Global Scale, Hela Cheikhrouhou, International Finance Corporation, World Bank Group

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SLIDO: Say it is a race - where will GENs get to scale first ?

Closing Day 1

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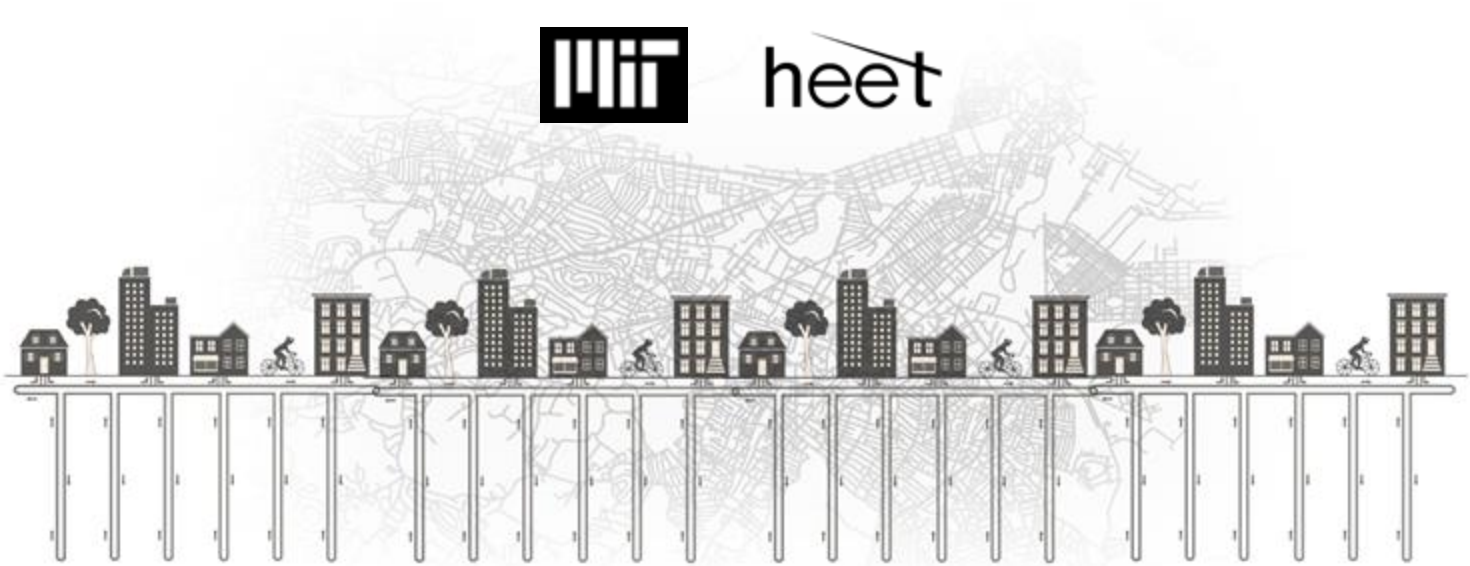

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Session 5: Design Principles for GENs

Moderator: Juliet Simpson, NREL

- **Introduction to Geothermal Heat Pumps, Connor Dacquay,** GeoFease
- **Systemic Differences Between Geothermal Heat Pumps and GENs, Nick Fry**, Jacobs
- **Introduction to Design of GENs, Brian Urlaub,** Salas O'Brien

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SLIDO: What advantages does a single-pipe ambient-temp loop design provide?

Coffee Break

Session 6: Construction of GENs

Moderator: Isabel Varela, HEET

- **Thermal Response Tests for Geothermal Boreholes, Garen Ewbank,** GreyEdge Group
- **Emerging Code & Standards for Ambient Temperature Loops, Mark Metzner,** Endurant Energy
- **Introduction to Drilling Geothermal Boreholes, Brock Yordy,** Geothermal Drilling Associatio
- **Constructing and Commissioning a GEN, Eric Bosworth,** Eversource Energy

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SLIDO: What innovations are most needed to build more, faster, for less ?

Lunch Break

Session 7: Researching GENs & Impacts

Moderator: Zeyneb, HEET

- **Discussion on existing grid impact knowledge with guests, Xiaobing Liu,** ORNL
- **Learning from GENs, Isabel Varela,** HEET
- **Techno-Economic Modeling of GENs, Juliet Simpson,** NREL

SLIDO: What data is needed to unlock investment and scaling?

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Coffee Break

Session 8: Case Studies of GENs

Moderator: Nick Fry, Jacobs

- **Colorado Mesa University, CO, Cary Smith,** Sound Geothermal Corporation
- **Framingham, MA, Mark Metzner,** Endurant Energy
- **Penn South Cooperative, Manhattan,** Jay Egg, EggGeo
- **MIT Thermal Energy Network (MITTEN) Plan, Susan Murcott,** MIT

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SLIDO Plusses, Deltas, and Key Learnings

THANK YOU to the Guest Lecturers - Thursday

8:45 AM Breakfast and Registration

9:15 AM 1) Framing the Challenge

Moderator: Zeyneb Magavi, HEET

A Systems View of the Energy Transition and Role of Methane Emissions, Jason Jay, MIT

Carbon Reduction Pathways for Building Stocks, Christoph Reinhart, MIT

Climate, Energy and Health Nexus for GENs, Jonathan Buonocore, Boston University School of Public Health

10:30 AM Coffee Break

11:00 AM 2) People Landscape for Geothermal Energy Networks (GENs)

Moderator: Ania Camargo, Building Decarbonization Coalition

An Ecological View of the Energy Transition, Nathan Phillips, Boston University

How GENs Can Meet Environmental Justice Priorities, Chris Rabe, MIT

How GENs Arose out of Moms Organizing to Protect Their Children's Future, Kelsey Wirth, Mothers Out Front

12:00 PM Lunch

1:00 PM 3) Policy Landscape for Geothermal Energy Networks

Moderator, Andrew Illif, HEET

Policy Case Study on the WARMTH Act, Lorig Charkoudian, Maryland State Delegate

How Thermal Energy Networks (TENs) & GENs Can Meet Workforce Needs, Ryan Murphy, Climate Jobs

The Rapidly Evolving Policy Landscape for GENs & TENs, Ania Camargo , Building Decarbonization Coalition

The Potential Role of GENs in the Massachusetts Natural Gas Transition, James Van Nostrand, Chair of Department of Public Utilities MA

2:30 PM Coffee Break

3:00 PM 4) Scaling Geothermal Energy Networks

Moderator, Zeyneb, HEET

The Growth of GENs in Europe, Sanjeev Kumar, European Geothermal Energy Council

Utility Perspective on Scaling GENs, Nikki Bruno, Eversource Energy

Business Models for Deploying GENs, Don Lessard, MIT (emeritus)

Expanding GENs at a Global Scale, Hela Cheikhrouhou, International Finance Corporation, World Bank Group

4:10 PM Closing

4:30 PM Adjourn

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THANK YOU to the Guest Lecturers - Friday

8:45 AM Welcome and Breakfast

9:15 AM **5) Design Principles of Geothermal Energy Networks**

Moderator, Juliet Simpson, NREL

Introduction to Geothermal Heat Pumps, Connor Dacquay, GeoFease

Systemic Differences Between Geothermal Heat Pumps and GENs, Nick Fry, Jacobs

Introduction to Design of GENs, Brian Urlaub, Salas O'Brien

10:30 AM Coffee Break

11:00 AM **6) Construction and Commissioning of Geothermal Energy Networks**

Moderator, Isabel Varela, HEET

Thermal Response Tests for Geothermal Boreholes, Garen Ewbank, GreyEdge Group

Emerging Code & Standards for Ambient Temperature Loops, Mark Metzner, Endurant Energy

Introduction to Drilling Geothermal Boreholes, Brock Yordy, Geothermal Drilling Association

Constructing and Commissioning a GEN, Eric Bosworth, Eversource Energy

12:30 PM Lunch

1:30 PM **7) Researching Geothermal Energy Networks and their Impacts**

Moderator, Zeyneb, HEET

Discussion on existing grid impact knowledge with guests, Xiaobing Liu, ORNL

Learning from GENs, Isabel Varela, HEET

Techno-Economic Modeling of GENs, Juliet Simpson, NREL

2:30 PM Coffee Break

3:00 PM **8) Case Studies of Geothermal Energy Networks**

Moderator, Nick Fry, Jacobs

Colorado Mesa University, CO, Cary Smith, Sound Geothermal Corporation

Framingham, MA, Mark Metzner, Endurant Energy

Penn South Cooperative, Manhattan, Jay Egg, EggGeo

MIT Thermal Energy Network (MITTEN) Plan, Susan Murcott, MIT

4:10 PM Closing

4:30 PM Adjourn

THANK YOU to ALL of you for #ThinkingThermalTogether

Until Next Year !

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RES.ENV 007 Geothermal Energy Networks (GENs): Transforming our Thermal Energy System

IAP 2025