U.S. DEPARTMENT OF ENERGY

Office of ENERGY EFFICIENCY & RENEWABLE ENERGY

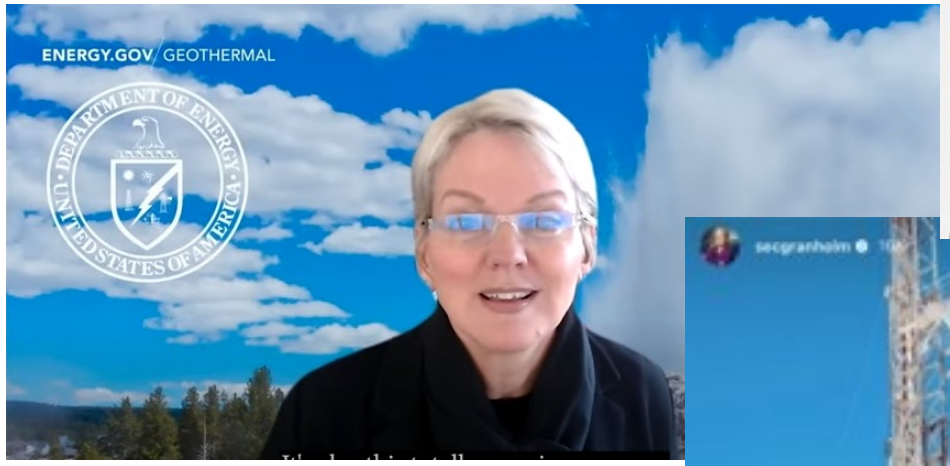
What's New at the U.S. Department of Energy's Geothermal Technologies Office?

Lauren Boyd, Acting Director

Presentation to: Stanford Geothermal Workshop

February 6, 2023

The Future of Geothermal is Hot!



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Environment & Energy

Energy Department Awards $15 Million for Geothermal Projects

Dec. 14, 2022, 12:49 PM

The Energy Department awards $15 million for geothermal projects in Colorado and California that will help reduce the cost of developing the energy source.

Ari Natter
Bloomberg News

- Occidental Petroleum and its partners from industry awarded approximately $9

YOUR CITY DISCOVER HOUSTON LIFE WEATHER TRAFFIC NEWSLETTERS

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
of geothermal energy investments.

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.

What Are Geophones?

The Tool That Could Unlock the Potential of Geothermal Energy

May 26, 2022 | By Lindsey McGuirk | Contact media relations

hoe County, Nevada. *Photo by Dennis Schroeder, NREL*

Bloomberg Green

The heat-pump fix

May 6th, 2022

To ditch fossil fuels for good, we must combine a range of technologies and approaches.

electricity would be enough to provide clean, reliable
sses. A key factor to unlocking that amount of
ion in subsurface seismic sensors,

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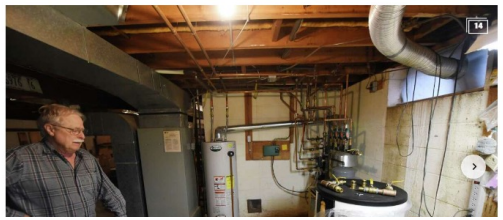
REAL ESTATE

Some Capital Region homeowners warming up to geothermal heat

Shayla Colon
Dec. 29, 2022



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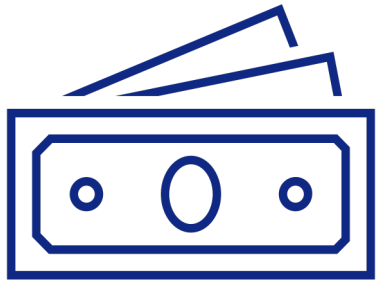
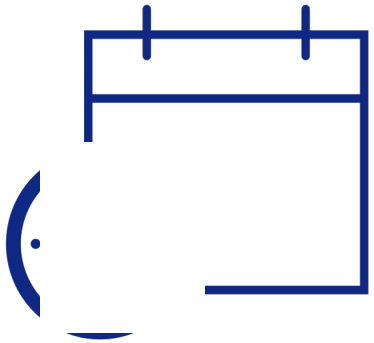
ENERGY earthshots
U.S. DEPARTMENT OF ENERGY

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

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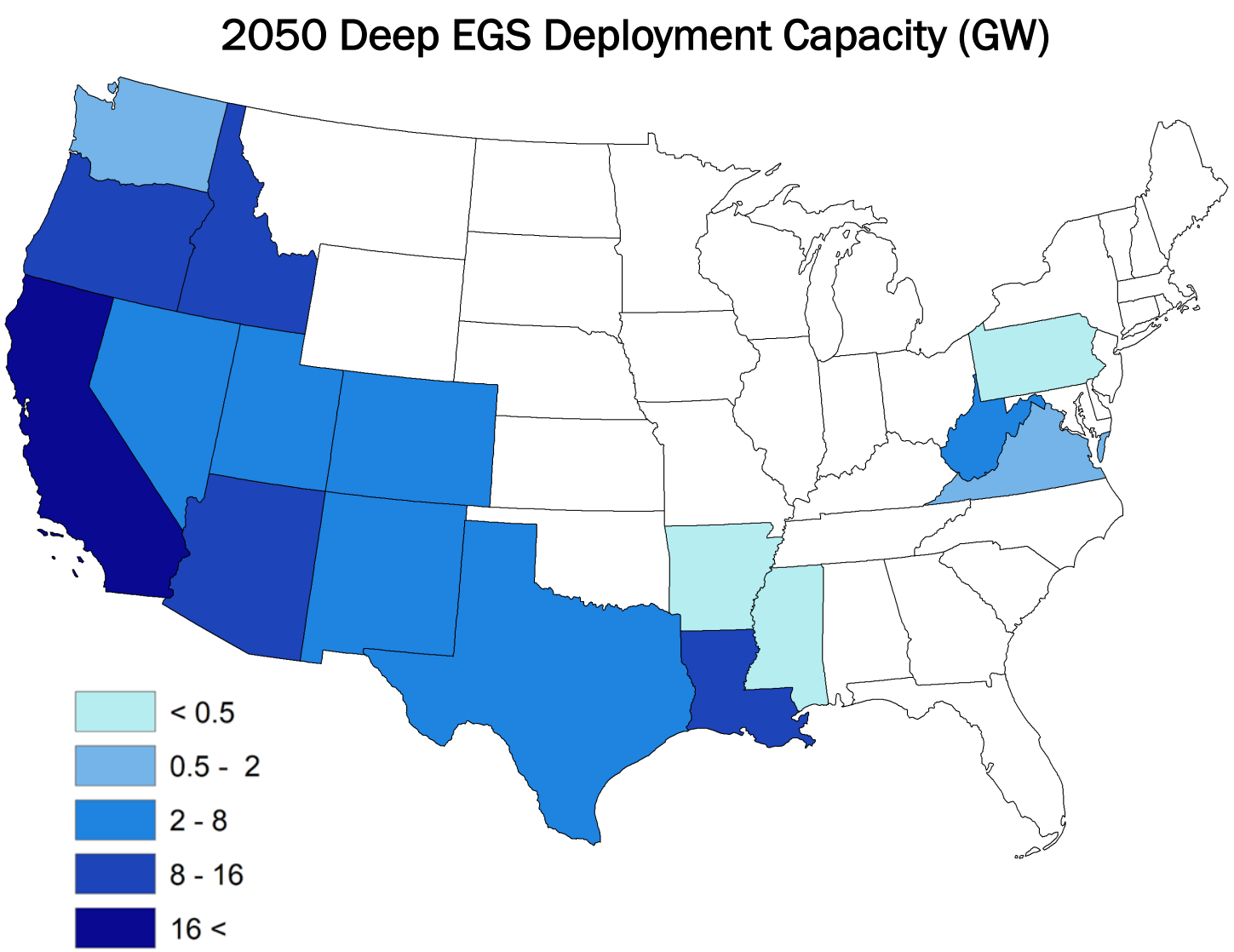
Enhanced Geothermal Shot



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

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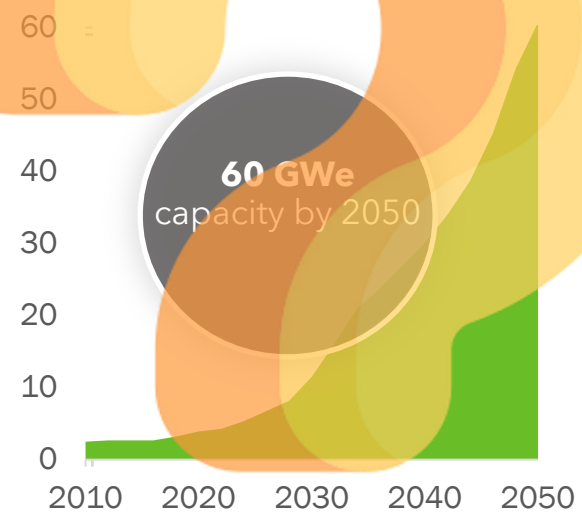
So what does this mean for the future of geothermal??

ELECTRIC

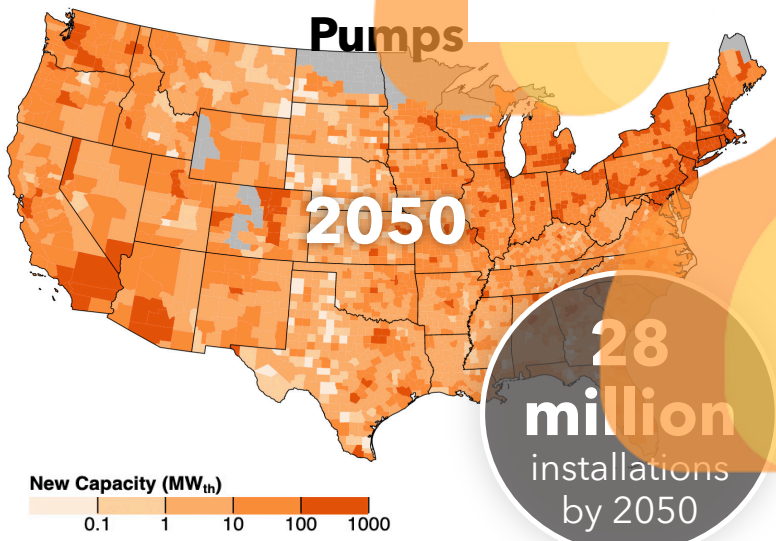
8.5% of all U.S. generation by 2050

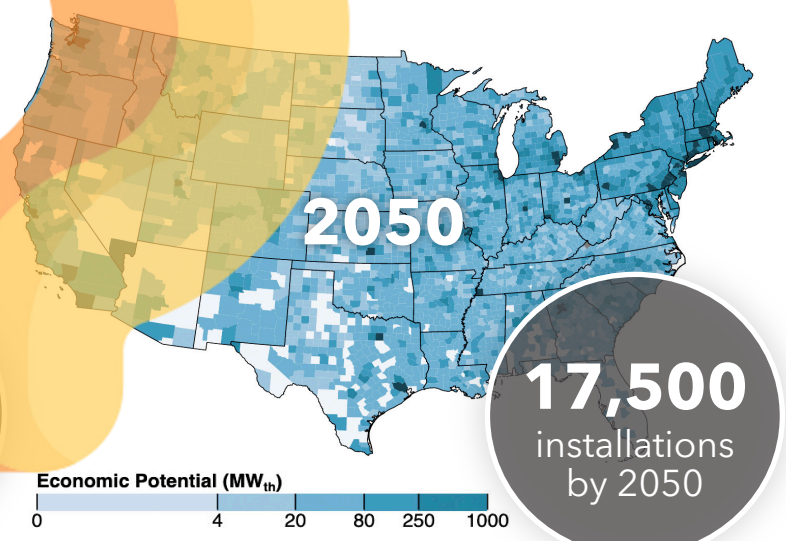


Source: Augustine et al. 2019

HEATING & COOLING

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





28 million installations by 2050

17,500 installations by 2050

up to **516 MMT** of avoided CO_2e

up to **1,281 MMT** of avoided CO_2e

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

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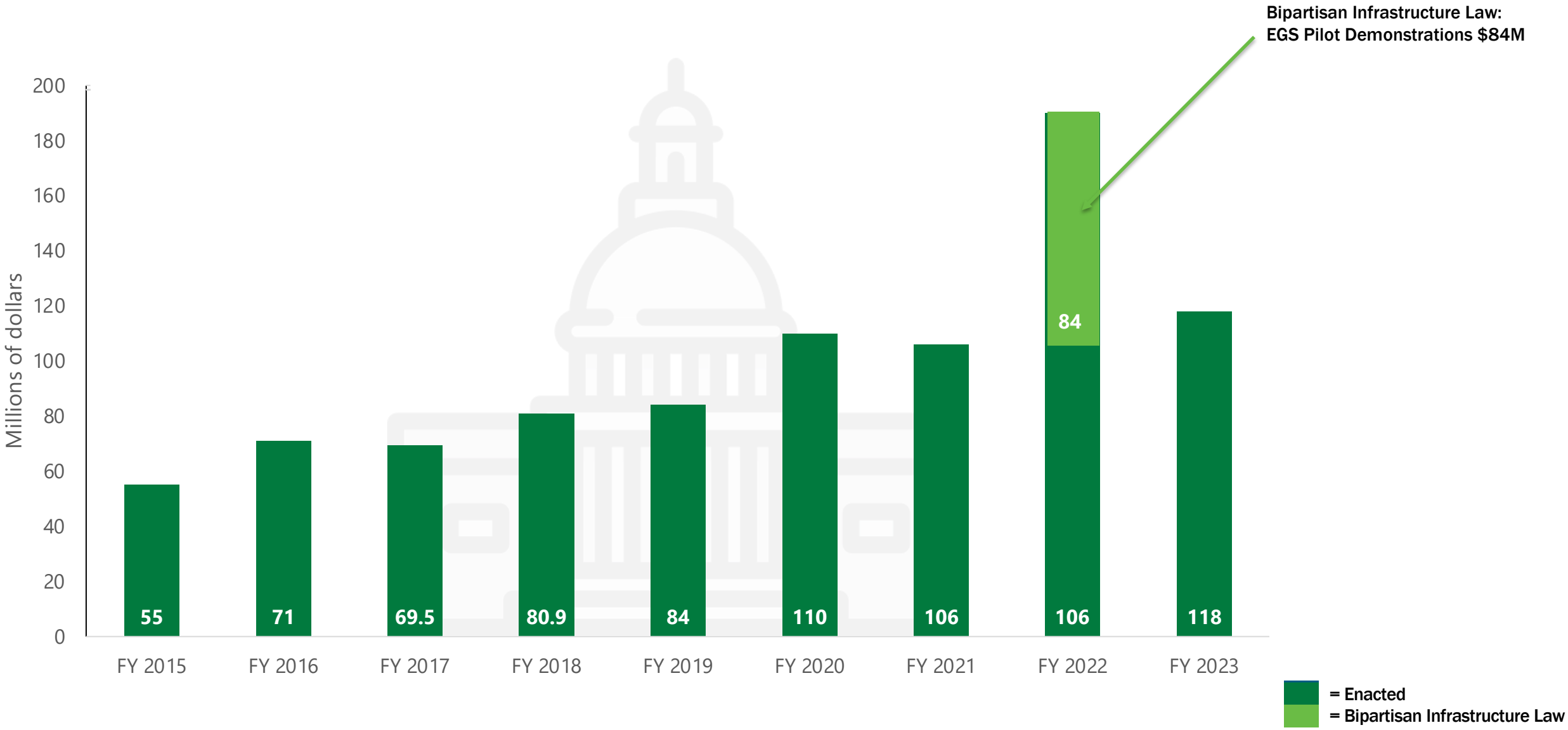
GTO Budget



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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).

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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.

EGS Enhanced Geothermal Systems

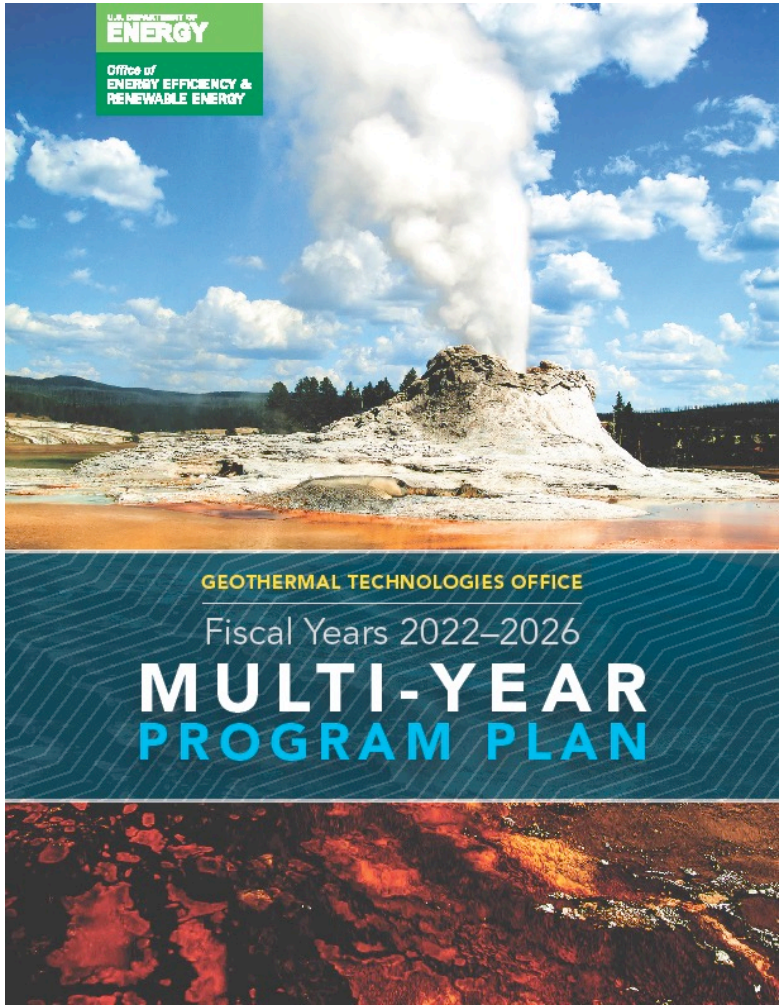
PILOT DEMONSTRATIONS

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

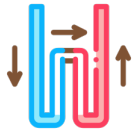
RESEARCH AREA	TECHNICAL OBJECTIVES
EXPLORATION AND CHARACTERIZATION	Improve resource targeting for all geothermal resource types
SUBSURFACE ACCESSIBILITY	Improve drilling costs toward the "ideal" cost curves used in the *GeoVision* analysis
SUBSURFACE ENHANCEMENT AND SUSTAINABILITY	Enhance and sustain 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's Program Areas

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

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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

UTAH FORGE
U.S. Department of Energy

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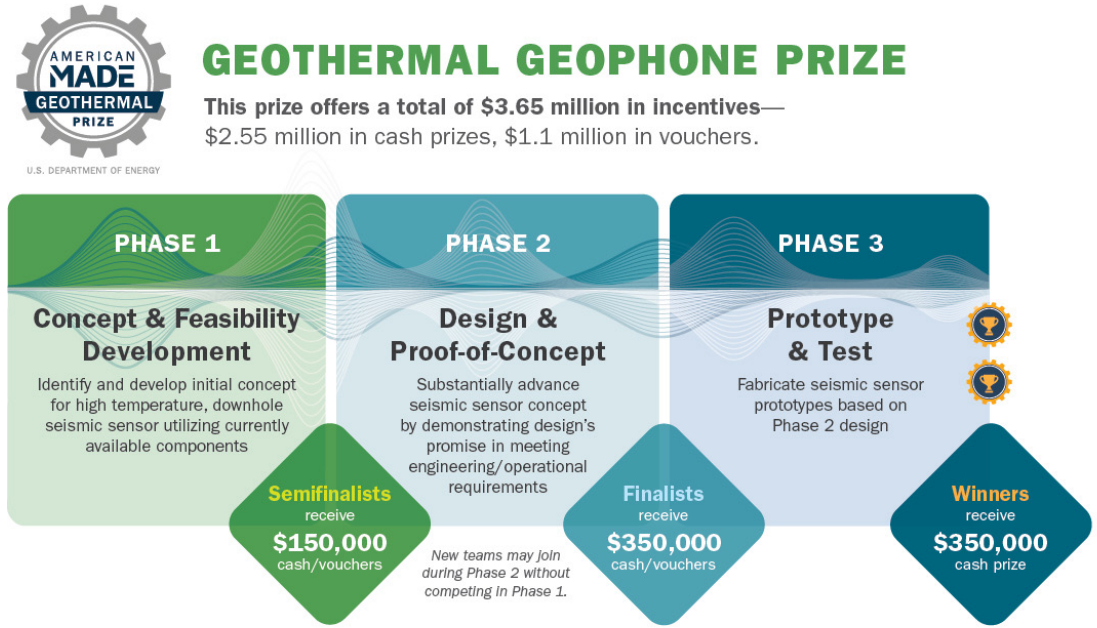
Other EGS Highlights

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

- $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/

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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)

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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.

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GEODE

Geothermal Energy from Oil and gas Demonstrated Engineering

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

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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

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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.

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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).

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!

the drill down

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