Geothermal Technologies Office

USEA 12th Annual Energy Supply Forum
October 2, 2019

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

Current Installed Capacity
3.8 GW

Undiscovered Hydrothermal
30 GW

Western US EGS potential
500 GW

Continental US EGS Potential
2.3 TW
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DOE Renewable Energy current priorities present opportunities for innovation and collaboration across offices.

- Energy affordability
- Energy integration
- Energy storage
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

USD millions

- FY2015: 55
- FY2016: 71
- FY2017: 69.5
- FY2018: 80.9
- FY2019: 84
- FY2020: 115

Senate mark: 90
House mark: 28
President's request: 28

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

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

District heating installations could increase by orders-of-magnitude, from a current total of 21 to as many as 17,500 nationwide.
Through increased geothermal deployment, America could...
...strengthen its energy base,
...achieve a more stable power grid,
...and gain valuable economic and environmental benefits.

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

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)

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

10 awards / $5.5 million in funding
### Play Fairway Analysis

<table>
<thead>
<tr>
<th>Drilling Site</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gabbs Valley, NV</td>
<td>Completed</td>
</tr>
<tr>
<td>Mount St. Helens, WA</td>
<td>Completed</td>
</tr>
<tr>
<td>Camas Prairie, ID</td>
<td>Completed</td>
</tr>
<tr>
<td>Granite Springs, NV</td>
<td>Completed</td>
</tr>
<tr>
<td>Lanai, HI</td>
<td>Underway</td>
</tr>
<tr>
<td>Mount Baker, WA</td>
<td>Completed</td>
</tr>
</tbody>
</table>

PFA helps geothermal operators **reduce upfront cost and risk** by targeting high-potential areas for detailed exploration.
Advanced Energy Storage Initiative [AESI]

Daniel Simmons, Assistant Secretary
Energy Efficiency & Renewable Energy (EERE)
Deep Direct-Use

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

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Basin</td>
<td>WV, NY, PA sites</td>
</tr>
<tr>
<td>Wassuk Range</td>
<td>Hawthorne, NV</td>
</tr>
<tr>
<td>Columbia River Basalt</td>
<td>Portland, OR</td>
</tr>
<tr>
<td>Cotton Valley</td>
<td>East Texas</td>
</tr>
<tr>
<td>Illinois Basin</td>
<td>Champaign-Urbana, IL</td>
</tr>
</tbody>
</table>

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.

- WVU Facilities Management
- West Virginia Geological & Economic Survey
- Lawrence Berkeley National Laboratory
- Cornell University
- 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
- AltaRock Energy
- City of Portland
- Oregon Health & Science University
- U.S. Geological Survey
- U.S. Navy Geothermal Program
- Power Engineers, Inc.
- University of Nevada-Reno
EERE seeks to demonstrate **added value** in regions where geothermal brines can deliver critical elements such as lithium.

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