



EMD's Geothermal Energy Committee



Geothermal Committee Annual Report - 2011

Richard J. Erdlac, Jr., Ph.D., P.G., Chair

March 23, 2011

Vice-Chairs:

- David Blackwell, Ph.D., (Vice-Chair: University), Southern Methodist University, TX
- Richard J. Erdlac, Jr., Ph.D., P.G., (Acting Vice-Chair: Industry), Calnetix, Inc.
- Open, (Vice-Chair: Government)
- TBA, (Vice-Chair: Representative of DEG)
- TBA, (Vice-Chair: Representative of DPA)

Advisory Committee:

- Paul Morgan, Ph.D., Colorado Geological Survey, Golden, CO
- Michael D. Campbell, P.G., P.H., I2M Associates, LLC, Houston, TX
- Steven Tischer, P.G. Arcadis, Midland, TX
- Cenk Yardimcilar, Ankara, Turkey

Observing Committee:

http://emd.aapg.org/members_only/geothermal/index.cfm#observers

Committee Activities

The primary effort has been the development of the Pre-Convention Short Course 12, An Overview of Geothermal Energy for the AAPG 2011 Annual Convention & Exhibition. Instructors were identified from industry, academia, and government to speak on geothermal development, with the emphasis being on geothermal in the oil and gas industry. At the time of this writing, 21 people had signed up for the course. In addition to advertising through the AAPG, a 2-page flyer was developed and sent to the Geothermal Energy Association to be announced in their weekly geothermal newsletter (<http://www.geo-energy.org/>).

Tom Anderson had to step down as Vice-Chair: Government on the committee. He and 26 other professionals employed at the Rocky Mountain Oilfield Testing Center had their positions

terminated from the facility. This had the suggestion of a serious cut in the operations of the facility involving oil, gas, and geothermal research. An email to and response from JoAnn Milliken, the Acting Program Manager for Geothermal Technologies, indicated that the RMOTC facility would continue its operations, including geothermal, as part of its charge.

Past DOE Geothermal Funding

In 2009 the Department of Energy issued \$338 million in awards through the American Recovery and Reinvestment Act toward the expansion and acceleration of geothermal development in all facets throughout the United States. This money was matched in a more than one-for-one basis with an additional \$353 million in private and non-Federal cost-share funds. This money went toward the support of 123 projects in 39 states, with recipients including private industry, academic institutions, tribal entities, local governments, and DOE's National Laboratories.

These grants were directed towards identifying and developing new geothermal fields and reducing the upfront risk often encountered with geothermal development through innovative exploration and drilling projects and data development and collections. The grants would also support the deployment and creative financing approaches for ground source heat pump demonstration projects across the country.

The projects that were selected for negotiation of awards fell into 6 categories:

1. Innovative Exploration and Drilling Projects (up to \$98.1 million): Twenty-four projects have been selected focusing on the development of new geothermal fields using innovative sensing, exploration, and well-drilling technologies.
2. Coproduced, Geopressured, and Low Temperature Projects (up to \$20.7 million): Eleven projects have been selected for the development of new low-temperature geothermal fields, a vast but currently untapped set of geothermal resources. This includes geothermal heat found in the hundreds of thousands of oil and gas wells around the U.S., where up to ten barrels of hot water are produced for every barrel of oil.
3. Enhanced Geothermal Systems Demonstrations (up to \$51.4 million): Three projects have been selected for the exploration, drilling and development of enhanced geothermal systems (EGS) to validate power production from deep hot rock resources using innovative technologies and approaches.
4. Enhanced Geothermal Systems Components Research and Development / Analysis (up to \$81.5 million): Forty-five projects have been selected to focus on research and development of new technologies to find and drill into deep hot rock formations, stimulate enhanced geothermal reservoirs, and convert the heat to power.
5. Geothermal Data Development, Collection and Maintenance (up to \$24.6 million): Three projects have been selected for the population of a comprehensive nationwide geothermal resource database to help identify and assess new fields.

6. Ground Source Heat Pump Demonstrations (up to \$61.9 million): Thirty-seven projects have been selected to demonstrate the deployment of ground source heat pumps for heating and cooling of a variety of buildings for a variety of customer types, including academic institutions, local governments and commercial buildings.

Potential Future DOE Geothermal Funding

The Geothermal Technologies Program, currently apportioned at \$43,120,000, has received congressional request of \$101,535,000 for FY 2012. This would be a major increase in funding availability, should this request be accepted. In the proposal, the DOE is looking at ways to bring down the cost and deploy new technologies for expanding geothermal development in large parts of the United States. The budget request names enhanced geothermal systems (EGS) (\$61.5 million), low temperature coproduced resources (\$14 million), systems analysis (\$5 million), innovative exploration technologies (\$15 million), and permeable sedimentary resources (\$6 million). This would be a major change in the program funding as summarized in the chart below.

	(Dollars in Thousands)	
	FY 2010 Current Appropriation	FY 2012 Request
Geothermal Technologies		
Enhanced Geothermal Systems	43,120	61,535
Low Temperature & Coproduced Resources	0	14,000
Permeable Sedimentary Resources	0	6,000
Innovative Exploration Technologies	0	15,000
Systems Analysis	0	5,000
Total Geothermal Technologies	43,120	101,535

The following quotes are extracted from the more detailed DOE GTP Budget Justification. These descriptions of potential funding areas have the potential to positively impact geothermal development in geographic areas where oil and gas are also being produced.

Enhanced Geothermal Systems

"In FY 2012, GTP will conduct RD&D of technologies that enhance geothermal reservoir performance and sustainability, reducing the costs of energy production. While the tools developed are critical to EGS, they can also be used to characterize reservoirs and optimally utilize all types of geothermal resources."

"During FY 2012, GTP will address priority R&D needs and will continue to demonstrate and validate flow rate or injection rate improvements at seven EGS field sites. These sites, which will be within or beyond reservoir stimulation phases, will demonstrate reservoir enhancements (through hydraulic, chemical, thermal, or other stimulation methods) and heat recover (from stimulated rock volume using water as a fluid). While EGS demonstration projects will continue to provide valuable reservoir characterization and stimulation data, the emphasis in FY 2012 will shift to EGS R&D projects focusing on technology areas that need attention and development, identified by examining Recovery Act project successes and knowledge base deficiencies."

CO₂ as Geofluid in EGS

"GTP will also explore the use of super-critical carbon dioxide (scCO₂) as a geofluid to harvest heat and produce electricity. This will decrease water consumption for EGS and could double heat recovery-to-power conversion efficiency. These efforts crosscut all geothermal resources because CO₂ can be used in any system where a geofluid is circulated to extract heat area."

"In FY 2012 GTP (in partnership with FE R&D) will advance understanding of the geochemical evolution of the reservoir, and flow and mining of scCO₂ with host fluids. The program will also develop and modify monitoring tools and methods to track CO₂ in geothermal reservoirs."

Low Temperature and Coproduced Resources

"In FY 2012, GTP will research, develop and demonstrate innovative power generation technologies, advanced working fluids, hybrid cooling systems, and high-performance heat exchangers to reduce LCOE of low temperature and coproduced resources."

Permeable Sedimentary Resources

"In FY 2012, GTP will demonstrate technical feasibility of energy production from permeable sedimentary geothermal reservoirs."

"To capture heat economically, circulating geofluid must access a high surface area and a large volume of rock. The investment in subsurface characterization in sedimentary formations by oil and gas developers can be leveraged to reduce up-front development risks, which are currently some of the greatest barriers and cost to geothermal development. Similarly, tools and technologies from the oil and gas industry can be immediately adopted for use. Water for use as a heat recovery fluid, or geofluid, may be readily available from the coproduced and discarded water of neighboring oil or gas reservoirs. Surface piping, well pads, access roads associated with neighboring oil and gas development, and other in-place infrastructure may be directly applicable to geothermal development."

Innovative Exploration Technologies

"In FY 2012 the program will conduct RD&D of exploration tools (e.g., remote sensing, seismic processing, and structural, geochemical and thermal signature tools) for resource confirmation in undiscovered geothermal fields. These tools will reduce high upfront exploration risks and project costs, encouraging the discovery of up to 30,000 MWe of conventional hydrothermal. GTP will advance game changing exploration technologies, both downhole and noninvasive, that have the potential to significantly lower upfront risk, e.g. airborne gravity. GTP seeks to improve distribution and resolution of data to better characterize the subsurface resource on a regional basis."

Systems Analysis

"Systems Analysis will continue analysis activities previously conducted under the EGS subprogram in FY 2010. In FY 2012 this new subprogram will conduct systems analysis, implement data gathering and assess the geothermal resource base for all geothermal resources. Development of analytical tools aims to reduce the costs and risks associated with geothermal

development, which inhibit the growth of geothermal in the U.S. This subprogram also provides analytical and technical support to inform the direction of GTP and project prioritization, and evaluated GTP's performance and ability to achieve its goals."

Geothermal in O&G Regions

Oil and gas companies previously mentioned that include Continental Resources, Denbury Resources, Inc., Hilcorp Energy, and Pioneer Natural Resources have been continuing with their coproduction development activities. Universal GeoPower and Louisiana Tank are also continuing at various stages in their planned geothermal production facilities.

Recently an oil and gas company (name withheld by request) has placed an ORC unit at one of its wells and is producing over 50 kW gross, with part of this power operating the system and the remainder being sold to the electric grid. Finally, a company called Continental Energy has advertised in the Geothermal Energy Association newsletter (<http://www.geo-energy.org/>) its interest in seeking local operators or parties with access to properties with hot oil or gas wells (shut-in or production) in Mississippi for the purpose of co-produced geothermal energy development.

Hedberg Geothermal Conference

The "Enhanced Geothermal Systems" Hedberg Research Conference was held in Napa, California from March 14-17. The conference was attended by 65 people from industry, academia, and government. Presentations and discussions were varied and the conveners will be drafting a final report to the AAPG regarding this meeting. I have requested that the final report also be cc'd through the EMD Geothermal Committee for inclusion on the geothermal website.

Among the discussion time was a somewhat heated conversation with DOE representatives on the small amount of funding being suggested (\$6 million) for geothermal out of permeable sedimentary rock when compared to the proposed 2012 EGS funding. The discussion was about the amount of funding put into EGS from the standpoint of drilling a granitic body, fracturing the rock to form a reservoir, and injecting water when geothermal could be more rapidly expanded by going to sedimentary rock with a more focused effort (and greater capital input) to produce geothermal energy from the 100's of thousands of O&G wells east of the Rockies. Apparently to date no EGS geothermal plant has been fully successful in its development of geothermal electrical power. DOE representatives indicated that there is room for changing the budget and is open for suggestions.

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