

Geothermal Technologies Office

USEA 12th Annual Energy Supply Forum
October 2, 2019

Dr. Susan G. Hamm, Ph.D.
Director



Image: Calpine



Agenda

- **Why Geothermal?**
- **Why GTO?**
- ***GeoVision* Report**
- **GTO Programs**

Why Geothermal?

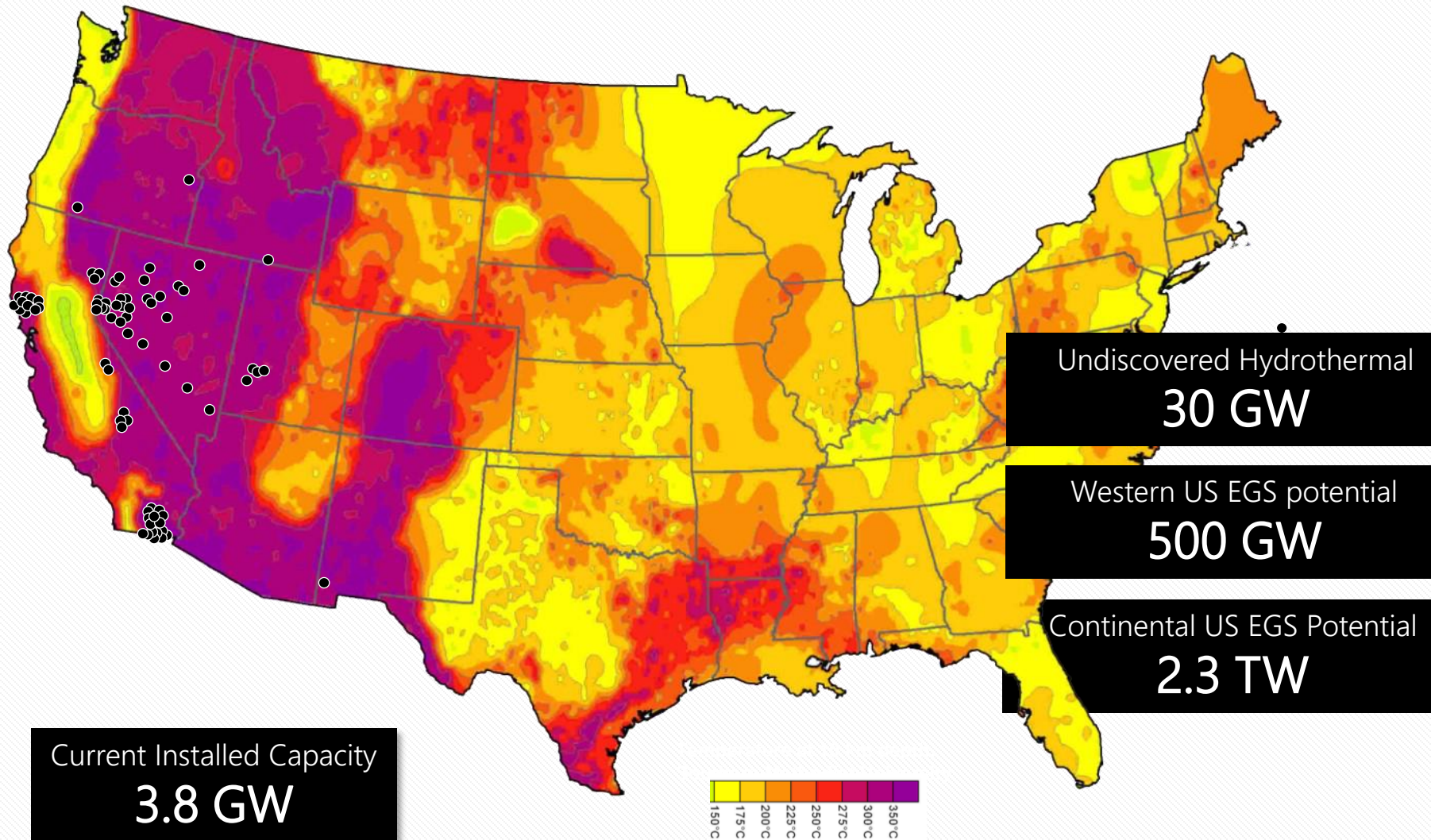
Beneath our feet lies vast, untapped energy potential.

Geothermal energy...

- **...is always-on.**
- **...is secure and flexible.**
- **...provides baseload power.**
- **...creates thousands of energy sector jobs.**
- **...is an everywhere solution.**



U.S. Geothermal Resources



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Why GTO?

DOE Renewable Energy current priorities present opportunities for innovation and collaboration across offices.

- Energy affordability
- Energy integration
- Energy storage



Solar Energy
Technologies Office



Wind Energy
Technologies Office



Geothermal Technologies Office



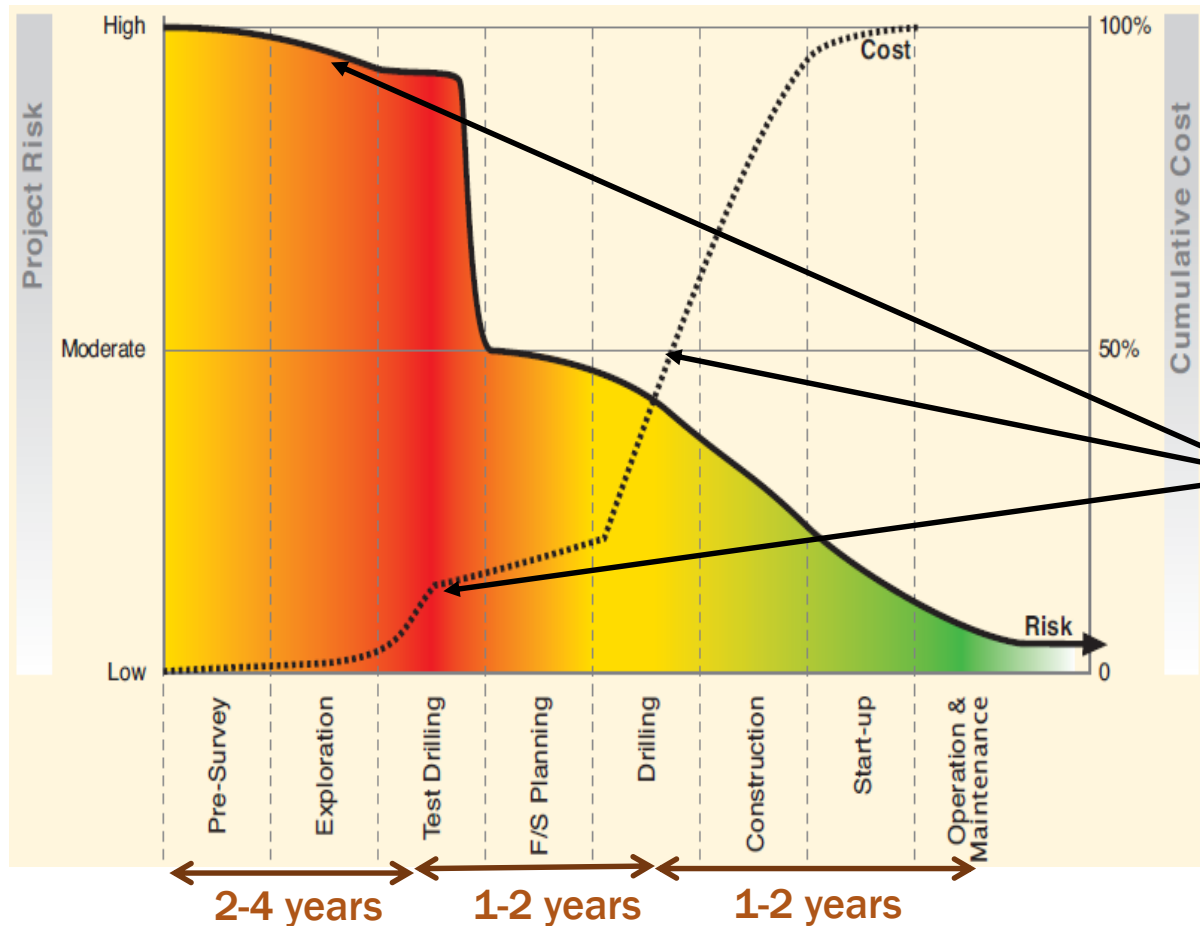
Water Power
Technologies Office



Grid Modernization
Initiative

GTO Mission

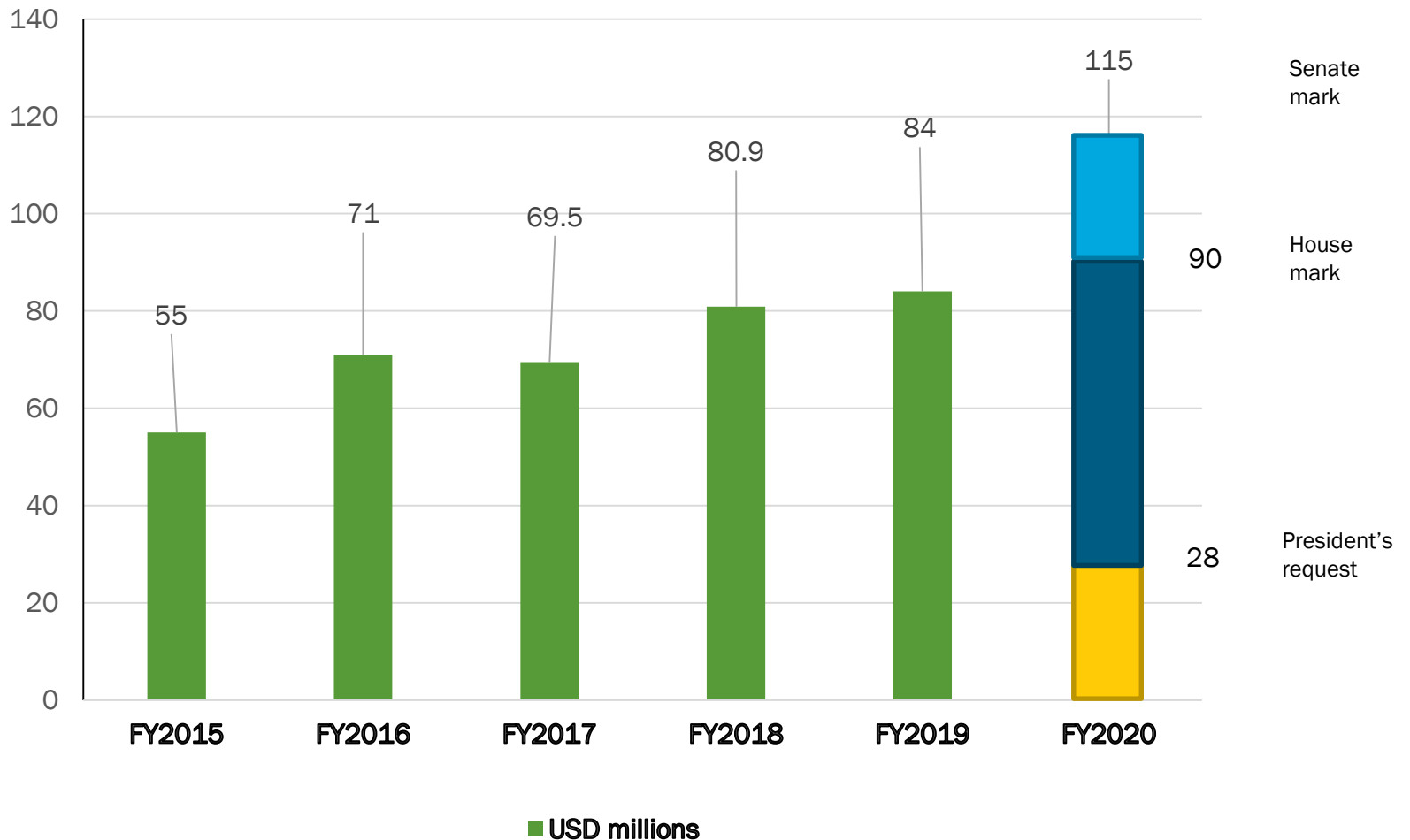
The mission of the **Geothermal Technologies Office (GTO)** is to support early-stage research and development (R&D) to strengthen the body of knowledge upon which industry can accelerate the development of innovative geothermal energy technologies.



GTO supports research in key areas such as drilling, success probability, and new technologies that help reduce early-stage risk and cost.

GTO Budget Overview & Major Activities

GTO Appropriations + FY 2020



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- GTO Programs

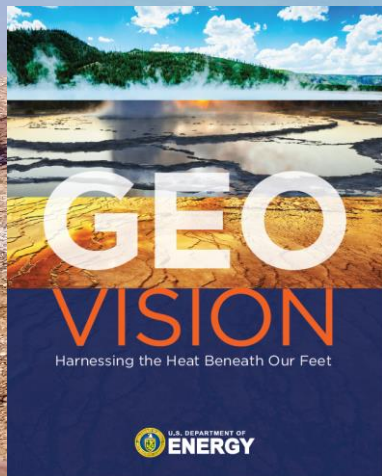
GeoVision Analysis

The *GeoVision* study addresses a **fundamental question:**

On the basis of detailed assessments of

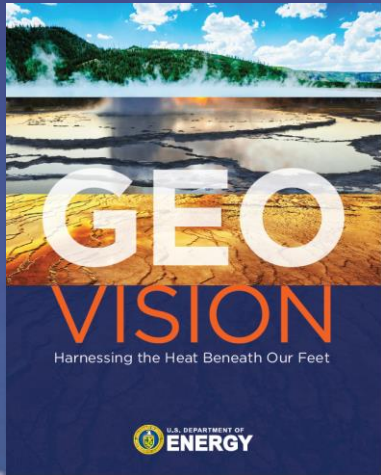
- the geothermal industry,
- barriers to deployment,
- and both existing and improved technologies...

...what level of deployment would be achievable and what would be the corresponding economic benefits to industry and the environmental impacts of those deployment levels on the United States?



www.energy.gov/geovision

GeoVision Report

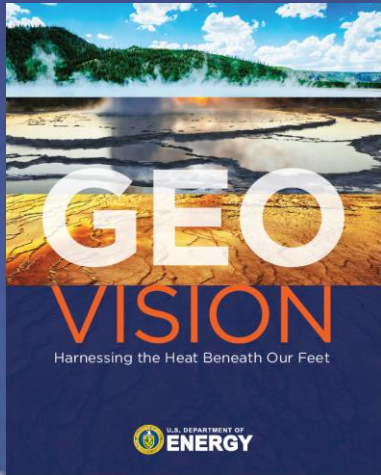


The *GeoVision* report is the product of years of rigorous research and analysis, with contributions from a broad range of participants representing industry, academia, national laboratories, and federal agencies.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

Image: *GeoVision* Report

GeoVision Report



Optimized permitting could cut development timelines in half, leading to a **doubling** of geothermal development (13 GWe by 2050) versus business-as-usual.

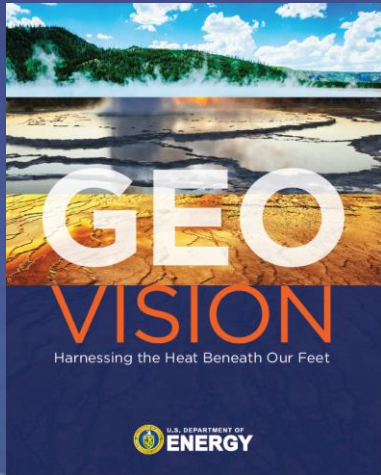
District heating installations could increase by orders-of-magnitude, from a current total of 21 to as many as **17,500 nationwide**.

Deployment could reach **60 GWe by 2050** with aggressive technology improvements.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

Image: GeoVision Report

GeoVision Report



Technology innovation is essential – it improves our understanding of subsurface conditions, helps to reduce risk, and accelerates growth of domestic geothermal power.

Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
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Image: GeoVision Report

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FORGE [Frontier Observatory for Research in Geothermal Energy]

FORGE is a flagship initiative to design and test a **breakthrough approach** to developing large-scale, economically sustainable EGS reservoirs.

What's next?

- Phase 3 launch pending a **Go/No-Go** decision.
- Phase 3 will encompass five years of unprecedented domestic research in Enhanced Geothermal Systems (EGS).
- Pending the Go/No-Go decision, **initial solicitations for FORGE R&D** are anticipated this fall.



- Insight into reservoir creation and sustainability gained from EGS Collab **directly supports FORGE research.**
- In the first phase, the team demonstrated creation of new hydraulic fractures and stimulation of natural fractures.
- Collab is in the process of receiving a conditional “go” for the project’s second phase.



COLLAB
A PATH TO **FORGE**
U.S. DEPARTMENT OF ENERGY

Efficient Drilling = Reduced Cost

- Drilling can account for up to **50% of the cost** of geothermal development.
- GTO is funding 10 projects for a total of \$14.5 million in funding in 3 areas:
 - Reducing common delays in drilling operations.
 - Innovative drilling technologies.
 - Accelerating technology transfer from the lab to the real world.

- Argonne Laboratory
- Sandia National Laboratories
- General Electric
- Oklahoma State University
- Texas A&M University
- University of Oklahoma
- University of Texas
- Oregon State University

Machine Learning for Geothermal Energy

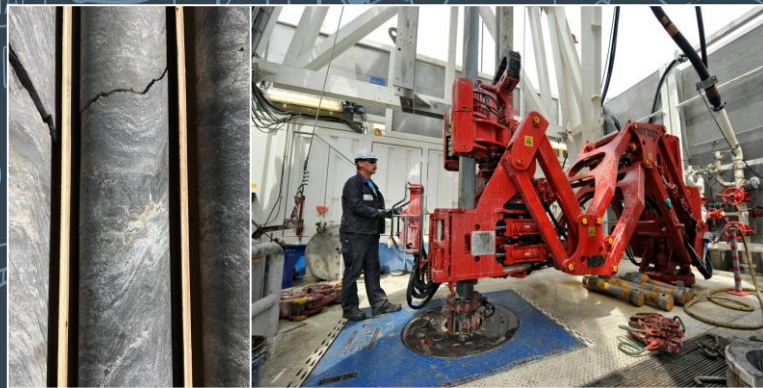
Machine Learning offers substantial opportunities for **technology advancement** and **cost reduction** throughout the geothermal project lifecycle.

Objectives:

- Identifying data acquisition targets (+drilling) with high scientific value for future work.
- Identifying new signatures for detecting hidden geothermal systems.
- Optimizing power production through plant/reservoir monitoring and analytics.
- Improving prediction and detection of trouble events.

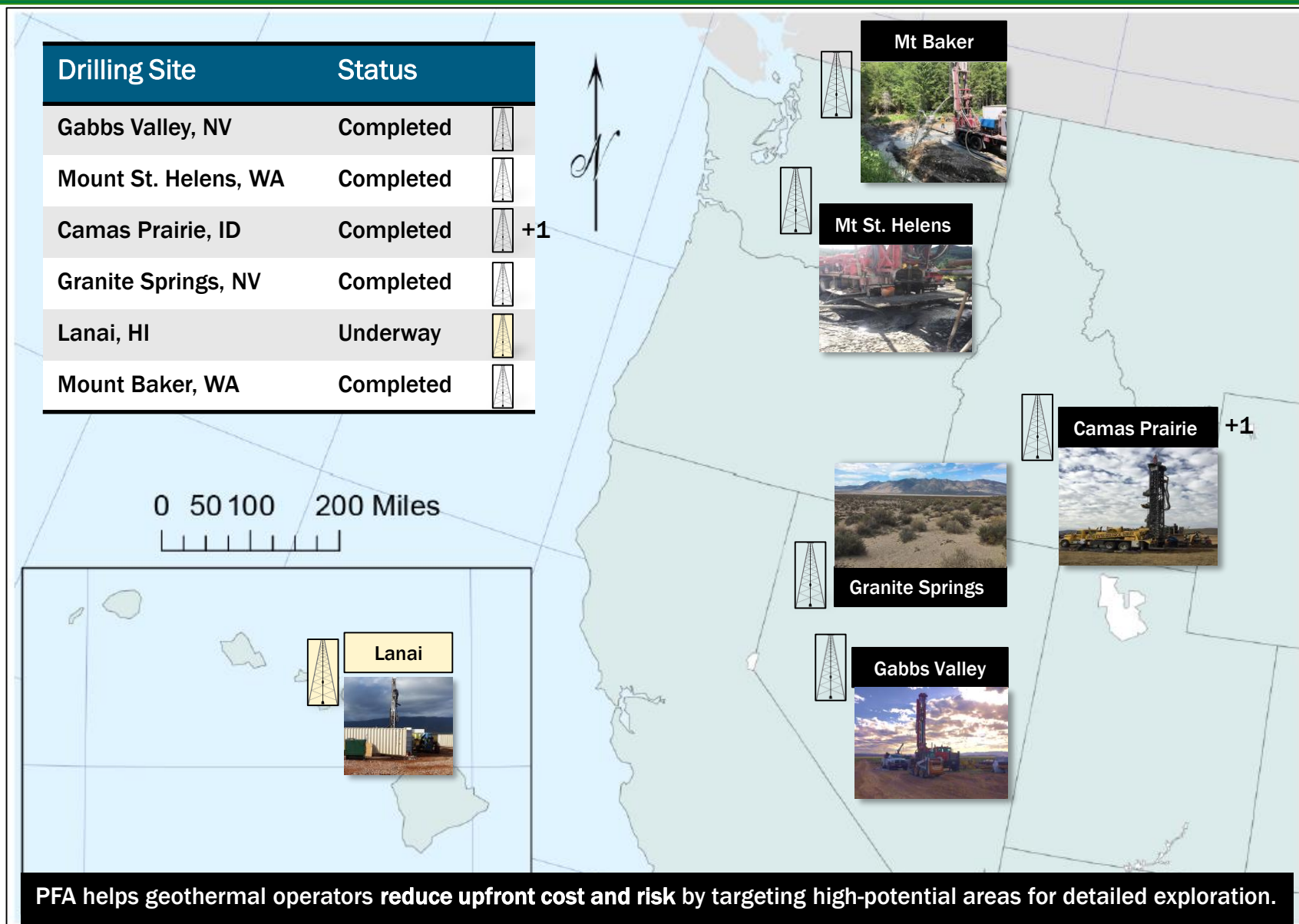
Awardees:

- Colorado School of Mines
- Lawrence Livermore National Laboratory
- Los Alamos National Laboratory
- National Renewable Energy Laboratory
- Pennsylvania State University
- University of Arizona
- University of Houston
- University of Nevada-Reno
- University of Southern California
- Upflow Limited (New Zealand)

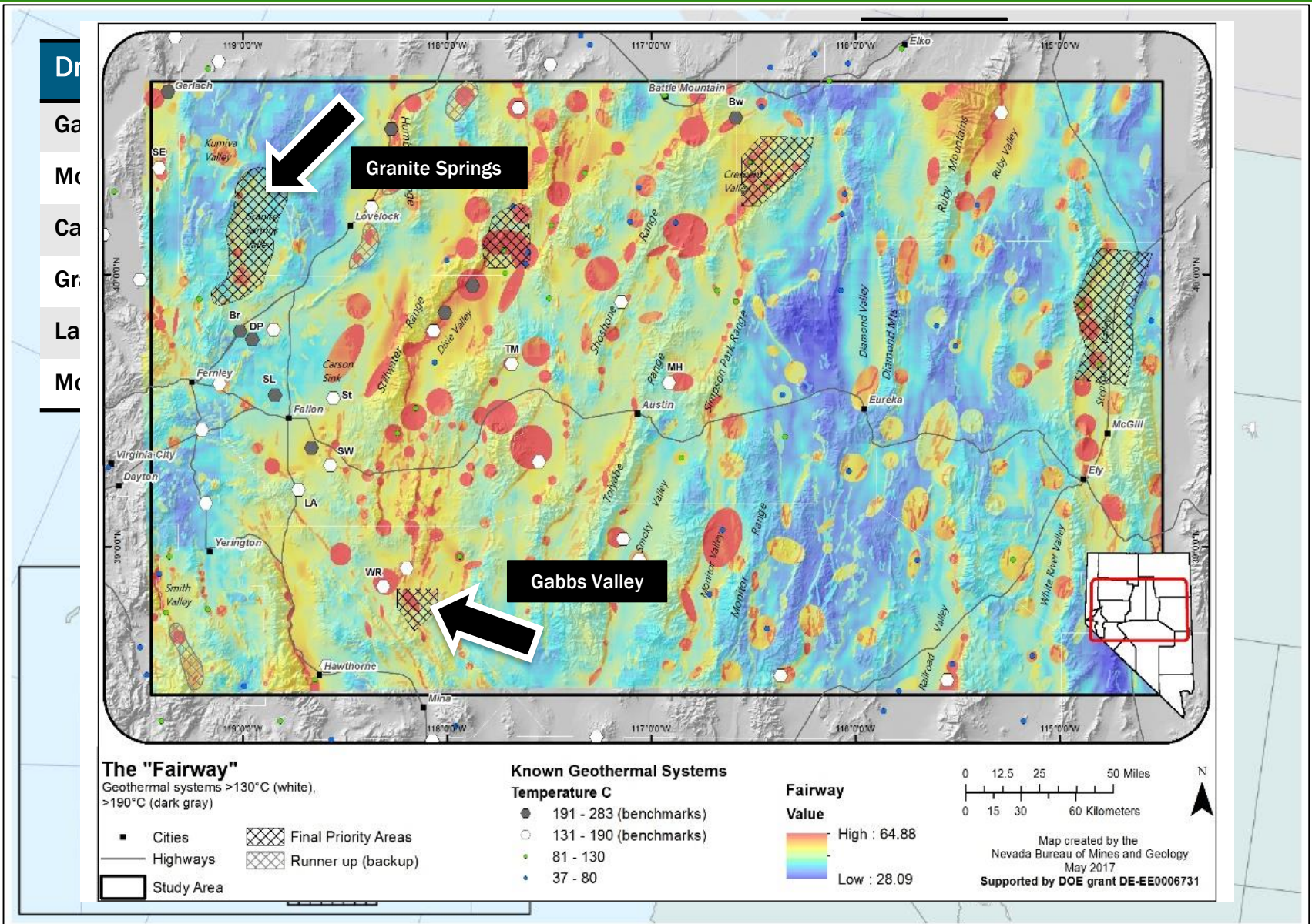


10 awards / \$5.5 million in funding

Play Fairway Analysis



Play Fairway Analysis



Advanced Energy Storage Initiative [AESI]



Daniel Simmons, Assistant Secretary
Energy Efficiency & Renewable Energy (EERE)

Advanced Energy
Storage Initiative
[Geothermal]

Deep Direct Use

Bi-directional Energy
Storage

Flexible Generation

Deep Direct-Use



- WVU Facilities Management
- West Virginia Geological & Economic Survey
- Lawrence Berkeley National Laboratory
- Cornell University



Portland
State
UNIVERSITY

- AltaRock Energy
- City of Portland
- Oregon Health & Science University
- U.S. Geological Survey



Cornell University

Seven research teams are currently assessing DDU feasibility in diverse regions across the U.S.

Appalachian Basin – WV, NY, PA sites

Wassuk Range – Hawthorne, NV

Columbia River Basalt – Portland, OR

Cotton Valley – East Texas

Illinois Basin – Champaign-Urbana, IL

Studies are underway to determine whether **low-temperature geothermal resources** can be used directly to heat and cool large-scale installations or districts. Cascaded heating and cooling (heat pumps and hybrid systems) may be included.



Sandia
National
Laboratories

- U.S. Navy Geothermal Program
- Power Engineers, Inc.
- University of Nevada-Reno



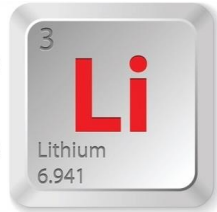
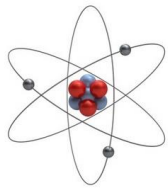
- University of Wisconsin-Madison
- Loudon Technical Services
- U.S. Army CER Laboratory
- MEP Associates
- Illinois Geothermal Engineering
- Trimeric



- Southern Methodist University
- Eastman Chemical
- TAS Energy
- Electric Power Research Institute



Lithium Recovery: Salton Sea Region

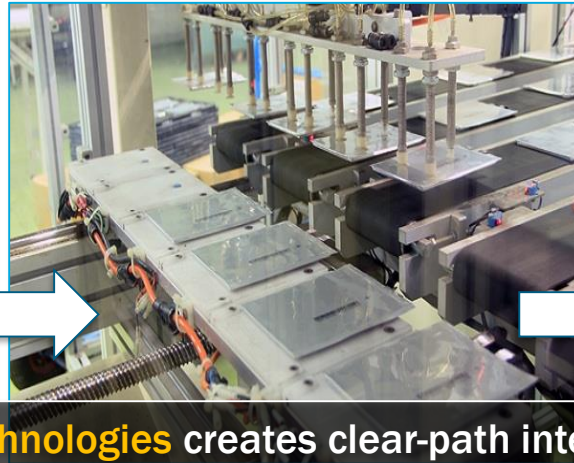


EERE seeks to demonstrate **added value** in regions where geothermal brines can deliver critical elements such as lithium.


Geothermal
Technologies
SUPPLY

Advanced
Manufacturing
PROCESS

Vehicle
Technologies
MARKET



Uniting innovative EERE technologies creates clear-path integration from supply to manufacturing to end-market, with improved efficiencies and economics.



“Making geothermal **more affordable** can increase our energy options for a more diverse electricity generation mix and for innovative heating and cooling solutions **for all Americans.**”

Rick Perry
U.S. Secretary of Energy

Visit us at: www.energy.gov/eere/geothermal

Image: GeoVision Report