EARTH & ENVIRONMENTAL SCIENCES

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One of the 17 U.S. Department of Energy national laboratories, Lawrence Berkeley National Laboratory was founded in 1931 on the belief that the biggest scientific challenges are best addressed by teams.

BERKELEY LAB

EESA at Berkeley Lab Geothermal Energy Fact Sheet

Scientists in pursuit of expanding access to **clean energy** are studying the process of extracting heat from rocks deep in the Earth's subsurface to generate geothermal energy. In enhanced geothermal systems, heat acquired from water circulating in stimulated rock fractures deep in the subsurface is extracted and converted to electricity.

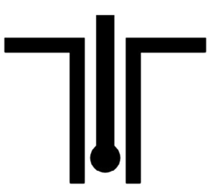
Geothermal energy requires hot subsurface rock, fluids, and permeability. Although geothermal energy currently makes up **less than 1 percent** of U.S. energy production, with better information about how permeability can be created and sustained in Earth's subsurface, enhanced geothermal systems technologies could fulfill their potential to **provide enough energy to power 100 million American homes.**

Geothermal Energy Research by EESA at Berkeley Lab

EESA researchers are developing innovative technologies for identifying and characterizing conventional and hidden geothermal systems.To create enhanced geothermal systems (EGS), we are using coupled process models, geophysical monitoring techniques, induced seismicity monitoring, and laboratory studies. We are developing methods for enhancing permeability and fluid flow to increase heat recovery through subsurface engineering.

For more information on geothermal energy research, contact Jens Birkholzer at jtbirkholzer@lbl.gov

EESA Geothermal Energy Research At a Glance



Berkeley Lab leads the Enhanced Geothermal Systems (EGS) Collab Project, a collaboration of nine other national labs and seven universities exploring the potential to improve enhanced geothermal systems technologies. At a field test site the team developed and built at Sanford Underground Research Facility (SURF) on the site of an old South Dakota gold mine, they are conducting experiments that involve injecting small amounts of water into the rock via 60-meter long boreholes at very high pressures until the rock fractures. Using a tool developed at Berkeley Lab called SIMFIP (Step-Rate Injection Method for Fracture In-Situ Properties), they can examine what happens to the openings of fractures created by stimulation when pressure is applied.

Researchers are developing an advanced, low-cost, automated tomographic imaging system that uses micro-earthquakes and a dense network of portable, low-cost seismic sensors to form high spatial and temporal resolution images of subsurface fluid flow, including flow conduits, barriers and heterogeneity in producing geothermal fields. Their goal is to allow geothermal operators to more efficiently carry out their operations, including drilling productive wells, avoiding drilling hazards and optimizing production.

EESA Geothermal Energy Research at AGU

Geothermal energy – Opportunities and Challenges
Presentation: U14D
Presenters: Pat Dobson

Stimulation and Flow Tests in Deep Crystalline Rock – The EGS Collab Project
Presentation: H11K-1648 (Poster hall)
Presenter: Tim Kneafsey

Fracture and stress characterization in crystalline rocks – Fracture displacement measurements associated with water injection in the COSC-1 borehole, Sweden
Presentation: H32B-05
Presenter: Yves Guglielmi

Direct Downhole Measurement of a Stimulated Fracture Displacement First Results from the SIMFIP Tool Tests performed during the EGS Collab Project
Presentation: H14D-04
Presenter: Paul Cook

Reactive-Transport Modeling of Redox-Driven Reactions and Fracture Sealing During Hydraulic Stimulation Experiments at the Homestake Mine, South Dakota COLLAB Site
Presentation: U21A-03
Presenter: Eric L Sonnenthal

The **TOUGH** ("Transport Of Unsaturated Groundwater and Heat") software codes were developed at Berkeley Lab in the early 1980s primarily for geothermal reservoir engineering. These simulators are now widely used at universities, government organizations, and private industry for applications to nuclear waste disposal, environmental remediation problems, geothermal energy production, and other uses that involve coupled thermal, hydrological, geochemical, and mechanical processes in permeable media.

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