Federal Energy R&D: Geothermal Technologies

BY DAVID M. HART AND COLIN CUNLIFF | APRIL 2018

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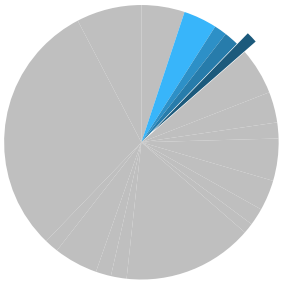
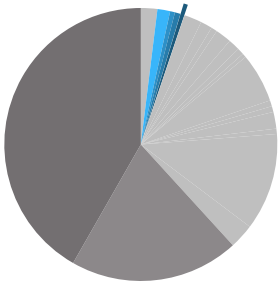
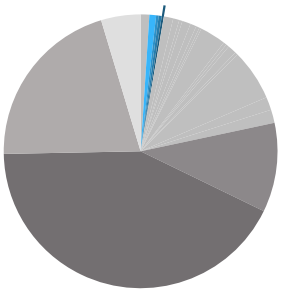


Geothermal (blue)
Other Renewables (blue)
Energy R&D (light gray)



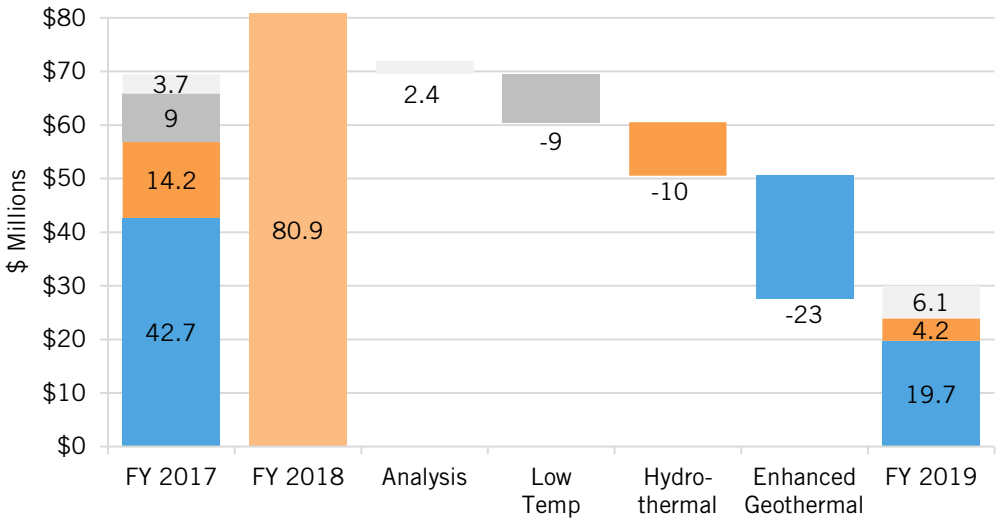
Geothermal & Energy R&D
Basic Science R&D
Defense R&D



Geothermal & Energy
Basic Science
Defense
Environ Mngmt
Other DOE

Geothermal technologies use heat from the earth, either directly for such applications as heating and cooling, or to generate electricity. The Geothermal Technologies program supports research and development of two main types of geothermal technologies: hydrothermal and Enhanced Geothermal Systems (EGS). Hydrothermal resources exist naturally in areas where there is sufficient temperature and permeability in the subsurface for the flow of fluids to generate electricity. EGS, on the other hand, requires rock stimulation for permeability enhancement and fluid injection to allow commercial-scale fluid flow that can be used for electricity generation.[1]

Figure 1: The FY 2019 Budget Request Would Cut Geothermal R&D by 63 Percent



What's At Risk

In addition to the current U.S. installed capacity of geothermal energy of over 3.8 gigawatts (GW), there is a vast source of untapped energy just waiting to be realized: an estimated 30 GW of hydrothermal plus more than 100 GW of geothermal energy through EGS.[2] The geothermal industry operates in a harsh subsurface environment in which unique technical and operational challenges must be overcome to realize this potential. Foremost among these challenges is the resources essentially being "out of sight" at a depth of anywhere from two to five kilometers, thus requiring new exploration technologies and tools to reduce the near-term cost and risk of development. DOE has set an ambitious goal of reducing the cost of electricity from newly developed geothermal systems from 22.4

cents per kilowatt-hour ($0.224/kWh) in 2014 to $0.06/kWh by 2030. Meeting this target (for both hydrothermal and EGS resources) requires R&D to harness lower-temperature resources more effectively, develop improved methods to stimulate new EGS resources, and characterize and model subsurface stress and other reservoir properties. Reductions in R&D funding threaten to delay or even derail the progress DOE has already made toward these targets.

Geothermal Technologies R&D Subprograms

Geothermal R&D is divided among four subprograms:

- **Enhanced Geothermal Systems (EGS)** explores materials and technologies that facilitate characterization of local stress, chemical constituents, and fluid and thermal pathways over time; ensure wellbore integrity over multidecadal time frames; and provide sustainable operation while achieving sufficient power-generation productivity.
- **Hydrothermal** R&D focuses on technologies necessary to find and access "blind" hydrothermal resources (i.e., showing little to no surface expression) by targeting innovative approaches to microhole drilling applications, self-healing cements, and subsurface imaging.
- **Low-Temperature and Coproduced Resources** targets RD&D on technologies applicable to geothermal resources below a temperature of 300 °F (150 °C); direct use of thermal resources for process and space-heating applications; and geothermal-enabling technologies, including thermal desalination processes and hybrid power designs that can be codeveloped with existing well-field infrastructures.
- **Systems Analysis** focuses on identifying and addressing barriers to geothermal adoption, as well as validating and assessing technical progress to inform the direction and prioritization of the portfolio.

Key Elements of the FY 2019 Budget Proposal

- **Elimination of the Low-Temperature and Coproduced Resources subprogram.** Although low-temperature resources have a lower power-conversion efficiency—due to lower temperature fluids—than other geothermal resources, they are abundant and highly accessible. A recent USGS assessment estimated the existence of 46.5 GW thermal of total beneficial heat available from geothermal resources below 90°C; however, further R&D is needed to address technical challenges and bring costs down in order to efficiently utilize this domestic energy resource.
- **A 54-percent reduction in the EGS subprogram,** including to its flagship field laboratory—the Frontier Observatory for Research in Geothermal Energy (FORGE)—which tests novel technologies and techniques that focus on EGS optimization and validation.

- **A 70-percent reduction in the Hydrothermal subprogram**, including discontinuation of the Play Fairways Analysis project, which validates new approaches for identifying blind resources, as well as discontinuation of the hydrothermal lab R&D in microhole drilling, subsurface imaging, and self-healing cements.
- **A $2.4-million increase in the Systems Analysis subprogram**, with new funding going to the cross-cutting Beyond Batteries initiative, which supports improved grid reliability and resilience.

ENDNOTES

1. DOE, "FY 2018 Congressional Budget Justification," (Washington, D.C.: DOE/CFO, 2017) 159.
2. EIA, Form EIA-860, table 3.1, (release date: November 9, 2017). https://www.eia.gov/electricity/data/eia860/; USGS, "Assessment of Moderate- and High-Temperature Geothermal Resources of the United States," (Washington, DC: USGS, 2008), https://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf.

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