

Clean energy rocks

Firms digging to generate cheap geothermal power

In looking for more sources of renewable energy to stave off global warming, the earth itself may have a solution.

Geothermal power — harnessing the earth's heat to produce electricity — produces essentially no greenhouse gas emissions and, unlike solar and wind power, is available 24 hours a day.

There's enough heat trapped deep in the earth to meet the nation's electricity demand thousands of times over, but getting to it at costs that can compete with coal-fired energy is a challenge.

A handful of Bay Area companies are working on ways to expand geothermal capacity through engineered or enhanced geothermal systems — also known as EGS — to ultimately produce power from the earth's heat anywhere.

Northern California is a hotbed of geothermal activity because hot rock exists naturally close to the surface. The Geysers, a complex of 22 geothermal plants along the Lake County-Sonoma County border in Northern California, is the world's largest such facility. Calpine Corp. operates 19 of its 22 identified geothermal sites which produce 725 megawatts of electricity — enough to power the entire city of San Francisco.

In places like the Geysers, water is piped into deep underground pockets where it turns to steam, which rises to run turbines on the surface and create power.

The problem with producing more geothermal power is that there is a limited number of naturally occurring reservoirs that are hot enough to produce efficient power and can be accessed by drilling.

Enhanced geothermal systems take geothermal power one step further.

"The thought behind EGS is to develop technology that allows us to create reservoirs that don't naturally exist (using) a man-made method from the surface," said Don O'Shei, CEO of Sausalito-based AltaRock.

AltaRock has filed for 15 patents and has 33 others in the pipeline to protect the process and technology it has developed for fracturing rock deep within the earth's crust to create heat reservoirs and tap geothermal power where it wasn't easily accessible before.

The company raised \$26.25 million from venture capital firms Khosla Ventures, Kleiner Perkins Caufield & Byers, Advanced Technology Ventures, Vulcan Capital and Google.org in 2008 that will help it demonstrate its technology on a large scale. But it will need tens, if not hundreds, of millions of dollars more to develop a commercially viable enhanced geothermal plant.

To find rock hot enough to run a power plant — at least 472 fahrenheit is generally considered the most efficient — wells typically must reach 20,000 to 30,000 feet deep. The cost increases exponentially the deeper you go.

"Drilling is really the cost driver for geothermal," said Jared Potter, CEO of Potter Drilling in Redwood City.

With traditional well-drilling into hard rock, drill bits have to be replaced every few hundred meters, which is expensive. Once holes are drilled miles into the earth, it can take days to extract each drill bit from a bore hole. A 2007 report by geothermal consulting firm GeothermEx, Inc., estimated a typical EGS well would cost between \$5 million and \$6 million in 2006 dollars and said major improvements in drilling could be party to the cost competitiveness of enhanced geothermal systems in the future.

Potter Drilling is working on ways to drill deeper into earth's crust more cheaply.

Potter's technology relies on a process called hydrothermal spallation, which uses high-pressure fluid to create fractures in the rocks. The process was invented by Jared Potter's father Bob Potter and MIT professor and geothermal expert Jefferson Tester, and is licensed from MIT.

Potter drilling claims using the technology takes less time and creates more stable bore holes than traditional well-drilling methods.

If the hydrothermal spallation works like the company thinks it does, "We could see factors of two to 10 times in the reduction of cost to drill bore holes, which really makes the economics look good," Jared Potter said. "It starts to look like coal."

The same GeothermEx report estimated that with reductions in exploration and drilling, operations and maintenance and power plant costs, EGS power could reach 4.42 cents per kilowatt hour. And with

a needed margin of 30 percent to 50 percent to satisfy a return on investment, EGS power could be competitive with conventional geothermal and most other power sources. If no improvements in drilling costs are made, EGS would be priced out of the market.

Google.org put \$4 million into Potter Drilling as part of its Renewable Energy Cheaper than Coal (RE

A report to the Department of Energy by a coalition led by MIT's Tester showed that tapping just 2 percent of the heat that exists between 1.9 and 6.2 miles down would provide 2,500 times the electricity the United States uses today.

He estimated that a \$1 billion investment in enhanced geothermal systems research and development over the next 15 years could yield more than 100 gigawatts of power by 2050 — or about 10 percent of projected U.S. energy usage.

In 2008, geothermal was eligible for just \$20 million in federal loan guarantees, which won't go very far.

"The problem with geothermal technology is it's heavily risk-oriented in the early stages," said Kenneth MacLeod, CEO of Western Geopower, which is developing a traditional 35 megawatt geothermal field at the Geysers. "With geothermal, you have to go out there and spend tens of millions of dollars for a feasibility study for a 35 megawatt project. For a 100 megawatt project, you have to spend \$30 or \$40 million to demonstrate potential capacity. There are not too many companies willing to take that risk."

EGS faces even greater cost challenges in proving its technology.

The viability of enhanced geothermal is entirely dependent on field tests that could take several years, said Tester during a phone interview from his office at MIT.

"I don't think this is the thing that can be done without doing the field work," he said. "You can say you're going to the moon, but one day you're going to actually have to go there."

lriddell@bizjournals.com / (415) 288-4968

