U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

GEOTHERMAL TECHNOLOGIES OFFICE FY 2018 BUDGET AT-A-GLANCE

The Geothermal Technologies Office (GTO) supports early-stage research and development (R&D) and critical feedback for innovative technologies that address key geothermal energy exploration and operational challenges. By advancing value streams for electricity production and deep direct use, GTO contributes to making geothermal energy a cost-competitive, widely available, and geographically diverse component of the national energy mix.

Economic Highlights

GTO strengthens U.S. energy security through strategic early stage R&D.

- From 1976 to 2008, GTO R&D ranked second in world geothermal energy patents and citations, with 90 patents issued. GTO-sponsored R&D is linked to 21% percent of all geothermal energy patents.

GTO stimulates the U.S. economy.

- Geothermal plants support more than two long-term jobs per megawatt (MW) installed. In 2016, the geothermal electric power industry employed nearly 6,000 Americans, an 11% increase over 2015.
- A 20-MW facility pays from $6.3 million to $11 million in property taxes and from $12 million to $22 million in annual royalties over a 30 to 50 year lifespan. Seventy-five percent of royalties are returned at state and county levels.

GTO delivers robust return-on-investment.

- For every $1 invested by GTO, $4.90 in economic benefits accrue. Long-term geothermal technology analysis reveals a 22% annual return on R&D investment over a 28-year period.

GTO works to identify and tap immense domestic potential.

- Current U.S. installed geothermal capacity is nearly 3.8 gigawatts (GW), enough to power 3.7 million homes. Vast additional resources exist, including an estimated 30 GW of undiscovered hydrothermal resources and 100+ GW of new geothermal energy accessible through Enhanced Geothermal Systems (EGS).

FY 2018 Priorities

Activity Highlights

- EGS Collaborative – Comprised of national lab-led teams, this effort aims to develop centralized small-scale testing facilities where seismicity, stress state, and permeability can be resolved and thermal hydro mechanical chemical (THMC) models can be validated. FY 2018 will focus on Experiment 2 at the Sanford Underground Research Facility (SURF) Mine in South Dakota to include shear stimulation and mixed mode fracturing; stimulation test designs based on detailed site characterization; and modeling to optimize preliminary test design and installation of novel monitoring networks.
- Hydrothermal R&D – Completion of three national lab projects aimed at innovations for reducing geothermal exploration costs (microhole drilling applications, self-healing cements, subsurface imaging). Microhole drilling allows smaller diameter wells, saving time and costs while capturing downhole data for resource evaluation. Self-healing cements is a major cost-saving activity that reduces instances of wellbore collapse due to cement bond failure. Innovative subsurface imaging will allow for discrete well targeting, increasing the probability of drilling success.
- Subsurface Technology and Engineering RD&D (SubTER) – Waterless Fracturing & Stimulation Fluids – In an effort to both reduce the impact of energy development on limited water supplies and to eliminate the problem of water disposal, an alternative set of hydraulic fracturing methods will be investigated to reduce or completely eliminate the use of water. As part of the Permeability Manipulation and Fluid Flow pillar under SubTER, candidate fluids will be investigated, such as carbon dioxide (CO2), gelled propane, and liquid nitrogen, to quantify the underlying physics and identify controls. These experiments will advance the technology for potential use in waterless EGS systems as well as unconventional oil and gas reservoirs.

FY 2018 Budget Request

Budget Authority (Dollars in Thousands)	FY 2018 Request
Enhanced Geothermal Systems	5,368
Hydrothermal	6,077
Systems Analysis	1,055
Total, Geothermal Technologies	**12,500**

Geothermal energy is an “always on” resource, with the potential to power tens of millions of American homes and businesses. GTO supports innovative geothermal R&D in an effort to expand usage by reducing costs and risks associated with geothermal exploration and development.

Major Accomplishments and Goals

GTO builds and leverages R&D partnerships with private sector innovators, providing expert insight needed to accelerate technology adoption.

- High Temperature Drilling – Working with Baker Hughes, GTO achieved design advances to ensure optimal drilling performance and durability in deep, complex, high-temperature conditions. This breakthrough has had far-reaching impact, extending to oil and gas operations and nuclear storage.
- Stillwater Site – Developed in cooperation with Enel, Stillwater is the world's first triple hybrid power facility. It combines 33 MW geothermal, 26 MW photovoltaic, and 2 MW of concentrated solar power, sufficient to generate renewable energy for more than 15,000 households.

GTO works to achieve practical goals supported by innovative, high-value initiatives.

- GTO's overarching goals – (1) reduce the levelized cost of electricity (LCOE) to $0.06 per kilowatt hour by 2020 for conventional geothermal, and by 2030 for enhanced geothermal; and (2) reduce risk for geothermal development by lowering drilling costs, boosting success probability, and driving advances in technology.
- FORGE – GTO's Frontier Observatory for Research in Geothermal Energy (FORGE) initiative leads the development and testing of breakthrough technologies in enhanced geothermal.
- SubTER – GTO unites with other DOE offices on projects to enhance collaborative control of subsurface resources.

Success Stories

High Temperature Drilling

Subprogram – Enhanced Geothermal Systems (EGS)

Collaboration – Baker Hughes

Background – Recognizing great potential in drilling efficiency (and related cost savings), the geothermal industry has for years sought to advance directional drilling capabilities in deeper, higher temperature environments.

Objective – Leverage advanced design innovation and materials technology to improve high-temperature drilling performance and durability in deep, complex, high-temperature conditions.

Success – Sustained a drilling operation for a continuous 270 hours – the longest time ever recorded for directional drilling. Far-reaching potential impact could extend to oil and gas operations and nuclear storage, while improving access to both new and existing subsurface resources.

Caldwell Ranch

Subprogram – Hydrothermal

Collaboration – Calpine

Background – At the Caldwell Ranch site in northern California, Calpine sought to demonstrate the viability of restoring depleted or underperforming geothermal resources.

Objective – Achieve the first ever successful reopening of an abandoned steam field by leveraging new reservoir interpretation techniques and imaging technologies.

Success – Following an idle period to permit natural reheating, yielded 11.4 MW of previously unavailable steam. In addition, various data sources were integrated to achieve superior 3D reservoir modeling, establishing a new geothermal standard.