

Geothermal Technologies Office – FY23 Mid-Year Update

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Hydrothermal Resources and Low-Temperature and Coproduced Resources

Presentation to: Association of American State Geologists (AASG)

March 2, 2023



The Future of Geothermal is Hot!



What Are Geophones?

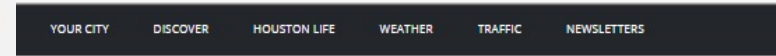
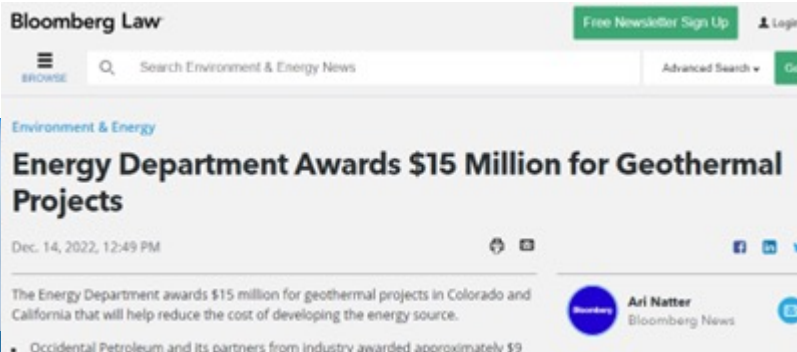
The Tool That Could Unlock the Potential of Geothermal Energy

May 26, 2022 | By Lindsey McGuirk | [Contact media relations](#)



Elmore County, Nevada. Photo by Dennis Schroeder, NREL.

The heat-pump fix
To ditch fossil fuels for good, we must combine a range of technologies and approaches.



US Energy Secretary Jennifer Granholm visits Houston to discuss potential of geothermal energy investments



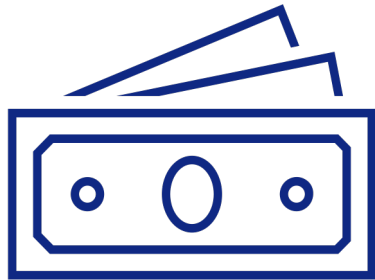
U.S. Secretary of Energy Jennifer M. Granholm visited Houston Thursday to discuss the potential of geothermal energy investments.

Granholm toured a state-of-the-art union worker training facility in the area focused on energy jobs.

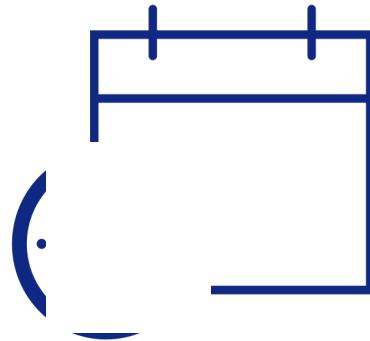
She was joined by Mayor Sylvester Turner, and Rick Levy, President of Texas AFL-CIO, to announce a major new geothermal energy initiative.



Enhanced
Geothermal



\$ 45/MWh



2035



Enhanced Geothermal Shot Analysis for the Geothermal Technologies Office

Chad Augustine, Sarah Fisher, Jonathan Ho, Ian Warren,
and Erik Witter

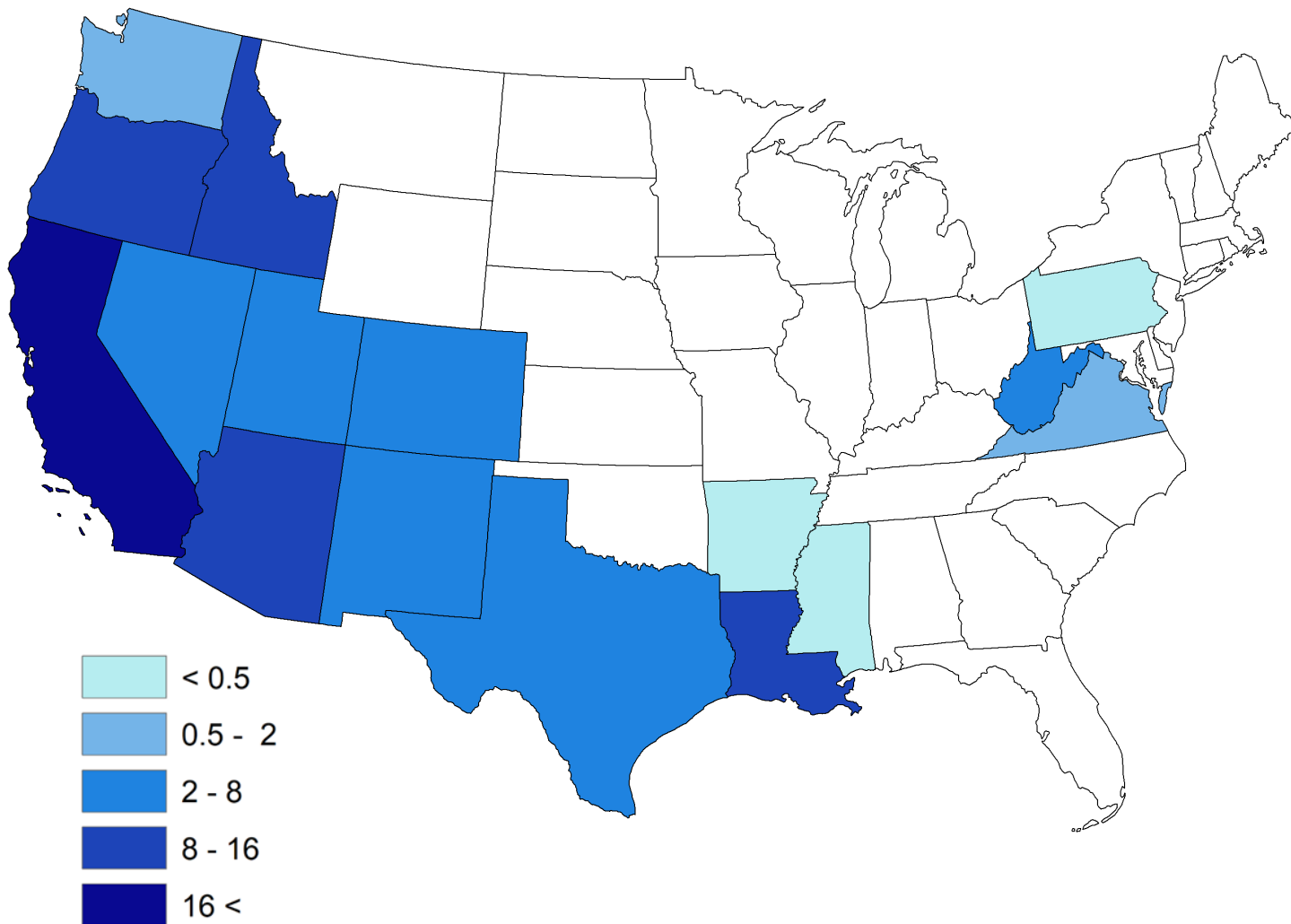
National Renewable Energy Laboratory

nrel.gov/docs/fy23osti/84822.pdf



Enhanced Geothermal Shot

2050 Deep EGS Deployment Capacity (GW)



90 GW_e by 2050



Expansion of geothermal for electricity generation



Clean heating & cooling for U.S. households

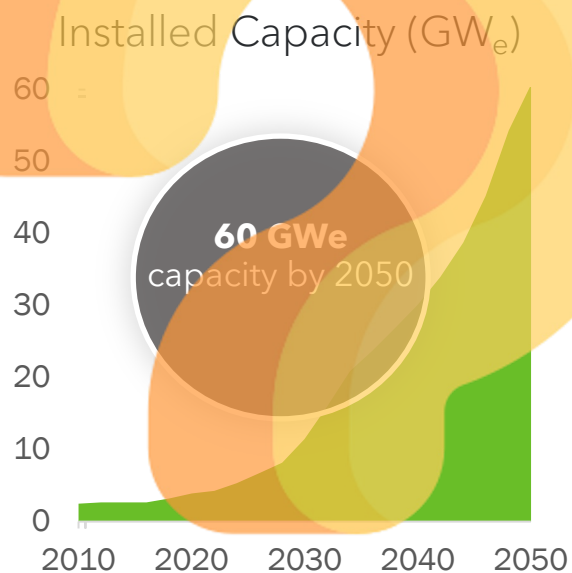


Drives just transition and leverages fossil workers

So what does this mean for the future of geothermal??

ELECTRIC

 **8.5%** of all U.S. generation by 2050

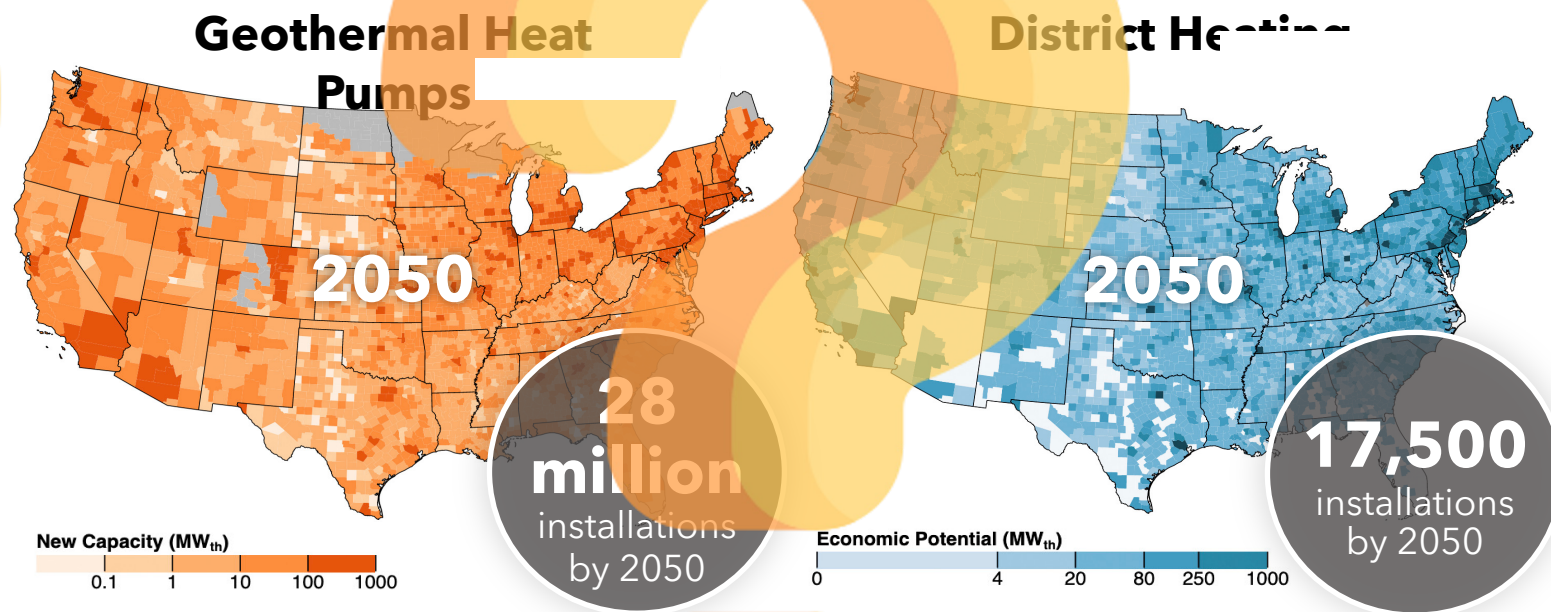


Source: Augustine et al. 2019

 up to **516 MMT**
of avoided CO₂e

HEATING & COOLING

 **23%** of U.S. Heating and Cooling market by 2050

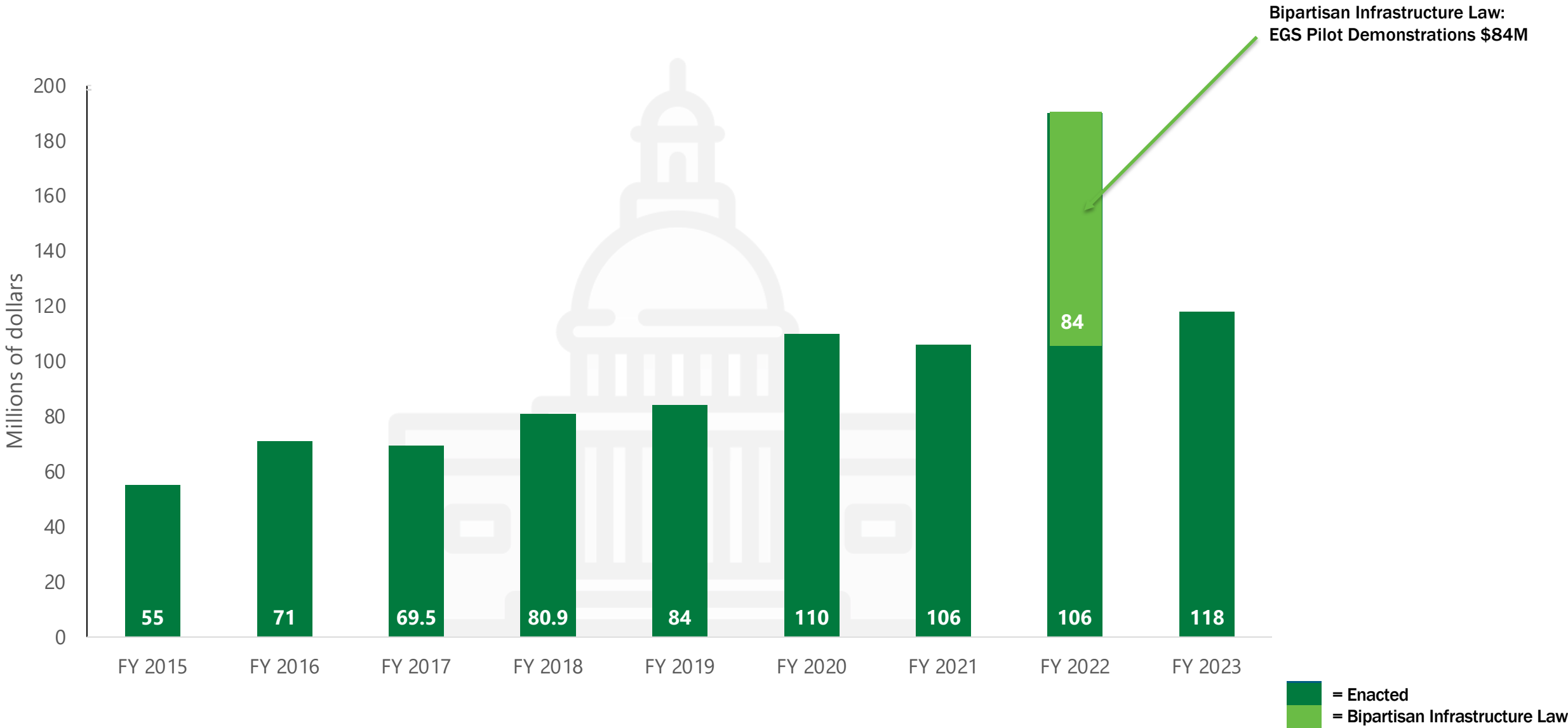


 up to **1,281 MMT**
of avoided CO₂e

Total Emissions Reductions =
removal of **26 million** cars per year



GTO Budget



Geothermal in the Inflation Reduction Act

- The Inflation Reduction Act of 2022, H.R. 5376 (IRA):
 - Extends the investment tax credit and production tax credit for renewables, including geothermal.
 - Provides a 30% tax credit, up to \$2,000, for purchase of a heat pump (geothermal or air source).





Geothermal in the Bipartisan Infrastructure Law

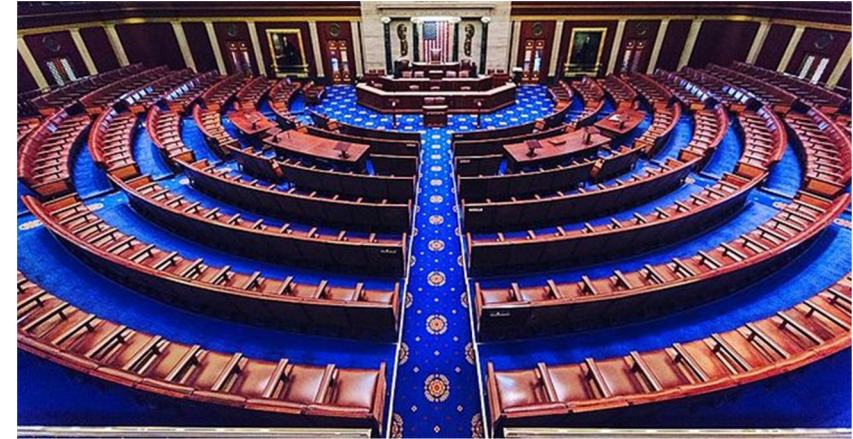
SEC. 41007. Enhanced Geothermal Systems Demonstrations

Topic 1: EGS Proximal Demonstrations: EGS demonstrations utilizing existing infrastructure proximal to existing geothermal/hydrothermal development with immediate potential for electrical power production.

Topic 2: EGS Green Field Demonstrations: Sites with no existing geothermal development and potential for shallow sedimentary, igneous and/or mixed metamorphic rock EGS with near-term electrical power production potential.

Topic 3: Super-hot / Supercritical EGS Demonstrations: Super-hot/ Supercritical EGS demonstrations located at well-characterized sites with near-term electrical power production potential.

Topic 4: Eastern U.S. EGS Demonstrations: Demonstration at a well-characterized eastern U.S. site, with existing wells in place and near-term electrical power/heat production potential.

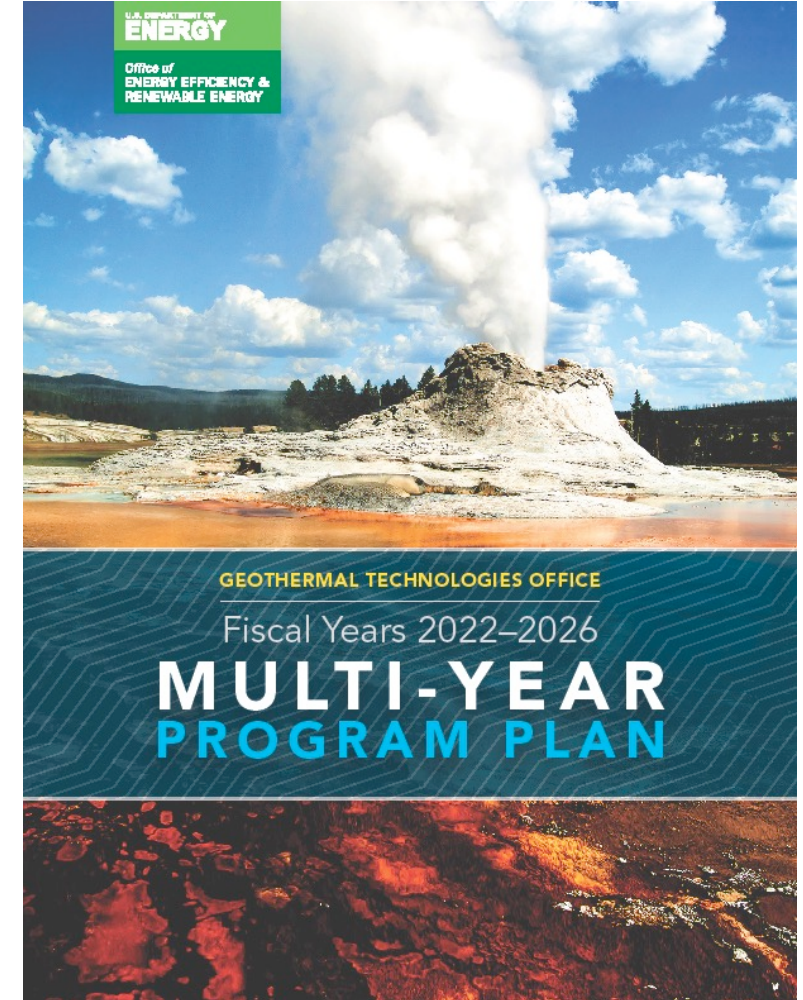


Priorities: 5-Year Strategy for GTO

The **Multi-Year Program Plan** is a 5-year plan of activities GTO will pursue to support the growth and long-term contribution of geothermal energy to the U.S. electricity grid and American homes and buildings.

Based on GTO's strategic goals for geothermal energy to contribute to the nation's clean energy future by:

- ✓ Providing generation for a carbon-free electricity grid
- ✓ Decarbonizing the U.S. building stock through direct-use applications, district heating and cooling, and geothermal heat pumps
- ✓ Helping to deliver economic, environmental, and social justice advancements.



<https://bit.ly/GTOMYPP>



GTO's Multi-Year Program Plan: Six Research Areas

RESEARCH AREA

TECHNICAL OBJECTIVES

EXPLORATION AND CHARACTERIZATION

Improve resource targeting for all geothermal resource types

SUBSURFACE ACCESSIBILITY

Improve drilling costs toward the "ideal" cost curves used in the *GeoVision* analysis

SUBSURFACE ENHANCEMENT AND SUSTAINABILITY

Enhance and sustain geothermal energy recovery

RESOURCE MAXIMIZATION

Accurately capture the value of geothermal energy resources

DATA, MODELING, AND ANALYSIS

Expand the capabilities of using data to identify and address barriers to geothermal deployment

GEOTHERMAL INTEGRATION AND AWARENESS

Expand stakeholder education and outreach to improve understanding of geothermal energy and advance geothermal technologies

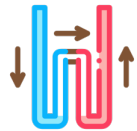
GTO aims to increase geothermal energy deployment through research, development, and demonstration of innovative technologies that enhance exploration and production.



Enhanced Geothermal Systems



Hydrothermal Resources



Low-Temperature and Coproduced Resources



Data, Modeling, and Analysis

Frontier Observatory for Research in Geothermal Energy (FORGE)

- Plan to drill 16B well this spring (~April)
 - Follows completion of 16A in 2022, the first-of-its-kind highly deviated well in hard and hot granite
- Applications **under review** for second solicitation
 - Will award up to \$44 million for testing and evaluation of new and innovative EGS tools and techniques
 - utahforge.com/rd/solicitations/ for details about what the research will cover





Other EGS Highlights

ReAmplify is providing \$8.4 million to establish the commercial viability of geothermal energy production in existing oil and gas wells.

energy.gov/eere/geothermal/wells-opportunity-reamplify

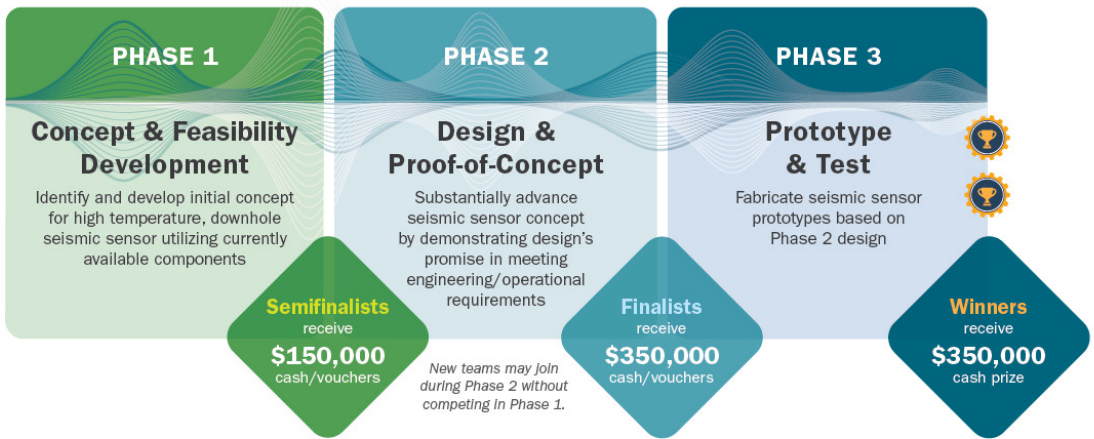
Four ReAmplify projects selected in 2022:

- Geothermix, LLC
- University of Oklahoma
- Transitional Energy
- ICE Thermal Harvesting



GEOTHERMAL GEOPHONE PRIZE

This prize offers a total of \$3.65 million in incentives—
\$2.55 million in cash prizes, \$1.1 million in vouchers.



Geothermal Geophone Prize

- \$3.65 million competition to address the challenges of operating seismic sensors in harsh geothermal environments
- 10 semifinalists in Phase 1
- Phase 2 currently open

americanmadechallenges.org/challenges/geophone/

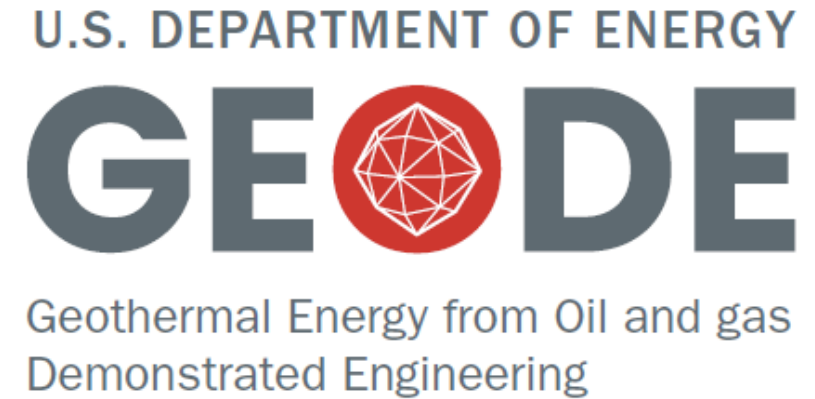
Drilling Demonstrations Campaign



- Will reduce the cost of developing geothermal energy by generating at least a 25% improvement in geothermal drilling rates
- Two projects selected:
 - **Geothermal Limitless Approach to Drilling Efficiencies (GLADE)** (Denver-Julesburg Basin, Colorado)
 - **Evaluation of Physics-Based Drilling and Alternative Bit Design** (The Geysers Geothermal Field, California)

Other Hydrothermal Highlights

- **GEODE** will establish a consortium to leverage oil & gas subsurface assets, technologies, and expertise to help solve geothermal energy's toughest challenges, while providing clean energy employment opportunities and environmental benefits for communities.



GeoFlight (Glamis Dunes) Photo courtesy Kyle Kendall

Hidden Systems

- INnovative Geothermal Exploration through Novel Investigations Of Undiscovered Systems (INGENIOUS)
- Basin & Range Investigations for Developing Geothermal Energy (BRIDGE)
- Collaboration w/U.S. Geological Survey:
 - Geoscience Data Acquisition in Western Nevada (GeoDAWN)
 - GeoFlight: Salton Trough

Federal Geothermal Partnerships

- GTO and the Federal Energy Management Program are partnering with federal facilities to consider low-temperature geothermal technology to heat and cool installations.
 - Technologies include geothermal heat pumps, district and community heating and cooling systems, and hybrid systems that include geothermal resources.
- Oak Ridge National Laboratory and its partners will develop a technical assistance framework and workflow aimed at a deployment-ready report, supporting the deployment of geothermal energy at federal sites.



Identify federal sites that are strong candidates for geothermal heating and cooling technologies



Provide technical assistance for site characterization/resource confirmation activities at these sites



Break ground for multiple innovative geothermal system deployments

Community-Scale Geothermal

Community Geothermal Heating and Cooling Design and Deployment initiative will help communities:

- Reduce energy burden and fossil fuel dependence
- Increase grid resilience & stability
- Improve environmental quality
- Support jobs

Eligible Projects:

- direct use
- heat pumps
- innovative designs & technologies

Selected to be part of the Department of Energy's Justice40 initiative





Non-Technical Barriers

GTO is supporting numerous national lab projects to assess and address non-technical barriers to geothermal deployment, including:

- State and local permitting challenges in California and Nevada
- Cost gaps among geothermal, wind, and utility-scale PV Power Purchase Agreements
- Quantitative techno-economic analysis of the impact of permitting timelines on cost of produced electricity from geothermal resources.





Hybrids Research

- Four national laboratory projects to investigate hybridized geothermal power plants through research, analysis, and modeling
 - Hybridization of a geothermal power plant with one or more low-carbon heat sources to increase the generation from new or retrofit geothermal power plants
 - Reservoir thermal energy storage technologies for creating geothermal reservoirs in permeable formations using a low-carbon heat source or low-carbon electricity
- Both topics require robust analyses that help build the case for commercial pathways to hybridizing geothermal power plants.



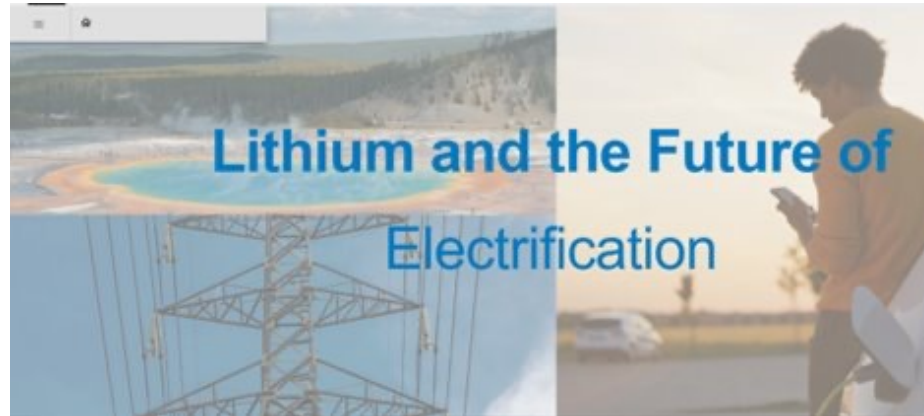
Aerial view of the Stillwater triple hybrid project (photo courtesy of ENEL Green Power North America, taken from “Better Together: New Synergies and Opportunities From Hybrid Geothermal Projects” by Ann Robertson-Tait and Douglas Hollett via [geothermal.org/our-impact/blog/geothermal-hybrid-renewable-systems](https://www.geothermal.org/our-impact/blog/geothermal-hybrid-renewable-systems)).



How to Engage with GTO

GTO is using multiple tools and resources to help spread the word about geothermal energy and engage with stakeholders.

- Funding Opportunities
- Updated Website
- Funding Opportunity Quick Guides
- The Drill Down
- Lithium Storymap
- Stakeholder Toolkits
- Infographics
- Project Postcards



Thank You!



Get the hottest geothermal news from *The Drill Down*, GTO's monthly newsletter!
Sign up today: geothermal.energy.gov



Interested in serving as a [merit reviewer](#) for GTO RD&D projects?

Send us your resume or CV:
doe.geothermal@ee.doe.gov