

Enhanced Geothermal Systems

The U.S. Department of Energy's (DOE) Geothermal Technologies Program (GTP) research, development, and demonstration (RD&D) activities are carried out in partnership with industry, academia, and national laboratories to improve technologies for finding, characterizing, accessing, and producing geothermal resources. The Enhanced Geothermal Systems (EGS) subprogram pursues RD&D projects to improve performance, reduce cost, and facilitate technology validation and deployment. EGS RD&D projects will move industry along the learning curve toward technological readiness.

EGS Technologies Metrics and Milestones Roadmapping Information Exchange

In an effort to facilitate development of and overcome the challenges associated with EGS, GTP invited subject matter experts to take part in *EGS Technology Roadmapping Information Exchange* held in San Francisco, CA, August 3-4, 2011.

The meeting focused on translating high-priority technology needs into targeted technology improvements. The meeting broke into three subgroups to discuss technology needs specific to:

- Reservoir characterization,
- Reservoir creation, and
- Reservoir sustainability/operation.

Action

At this time GTP would like your input on the technology improvement areas identified at the meeting. Input from a diverse group of experts is paramount in developing a robust technology roadmap. Some questions to consider:

- Do you think there are other new or innovative technologies that were missed as part of this evaluation?
- Are there additional technology improvement areas that should be included?
- Do you have any comments on the timelines or metrics used to evaluate these technologies?

We would greatly appreciate your insight in order to further refine the final roadmap.

Comments

Please feel free to attach your comments to this document or email them to the address below for consideration before February 29, 2012.

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EGS Reservoir Characterization



Enhanced geothermal systems, such as this planned one in California, must undergo quake risk analysis. J. WILSON/THE NEW YORK TIMES/REDUX/EYEVINE.*

Reservoir Characterization Technology Improvement Areas Identified at the August 2011 Meeting

- 1) **Develop the ability to isolate zones in a reservoir**
 - a) High Temperature (HT) Super packers
 - b) HT Chemical diverters
 - c) HT Chemical diverters for drilling
- 2) **Develop high temperature logging and imaging tools**
- 3) **Develop new techniques for accurately and efficiently measuring pressure, flow, and temperature down hole**
- 4) **Build a public database of rock properties for various granites (as often used on O&G for other rock types) to increase validity of models and to facilitate the design of more effective simulations**
- 5) **Develop remote/surface fracture imaging technologies (can be deployed at the surface without the need for investment in a well)**
 - a) Reflection Seismology
 - b) Electrical Methods
 - c) Ambient Noise Tomography
 - d) Electro-Seismics

*From Geothermal quake risks must be faced, Domenico Giardinat, Nature 462, 848-849 (17 December 2009); doi:10.1038/462848a; Published online 16 December 2009.

Technologies to Isolate Zones

Super packer withstands high-temperatures, has an effective pressure seal, and accommodates irregular wellbores

Technology Advancement	Technology Metrics			
	Metric Unit for Advancement	2011 Status	Target	When
Super packers	Temperature (°C)	300°C	>300°C	2017
Chemical diverters (also for drilling)	Temp (°C), pressure dif. (psi), and Duration (days)	Temp (°C), pressure dif. (psi), and Duration (days)	300 °C, ΔP >2,000 psi, and 21 days	2017

High Temperature Logging & Imaging Tools

Real-time mass “fluxometer” and integrated pressure/flow/temperature tool

Technology Advancement	Technology Metrics			
	Metric Unit for Advancement	2011 Status	Target	When
Mass “fluxometer”	Mass flux accuracy (l/s)	NEW	+/- 0.2 l/s	2015
Integrated Pressure/Flow/Temp (PFT) Testing Tool	Precision (P, m/s, and T)	+/- 50%	+/- 10	2018

U.S. Granite Database

Database/information on the variability of crystalline rock strengths

Technology Advancement	Technology Metrics			
	Metric Unit for Advancement	2011 Status	Target	When
Simplification of data acquisition and interpretation	New database	0	1	2015

Fracture Imaging Technology

Locate and map in 3D fractures and faults relevant to EGS

Technology Advancement	Technology Metrics			
	Metric Unit for Advancement	2011 Status	Target	When
Reflection seismology	Temperature (°C)	300°C	>300°C	2017
Electrical methods	Temp (°C), pressure dif. (psi), and Duration (days)	7-10 days, 170 °C, and pressure = ?	300 °C, ΔP >2,000 psi, and 21 days	2017
Ambient noise tomography	Spatial resolution (m)	New to geothermal	+/- 10m	2030
Electro-Seismics	Location error (m)	New	+/- 10m	2030