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Consultants Corner

Engineering for the future

Hot Stuff!

Geothermal energy is hot stuff. *Geo* means earth and *thermal* means heat; and when combined, *geothermal* literally means "earth heat." Geothermal energy is a versatile resource that ranges from heat pumps and direct use activities on the low temperature end, to electrical power production on the high temperature end of the spectrum. Geothermal energy is considered a "green" or "alternative" energy source, along with wind, solar and biomass energy sources.

The source of geothermal heat is born deep inside the core and mantle of the earth. The heat is transferred from these great depths to within several miles of the surface as molten rock (magma). This magma heats up the surrounding rock, making a potentially wide area of residual heat. In a few places, the heat can be transferred to the surface as lava, forming volcanoes.

The shallow crust of the earth in some places can be more than 300ºF at depths shallower than 5,000 feet below the surface. In those areas, deep groundwater is heated by the hot rock and the heated water forms circulating pools of hot water under the earth, called reservoirs. In some places the hot water and steam can escape to the surface as hot springs, geysers and other surface features similar to those found at Yellowstone and Mount Lassen National Parks.

For power production, the hot water reservoirs are tapped by drilling wells, similar to oil wells, and piping the hot water to a power plant, where the steam is separated from the water and used to turn a turbine to produce power. The cooled water is injected back into the earth to be reheated by the still hot reservoir rock. Thus, geothermal energy is a "renewable resource."

12.5 Megawatt Desert Peak Power Plant, Nevada.

An equally important fact is that a geothermal energy power plant produces far less than 10% of the greenhouse gases generated by equivalent-sized oil, natural gas or coal-fired power plants. This makes geothermal energy a smart "green alternative energy resource" where it exists.

The exploration and development of geothermal systems is really a hybrid of the mining and oil and gas industries. The larger and hotter geothermal systems used in power production are basically hydrothermal mineral deposits in the making. As such, these systems have many of the physical characteristics of gold or copper deposits. However, the ways to reach the hot water and exploit it to generate power is done by using oil drilling technology because it is common to drill geothermal production and injection wells that are more than a mile deep.

Geothermal power plants come in all sizes and shapes, from plants as small as 300 kilowatts to over 100 megawatts. One

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megawatt is equal to 1,000 kilowatts and is the equivalent of the electrical usage of 1,000 U.S. homes. The U.S. produces nearly 3,000 megawatts of geothermal power—more electricity from geothermal energy than any other country in the world. California produces more than 60% of the geothermal power produced in the U.S. Currently, geothermal power plants are being developed in Nevada, Oregon, Idaho, Utah and California.

Geothermal power plants are "base load power," which means the power is available 24 hours a day, every day, every year, for decades. Geothermal power plants have some of the highest on-line reliability of any commercial power facilities, commonly operating over 90% of the time during a typical year, rivaling the records of nuclear power plants. By way of contrast, most "alternative energy" power plants operate less than 40% of the time, and not always when the energy is needed most.

Geothermal power is extremely useful for more than power production. Geothermal resources are common at temperature ranges of less than 200ºF. This type of water is perfect for a wide range of "direct use" applications, such as food processing, fish farming, greenhouse crop growing, lumber drying, paper processing and the ever-popular hot spring spa bathing.

In the U.S., most of the high and low temperature water resources are in the western states, generally west of the Rocky Mountains. However, heat pump technology can be used almost anywhere in the country. Heat pumps utilize the difference between the existing air temperature and the natural heat of the earth at depths of generally 3 to 20 feet below the surface.

Geothermal exploration well being drilled in Imperial County, California.

Since the soil and shallow groundwater are excellent insulators, the temperature of the earth at that shallow depth is generally the average annual temperature of that location. Thus, in the summer it is cooler and in the winter it is warmer than the outside air temperature, and the heat pumps can be used to supply "warm" liquid in the winter and "cool" liquid in the summer by circulating that air or liquid to the home, cutting heating and cooling costs.

The Earth Systems group of companies is involved in both direct use and power production geothermal energy projects. We have consulted and assisted firms in resource assessment, permitting and exploration activities for potential power production prospects in California and Nevada. We are also involved in hydrogeologic and resource assessments of direct use geothermal systems in California. Earth Systems has participated in U.S. Department of Energy and California Energy Commission grants for geothermal exploration.

Contact Alex Schriener if you have any questions on the topic. Alex has 30 years of experience in the geothermal industry as a resource manager and geologist. He has managed development and exploration projects in some of the nation's largest geothermal areas and has completed exploration projects in the U.S., Asia and Central America. He can be reached at 800-924-7015.

—Alexander Schriener, Jr., PG

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