FOCUS ON GEOTHERMAL

Extracting Earth's Energy

U.S. GEOTHERMAL READY TO TAP STEAM

By Al Senia

GEOTHERMAL ENERGY MAY be about to enter the nation's alternative energy mix in a significant way.

In a remote desert Idaho location, a new $35 million geothermal energy plant is being constructed at a site where, 30 years ago, proponents believed geothermal promised a true energy breakthrough. This time, however, a new vision – as well as a substantial federal tax credit, growing concern about global warming and high natural gas prices – may make the critical difference in giving the technology real legs.

Still, the Raft River power project near Malta, Idaho, some 200 miles southeast of Boise, at first glance might ignite some skepticism. Workers are drilling wells one mile deep in the Idaho desert, looking to extract 300-degree water, which can be converted into energy that would be sold to regional utilities and then pumped back into the Earth's crust. Officials with U.S. Geothermal, the renewable energy development company that is overseeing plant construction, intend to produce 10 megawatts monthly average power output from the binary-cycle geothermal plant beginning in the fall of 2007. That would generate $5 million in annual revenue, according to company officials. Idaho Power recently signed a 20-year purchase agreement with U.S. Geothermal.

Daniel Kunz, the company's CEO, hopes a second phase of the plant will go online in late 2008, producing an additional 25 megawatts of power. A third phase is planned for 2011 with the potential for another 50 megawatts of production. "We see the ultimate potential here to produce a couple of hundred megawatts of clean energy," said Kunz. "The technology is not new. It's 25 years old. But it is unique in its reliability. It's tried-and-true technology. We have the newest generation of it."

Karl Gawell, executive director of the Geothermal Energy Association (GEA), believes Raft River will do a lot to validate the recognition of geothermal power as an alternate energy source in the western United States "Geothermal in some ways is still a pioneering technology," said Gawell, "Raft River is the first (geothermal) project in a new region that is proving that it is not a get-rich-quick scheme. It is really important because this Idaho resource has never been tapped before, and many people believe it is a major resource."

According to GEA, Raft River is one of 45 geothermal power projects currently under development in nine western states. The projects have the potential to produce between 1,818 and 2,095 megawatts for the power grid, nearly doubling the total current geothermal power production in the United States Gawell noted that the availability of geothermal energy varies by region, with California already emerging as the industry leader. In that state, GEA says the percentage of electricity derived from geothermal exceeds seven times the national average. Geothermal is the largest non-hydro renewable-energy source in California. In another study, the Western Governors' Association Geothermal Task Force identified more than 100 sites in the United States with near-term development potential.

However, geothermal still has to prove its economic viability. Raft River could help achieve that goal. Last August, a financial partnership was formed between U.S. Geothermal (which is publicly traded on the OTCBB stock exchange) and an affiliate of the Goldman Sachs Group to own, construct and operate Phase 1 of the plant. U.S. Geothermal made a $5 million cash contribution to the partnership, called Raft River Energy I. U.S. Geothermal is also transferring seven existing production and injection wells, as well as specific geothermal rights and leases covering 1,800 acres from the 5,200 total acres of geothermal rights current held. The Goldman Sachs affiliate kicked in the $34 million needed for construction. Officials say an independent assessment shows there is a 50 percent probability that 15.6 megawatts per square mile exists at Raft River.

Just the fact that such a partnership could move forward helped validate the financial viability of geothermal as an important future energy source, Kunz and others believe.

Source: www.usgeothermal.com

Steam rising from the testing of a geothermal well 200 miles southeast of Boise, Idaho.

News Flash www.energycentral.com

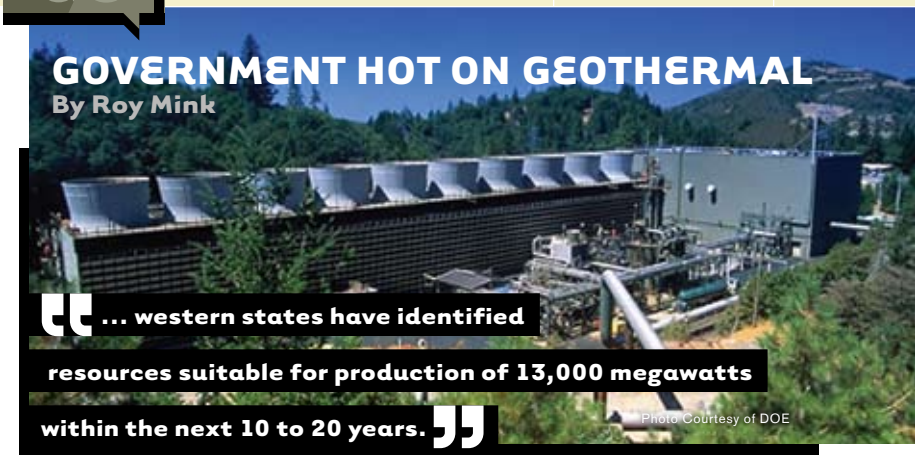
CARBON DIOXIDE BURIAL IN NEBRASKA

Carbon dioxide produced by coal-burning power plants could be readily injected into southeast Nebraska or the state's western Panhandle, according to Edward Steadman, a professor at the University of North Dakota.

"The Plains states are in a good position because we have fairly nice geology," he said, according to a news report.

GOVERNMENT HOT ON GEOTHERMAL

By Roy Mink



> "... western states have identified resources suitable for production of 13,000 megawatts within the next 10 to 20 years."

Photo Courtesy of DOE

THE EARTH HOUSES a vast energy supply as geothermal heat — a domestic resource equivalent to at least a 20,000-year energy supply at our current rate of consumption — and it is being renewed. Geothermal energy is used in all 50 states, and it will make a great difference to our nation's energy supplies. I am excited that additional geothermal energy plants are beginning to come on line as a result of better technology, favorable policies, and enhanced public awareness of the environmental benefits. The Department of Energy's geothermal technologies program seeks to make geothermal energy the nation's environmentally preferred baseload energy alternative.

On the federal policy front, the 2005 Energy Policy Act streamlined leasing requirements, which is expected to lower costs for potential developers. The law also mandated that the U.S. Geologic Survey conduct a detailed resource assessment, the first since 1978. This should enable developers to more accurately identify areas for potential geothermal resource development, leading to reduced exploration costs and risks. The act extended the production tax credit for geothermal power facilities in place before Jan. 1, 2008, by two years. This will enhance cost-competitiveness.

An innovative, geothermal power plant was recently commissioned at Chena Hot Springs in Alaska, using equipment based on mass-produced chiller systems to generate electricity from geothermal water at 165 degrees Fahrenheit.

Another exciting opportunity involves the capture of energy in the copious hot water that flows from oil and gas wells in much of the Gulf Coast area, extending through Texas and Oklahoma and on into Wyoming. Low-temperature power plants make this new application possible, with geologists and geophysicists estimating available resources for potential installations totaling about 5,000 megawatts in the near future.

A recent MIT analysis estimates that geothermal's long-term potential is many times U.S. energy demand.

According to the Western Governor's Association, the Western states have identified resources suitable for production of 13,000 megawatts within the next 10 to 20 years. Of these, 5,600 megawatts are considered by industry to be viable for commercial development by 2015 at levelized busbar costs of about 5.3 to 7.9 cents per kilowatt-hour assuming commercial financing and the production tax credit. This estimate does not include the potential geothermal production from oil and gas wells, or the much greater potential of deeply buried hot rock.

These exciting new opportunities for geothermal energy will advance geothermal power generation so that it becomes an even greater contributor to the power infrastructure and economic well-being of the United States.

Big Geysers, a 75-megawatt geothermal power plant located in northern California.

***Dr. Roy Mink** is program manager at the U.S. Department of Energy geothermal technologies program.*

Geothermal supporters concede that the technology first gained prominence – and quickly flopped – when the U.S. faced its first energy crisis in the 1970s. In fact, the Raft River site was touted as a solution in the 1970s and attracted $40 million in investment capital back in 1982. Ironically, it is those wells drilled back in 1982 that Kunz is now focusing the company's efforts on developing.

BACKGROUND WORK

"The government did a vast amount of work on the geology in the 1970s," said Kunz. "They put in 14 monitoring wells and built the original plant. The project was a success, but the production costs were high." That first geothermal facility actually produced seven megawatts of power for about eight months, Kunz said. But the federal government's decision in the early 1980s to privatize geothermal energy development helped doom the project, Kunz asserted, because the energy produced wasn't cost-competitive. The original plant was disassembled and sent to Nevada, but the wells and the geological studies showing the potential of the energy source, remained. U.S. Geothermal acquired the rights about four years ago. "We recognized it as a tremendous resource," said Kunz. "Our business plan is to commercialize the existing well fields by building a new (geothermal) plant on top of the site."

What will be different this time around at Raft River? Kunz and others in the industry believe one key factor was the 2005 passage of the Energy Policy Act, which extended the full federal production tax credit, formerly limited to wind power plants, to geothermal facilities. The measure also authorized increased research funding by the Department of Energy and provided funding to the Bureau of Land Management to address a backlog of geothermal leases and permits. The geothermal lease backlog is estimated to be 25 years. The current tax credit expires in December 2007, which means geothermal plants must be producing power by that time to be eligible. Industry watchers contend that doesn't provide much time for geothermal plants to get authorized and operational.

In Raft River's case, that new tax credit is expected to generate approximately $1.7 million annually when the plant goes online. The credit provides $19 per megawatt-hour produced during the next 10 years. That kind of windfall could make the difference between financial success and failure for geothermal

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GOOGLE POWER SAVINGS

Google wants the computer industry to help cut power use by servers, according to the *Independent* newspaper in the United Kingdom.

Google has managed to achieve significant power savings and is willing to share it with hardware makers.

Computes and servers waste as much as 40 percent of their energy, but Google scientists have reduced that waste to 10 per cent.

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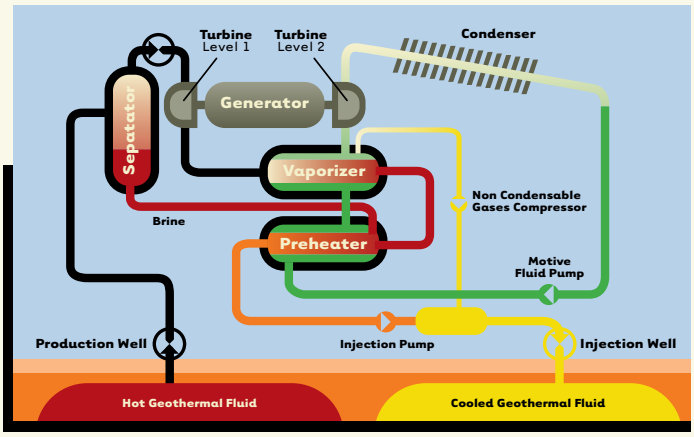
FOCUS ON GEOTHERMAL

guest opinion

BOOSTING OUTPUT

By Daniel N. Schochet



The combined cycle technology boosts power output at geothermal sites.

Source: Ormat

THOUGH GEOTHERMAL POWER plants have been producing reliable energy for three decades or more, the advances in the power-conversion technology have increased the power-conversion efficiency, lowered the cost of energy generation and improved sustainable management of the geothermal resources.

Of the 8,000 megawatts of geothermal plants installed worldwide, most use steam turbines operating on dry steam or steam produced by single-flash or double-flash systems. About 800 megawatts are Ormat binary-based power plants, combinations of steam and air-cooled binary systems.

The steam is derived either directly from the geothermal source or from "flashing" a portion of the pressurized hot geothermal fluid into steam.

In a binary plant, the geothermal energy is transferred to an organic working fluid in a vaporizer/boiler. The working fluid characteristics allow it to vaporize at lower temperatures, with vapors that efficiently drive low-speed turbines, which are directly coupled to a generator. The spent organic vapors are condensed back to liquid form an air-cooled condenser, and pumped back into the vaporizer. The cooled geothermal fluid is injected back into the reservoir.

For geothermal resources from 200 to 350 degrees Fahrenheit, binary technology is used to convert the geothermal heat to electrical power. Most of yet undeveloped resources are in this category. Turbine efficiency has been increased by some 20 percent in the past two decades.

For resources with temperatures from 350 to 400 degrees, where the flashed steam produces from 10 to 30 percent of the usable energy, the binary plants are also cost-effective.

Separated steam is introduced in the vaporizer to vaporize the organic fluid. The geothermal condensate at the vaporizer exit is then mixed with the hot separated brine to provide for the preheating of the organic fluid. The dilution of the brine with the condensate effectively lowers the precipitation temperature of the silica dissolved in the brine, allowing the fluid to be cooled to a lower temperature and adding 20 percent more heat to the cycle. This additional heat produced an additional 600 kilowatts.

For geothermal resources over 400 degrees, energy is best captured by a geothermal combined cycle unit where the steam first flows through a back-pressure steam turbine and then is condensed in the binary cycle vaporizer. In this cycle, only dry steam contacts the steam turbine train and air-cooled condensers are effectively used. This allows for 100 percent injection of geo fluids, has near zero emissions and is adaptable to resource changes.

In the past two decades, binary combined-cycled geothermal plants have achieved greater efficiency and promise to expand near emissions-free geothermal power production domestically and worldwide.

***Daniel N. Schochet** is vice president of Ormat Nevada.*

News Flash
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ORMAT UNITS FINISHED

Ormat Technologies has announced it has completed four recovered energy generation plants along pipelines in the Dakotas. The Ormat-owned units will have a capacity of 22 megawatts, and the power will be sold to Basin Electric in Bismarck.

The units will not produce greenhouse gases and generate power from hot exhaust gases from compressor stations along the pipeline.

"The tax credit provides a huge incentive for geothermal development."

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projects such as Raft River.

"The tax credit provides a huge incentive for geothermal development," said Gawell of the Geothermal Energy Association. "It brings the price of the power plants down to a more acceptable level. It also brings in investors because it provides them a tax advantage. But it is an all-or-nothing deal because the tax credit requires that you have to be online by Jan.1, 2008 to take advantage of the credit. It usually takes two to three years to build a plant." The GEA and others are pushing Congress for an extension of the federal tax credit.

The move to geothermal is also being aided by a renewed focus on controlling greenhouse gas emissions by western states such as California, which earlier this year approved a plan to slash emissions 25 percent by 2020.The plan mandates caps on carbon dioxide and other emissions, which is resulting in a move toward clean alternative energies such as geothermal, wind and biomass. "California has clearly been pushing the envelope in developing an alternative energy future," Gawell noted. He estimates that state alone has between 5,000 and 25,000 megawatts of undeveloped geothermal resources. If geothermal proponents have their way, all that energy could be headed onto the grid during the next decade.