U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

GEOTHERMAL TECHNOLOGIES PROGRAM

Chena Power, LLC's mobile geothermal power plant unit will use co-produced fluids from oil and gas wells to generate electricity. The unit, shown here, traveled from Alaska to Nevada, for the Geothermal Resources Council Annual Meeting in the fall of 2009. Today, the unit is installed at a remote site in Utah for testing.

Geothermal Energy Production with Co-produced and Geopressured Resources

The U.S. Department of Energy's (DOE) Geothermal Technologies Program (GTP), with support from DOE's national laboratories, conducts research, development, and demonstration projects throughout the United States on co-produced and geopressured geothermal energy resources.

The American Recovery and Reinvestment Act of 2009 expanded GTP's demonstration work into geopressured fields and geothermal co-production from oil and natural gas fields. GTP supports demonstrations of these innovative technologies to advance geothermal energy use and production.

Co-Produced Resources

An average of 25 billion barrels of hot water are produced annually from oil and gas wells within the United States. Historically this hot water has been an inconvenience and has required costly disposal; however, it is now being looked at as a resource that can be used to produce electricity for field operations or sold to the grid. Co-produced geothermal resources can deliver near-term energy savings, diminish greenhouse gas emissions, extend the economic life of oil and gas fields, and profitably utilize abandoned oil and gas field infrastructure.

Innovative technologies are expanding the geothermal resource base by utilizing lower-temperature fluids. These technologies currently use a binary Organic Rankine Cycle (ORC), which transfers the heat from geothermal fluid (mostly water) to a second fluid that vaporizes at a lower temperature and higher pressure than water. This vapor is then used to drive a turbine to produce electricity. This type of system is closed-loop with minimal emissions.

Technology Benefits

- Capacity ranges from 200-280 kW to more than 100 MW
- Design flexibility and reduced construction lead times
- Scalable plant sizes based on local geothermal resource and demand
- Ability to utilize off-the-shelf units, easily added to when more generation potential is identified.

Demonstration Projects

A major early success story validating co-production was the Ormat Technologies and Rocky Mountain Oilfield Testing Center project, which, in September 2008, achieved the first successful generation of electricity from binary geothermal technologies integrated into existing oil and gas field infrastructure. Since its inception, the Ormat power generating

The Rocky Mountain Oilfield Testing Center in Wyoming was one of the first projects to validate the use of co-produced geothermal fluids from oil and gas wells for power generation. The binary cycle plant, shown here, produces approximately 200 kW of electricity.

unit, the Ormat Energy Converter, produces 150-250 net kilowatts (kW) of power from co-produced fluids in Wyoming.

More recently, Chena Power, LLC has developed a mobile geothermal power plant, funded in part by DOE, to showcase that low-temperature, co-produced resources across the United States can be accessed and used for power generation. In May 2010, the first mobile geothermal power plant was deployed on a site in Utah where existing oil and gas wells have geothermal power potential. The transportable, 289 kilowatt hour geothermal power plant is expected to lower development costs, and reduce permitting requirements.

Thanks to Recovery Act funding, the University of North Dakota has begun a project to demonstrate the technological and economic feasibility of electricity generation from low-temperature geothermal water using binary, ORC technology. An ORC system will be installed at an oil field in western North Dakota where geothermal fluids can be found at depths of 10,000 feet. These fluids will be used to operate and monitor an on-site power plant for two years by a team of industry engineers, scientists, and project developers who will create engineering and economic models for geothermal ORC energy production.

Another Recovery Act-funded, co-production project is Universal GeoPower, LLC's demonstration of the technical feasibility and economic viability of geothermal electricity production from oil and gas well co-produced water. The project team plans to install, operate, and report data from a modular, replicable power plant at an oil and gas well in Liberty County, Texas. The location is important for new geothermal development due to the more than 37,000 possible sites in Texas and the neighboring Gulf Coast that can replicate the power plant technology. The project team estimates that ultimately more than 7,800 megawatts (MW) of power could be produced, allowing four trillion standard cubic feet of otherwise abandoned natural gas to be recovered, and a significant number of jobs could be created in the region.

Geopressured Resources

In some cases co-produced fluid (brine) is trapped under an impermeable layer of caprock while a layer of sediment rapidly builds over it. The weight of the sediment layer on the trapped fluids results in elevated pressures. These fluids are called geopressured resources; temperatures typically range from 90°C to 200+°C. The reservoirs that hold this fluid often contain dissolved natural gas that may not be economical to produce alone, but can be economically developed in combination with geothermal energy production from the hot brine. Geopressured brine reservoirs are located along the Pacific coast, in Appalachia, beneath the Gulf of Mexico, and in other deep sedimentary basins in the United States.

In the 1980s, DOE's Gulf Coast Geopressured-Geothermal Program confirmed the existence of a geopressured-geothermal system within the Pleasant Bayou test facility. Located in Brazoria, Texas, the site was used from 1989-1990. An onsite geopressured-geothermal hybrid cycle 1 MW plant used a mixture of methane and geothermal brine fluids. The plant generated more than 3,400 megawatt hours from November 1989 to May 1990, and was found to be technically feasible; however, the Program and the Pleasant Bayou project disbanded shortly after due to energy prices and lack of commercial production support.

Today, due in part to the increase in electricity prices and technological advancements seen over the last two decades, as well as national support for developing clean, renewable energy and job opportunities, it's possible to develop thousands of megawatts of geopressured-geothermal power in the southeastern United States.

Current Demonstration Project

Louisiana Geothermal, LLC, through a partnership with GeothermEx, Inc., Louisiana State University, and The Shaw Group, Inc. is currently working to demonstrate the commercial feasibility of geopressured-geothermal power development at the Sweet Lake Oil and Gas Field in Cameron Parish, Louisiana.

The goal of the project is to exploit high-pressured hot brines at depth in Cameron Parish. The project team will develop conceptual and numerical models; devise surface technology and power plant design; drill an injection well and conduct a long-term test of a production well; construct all surface facilities and power plants; and start power generation. Once the power plant is operational, the team will assess the technical and economic aspects of performance of the constructed system and evaluate direct and indirect job creation from the project.

It's expected that the power plant(s) at the Sweet Lake Field site will create electricity from heat and kinetic energy from the brine in the geothermal well, in addition to natural gas. If successful, these power plants will showcase the first economically viable demonstration of geopressured-geothermal energy technology.

For more information, visit the GTP website at www.geothermal.energy.gov. Learn more about GTP-funded projects at *www.geothermal.energy.gov/projects/*.

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