Geothermal Operations: From Oil & Gas Foundations to Next-Generation Energy

Opportunities in Well Repurposing, Permitting, and State Policy

April 23, 2026

Summary

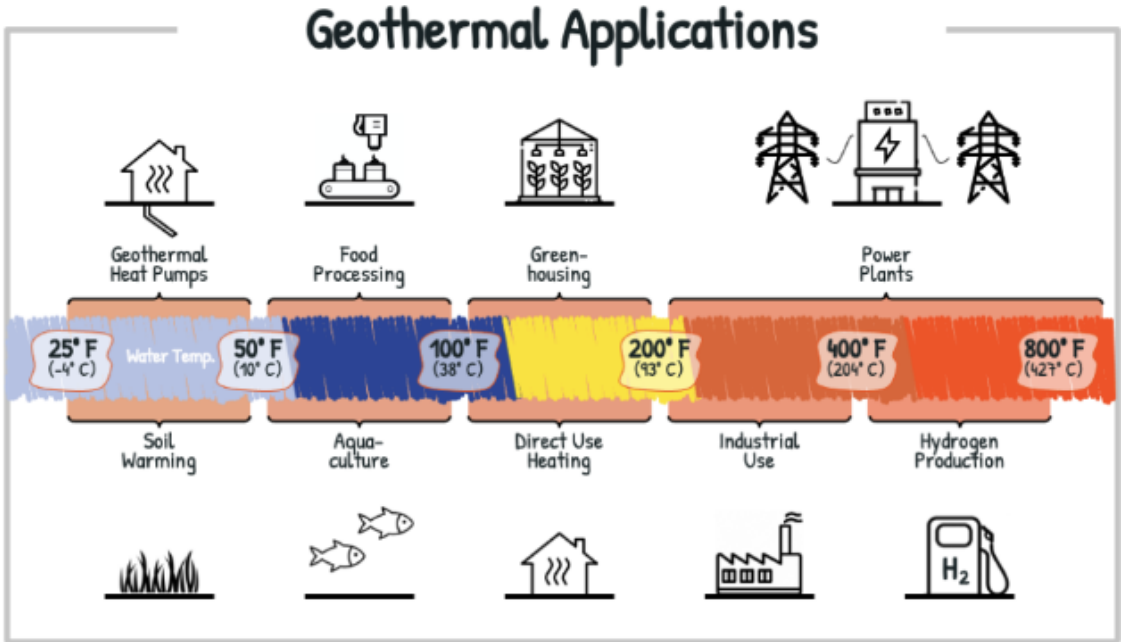
- Speaker Background
- What is Geothermal?
- Geothermal Industry Perspective
- Oil and Gas Co-Production and Conversion
- State Action on Geothermal Regulations & Permitting
- Conclusions

An Oil & Gas Foundation for Geothermal Innovation

- Johanna Ostrum
  - B.S. Geological Engineering
  - 15 years Oil and Gas: Noble Energy, SM Energy, Extraction Oil & Gas
  - 6 years Geothermal
  - COO Gradient Geothermal

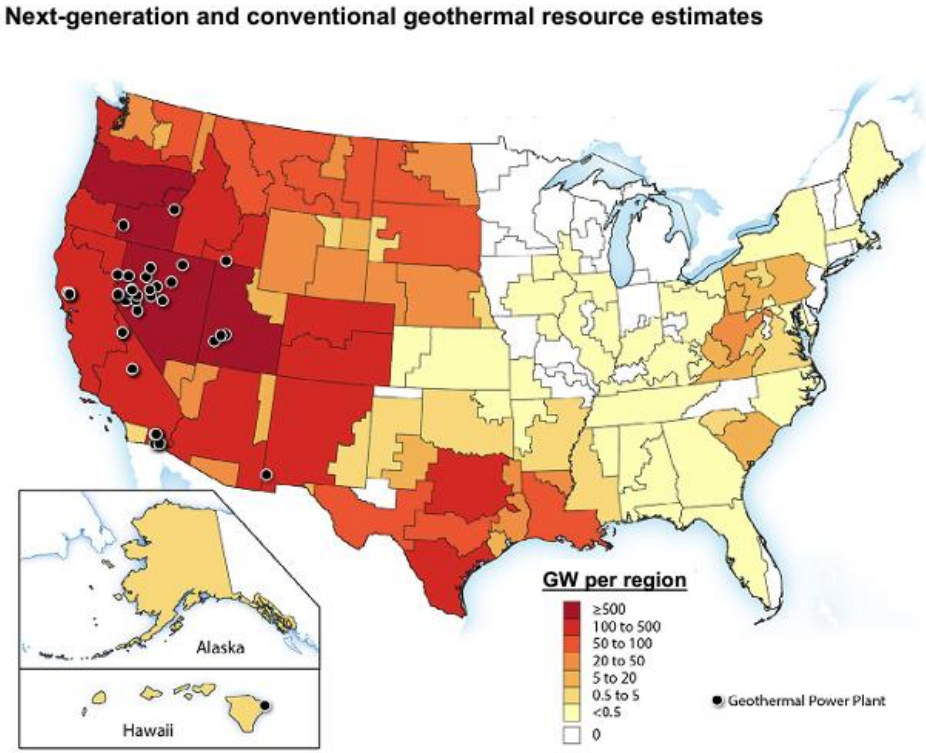
What is Geothermal Energy

- The natural and never-ending heat produced by the earth
- The two sources of geothermal heat
  - Radioactive decay of the earth's core
  - Leftover heat from Earth's formation
- Two broad categories of Geothermal Energy
  - Direct Use
  - Power Generation



Geothermal History

- Geothermal energy has been used by humans for thousands of years for cooking and bathing
- The world's first geothermal plant was completed in 1913 in Lardello, Italy
- The Geysers, located in CA, first opened in 1960 and has been producing geothermal electricity since then
  - The US is the largest producer of geothermal electricity in the world
  - California is the #1 producer of geothermal electricity, generating 69.5% of the nation's geothermal power (5.8% of its own needs)



Geothermal Energy

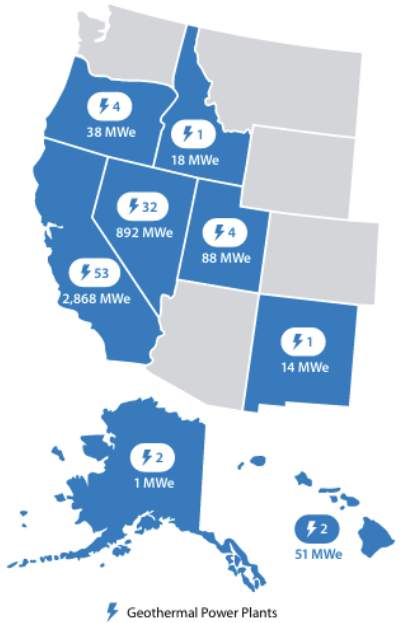
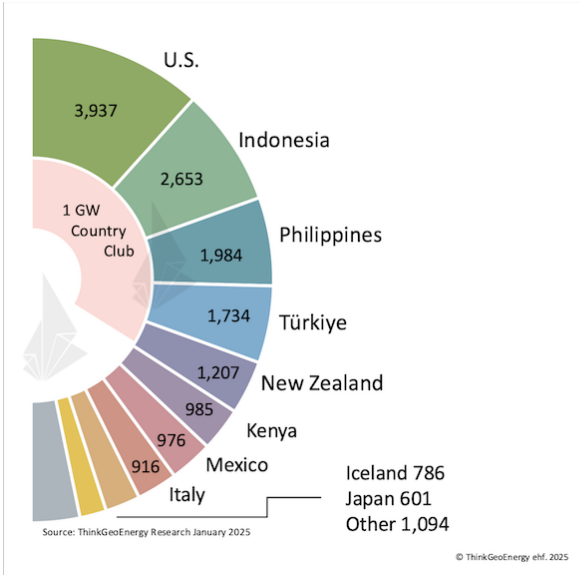
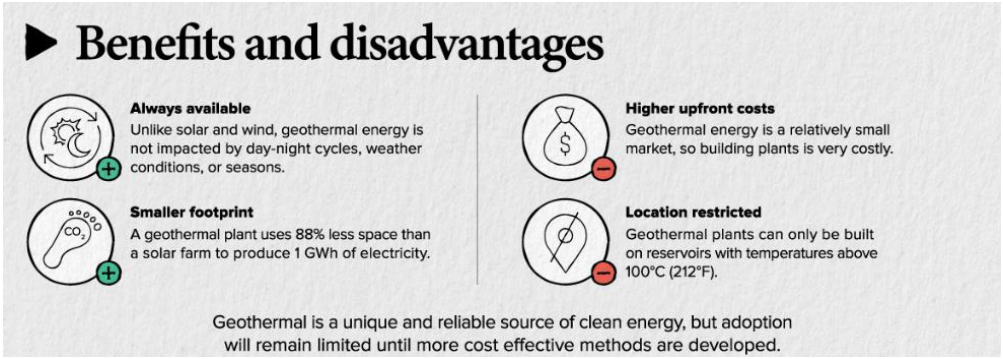


Figure ES-2. Distribution and installed nameplate capacity of geothermal power plants in the United States as of June 2024. *Data from EIA (2024a, 2024d). In the power plant totals for each state, a single plant is described by the installation year (Appendix B) as it can consist of one or more generating units installed over years. Some plants (e.g., Puna in Hawai'i and McGinness Hills in Nevada) have been expanded in subsequent years after the first unit was installed. These are treated as separate plants as shown in Appendix B. This does not include planned plants that are not yet operational.*



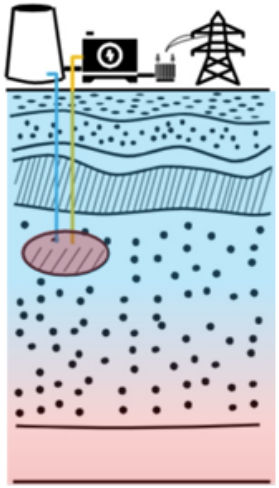


Geothermal Well Types

Power Generation

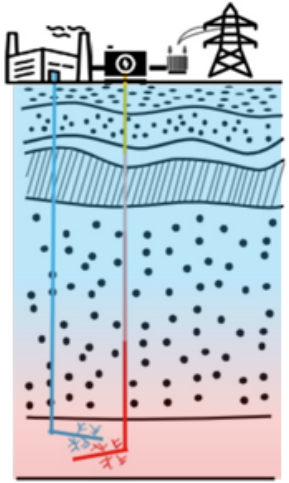
Conventional — **Next-Generation**

Hydrothermal



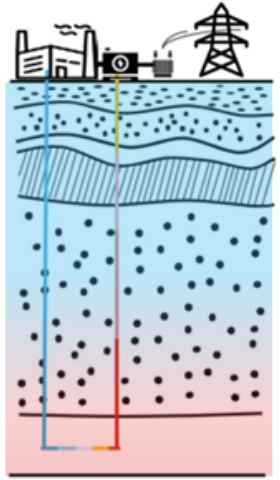
- Fluids circulate openly through naturally occurring fractures
- Limited estimated total resource (~40 GW)
- ~4 GW on the grid today

Enhanced Geothermal Systems (EGS)



- Fluids circulate openly within a well pair connected by fractures engineered with hydraulic fracturing & horizontal drilling
- Large estimated total resource (5+ TW all next-generation geothermal)
- Scales through modular deployment of many well pairs

Closed Loop Geothermal Systems



- Fluids circulate through a long series of closed wellbore loops permeating the subsurface
- Large estimated total resource (5+ TW all next-generation geothermal)
- Scales through modular deployment and increasing wellbore lengths

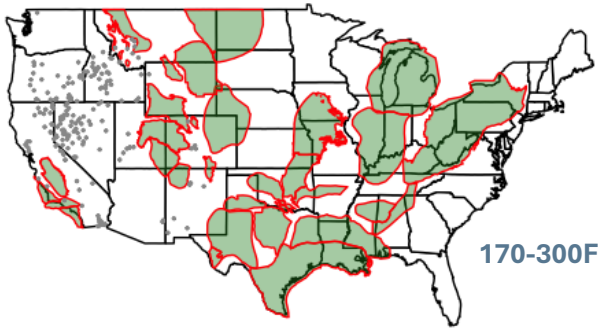
Geothermal Co-Production

Converting or Co-Producing Geothermal Energy from Existing Oil & Gas Wells

- **Wider Geographic Reach:** Lower temperature geothermal resources are available from existing oil and gas wellbores across the US and the world
- **Lower Cost:** By focusing on fluids that are already produced, there is significant cost reduction on exploration and drilling which are often 60% of project cost.
- **Faster Deployment:** This also applies to deployment time which is greatly reduced from 7 years down to 6 months.

Current High- and Medium-Temperature Geothermal Project Locations
Geothermal Sites (USGS)

Available Low-Temperature Geothermal Project Locations
Available Geothermal Resources



Gradient Geothermal Intro

Gradient provides baseload, modular, renewable geothermal power and cooling for Data, Telecom, and Energy Infrastructures:

- **Generate clean electricity**
- **Cool produced fluids**
- **Reduce greenhouse gas emissions**

Gradient Geothermal and our predecessor company, Transitional Energy, was founded in 2020

Headquartered in Denver, CO

First Installation

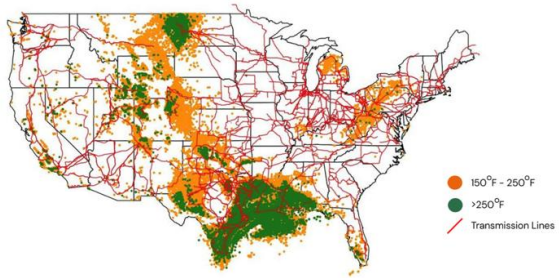
Blackburn Field, Eureka County, Nevada
Installed April 2022

Gradient Geothermal

Current Market:

- Energy, Cooling, and Thermal Networks at Oil and Gas Wells

- US example of ~500,000 available wells out of ~2.9 MM total wells
- A capital-light approach
- Rapid deployment
- Technology Readiness Level 9
- No exploration, no drilling
- Does not rely on Site Uptime



Map of US Well Sites by Temperature

Power Gen from Stable Liquid Flows

- Any combo of water and oil
- Works with field chem programs


Current Project: Pine Valley, NV

Cooling and Power Gen From Liquid Flowback or High- Pressure Gas

- Replaces fluid chillers
- Mobile to follow cooling needs
- Generates power when thermal mass allows
- Handles most pressure ratings
- Any combo of water and gas


Current Project: Williston Basin, ND

Thermal Energy Network

- Repurpose of watered out or abandoned oil/gas wells
- Transforms liability into an asset
- Delivers heat to local community


Current Project: Pierce, CO

How Does the Technology Work

Technology: ORC/HXC Sled

- Off-the-shelf ORC generator and Dry Cooler
- 170° F (80° C) Minimum Temp / 300° F (150° C) Maximum Temp
- 2,000 bpd Minimum Flow Volume / Unlimited Maximum Flow Volume
- Rated from -40° F to 120° F Ambient Temperature
- Proprietary Heat Exchanger sled with IP protection
- No consumptive use of water

State Level Momentum is Accelerating Geothermal Development

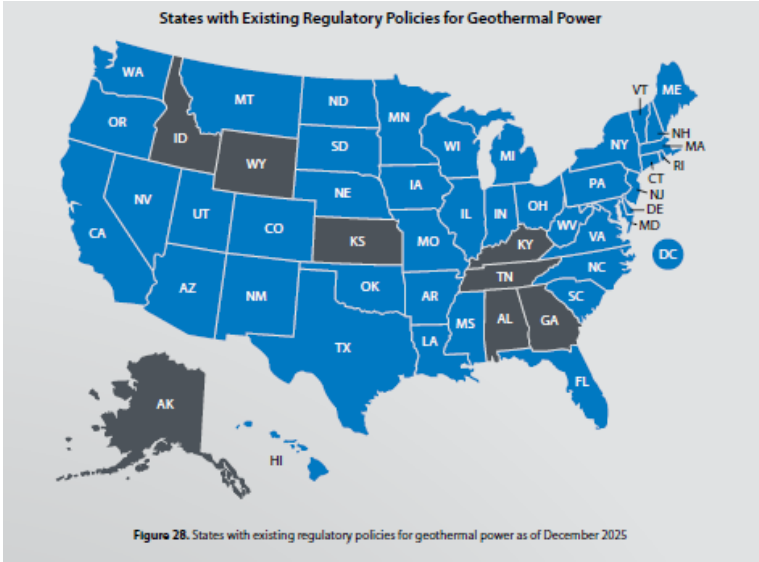
Policy is shifting from exploration to deployment

What's driving activity:

- Energy security and grid reliability concerns
- Desire to leverage existing oil and gas assets
- Economic reuse of idle and marginal wells
- State-level decarbonization goals

What are states doing:

- Clarifying ownership of subsurface heat / minerals / water
- Creating pathways to repurpose existing wells
- Funding pilot and demonstration projects
- Establishing thermal energy network frameworks
- Aligning geothermal with existing oil and gas regulatory bodies



National Lab of the Rockies, 2025 U.S. Geothermal Market Report

~15+ states have introduced or passed geothermal legislation in the last 2–3 years

Most policies are designed to work *with* oil and gas, not replace it

Examples of State Action

Colorado: Regulatory Clarity + thermal networks

- Clarified jurisdiction under ECMC
- Passed TENs legislation
- Grant program and Tax Credit
- Geothermal heat is a surface right

New Mexico: Funding & Market Development

- Establish Geothermal Development Fund
- EMNRD handles permitting
- Funding pilot and demonstration projects
- Geothermal resources owned by mineral estate

Texas: Defining ownership & regulatory path

- Clarified jurisdiction under Railroad Commission
- Geothermal heat is a surface right

North Dakota: Oilfield Integration

- Geothermal Feasibility Study
- Repurposing inactive oil and gas wells
- Create a policy and regulatory framework

Alabama:

- SB174: Repurposed oil & gas wells for geothermal + alternative energy
- Formal approval process via Oil & Gas Board

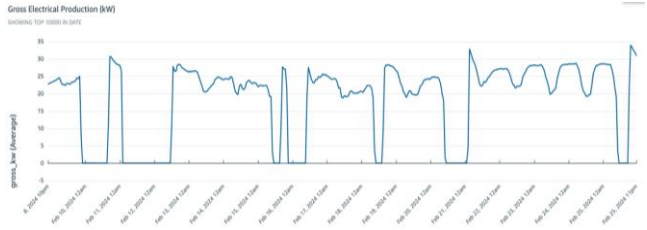
Gradient Geothermal

Contact Information:

Ben Burke, Chief Executive Officer:
ben@gradientgeothermal.com
(860) 655-6837
Johanna Ostrum, Chief Operating Officer:
johanna@gradientgeothermal.com
(406) 690-4849

Gradient Geothermal

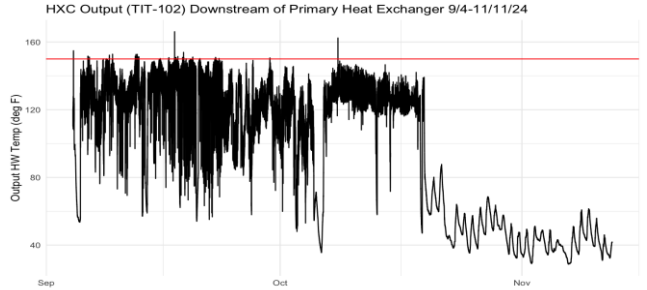
Case Study 1: Power Generation from Long-Term Stable Produced Fluids



Pine Valley, NV

- DOE Wells of Opportunity-funded project
- Pathway to 1 MW at existing oilfield
- Four season operations
- Grid-tied
- 4200 bwpd, 195° F input, Air Cooled

Case Study 2: Cooling Produced Fluids on Liquid Flowback



Williston Basin, ND

- Cooling produced fluids on liquids flowback from a new pad turn-on
- Met 150° F cooling spec 99.3% of time
- Modular layout for following completions crew to where cooling is needed across asset