Low-Temperature and Coproduced Resources

Low-temperature and coproduced resources represent a growing sector of hydrothermal development in the geothermal industry. Considered nonconventional geothermal resources below 150°C (300°F), these applications can bring valuable returns on investment in the near-term, using unique power production and resource optimization methods.

Low-Temperature Resources

Increasingly, low-temperature resources—once used predominantly for direct-use applications such as heating, fisheries, and industrial processes—can now also be used for power generation in suitable conditions. Low-temperature technologies have the potential to utilize geothermal resources from across the nation, expanding geothermal power potential beyond the western United States.

Coproduced Resources

Coproduced resources use hot fluid—a by-product of oil, gas, and other material harvesting processes—to generate electricity. While the quality of the resource depends on water volume and temperature, these technologies have the potential to extend the economic life of oil and gas fields.

Geothermal Desalination

Geofluids and the coproduced fluids from Oil and Gas operations can be high salinity. Due to their limited potential for reuse, operators incur high costs for disposal or reinjection. Geothermal has the potential to address both energy and fresh water needs. Geothermal desalination has the potential to reduce the volume and cost of fluid requiring disposal by treating produced fluids to generate a purified water stream. Thermally driven processes, such as forward osmosis, are ideal for desalination using the heat within the fluid to drive the water purification treatments.

Visit the Geothermal Technologies Office (GTO) website at **geothermal.energy.gov** for more information, or contact **geothermal@ee.doe.gov**.

Dixie Valley Bottoming Binary Plant: Terra-Gen was funded by the American Recovery and Reinvestment Act of 2009 to demonstrate the technical and economic feasibility of electricity generation from nonconventional geothermal resources of 223°F, employing the first commercial use of a supercritical cycle at a geothermal power plant inlet temperature of less than 300°F. Since September 2012, the plant has been online and producing 6 MW gross.

Geothermal Value-Added Technologies

The U.S. Department of Energy's (DOE) Geothermal Technologies Office (GTO), in partnership with DOE's national laboratories, universities, and small businesses, conducts research, development, and demonstration projects throughout the United States on low-temperature and coproduced geothermal resources. Recent funding opportunities have enabled GTO to support work that extends into sedimentary basins, including geothermal resources colocated within oil and natural gas fields. GTO strives to demonstrate innovative technologies that will lead to advanced geothermal energy use and electricity production in these currently underutilized resource areas.

In the power generation cycle, low-temperature geothermal resources can be challenging because the highest temperature has a very strong effect on overall efficiency. However, these resources are widely available, and with newer technologies, unit installations have doubled in the United States in the last 15 years.

In addition, there are numerous applications for low-temperature geothermal energy beyond power generation, including space heating and cooling, water purification, and radiant heating. The Office is also looking at the potential for mineral recovery from geothermal fluids. These and other direct use low-temperature activities continue to gain ground in the United States.

Because they are so plentiful, low-temperature resources have the potential to make a significant contribution to the national geothermal portfolio. The U.S. Geological Survey is currently in the process of updating their assessment of untapped low-temperature geothermal resources in the United States and should have results in fiscal year 2016.

Value Proposition

The GTO is exploring opportunities to partner with Industry to deploy binary systems in operating commercial oil and gas (O&G) fields.

GTO Provides:

- Units at low/nominal cost (subject to final contract)
- Funds for minimally invasive and fast installation
- Necessary O&M of the unit

Industry Partner Provides:

- Site Access for installation and contingency operations
- Shared information on coproduced water volumes, temperature, flow rate, fluid chemistry, and power production and operability
- Design and engineering of the field (for cost estimate)
- Clearly defined site ownership/control

Technology Benefits of Low Temperature Power Production Units

- Capacity range from 50 kW to more than 10 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 adaptable to higher output when more generation

Project Highlights

Idaho National Laboratory
Produced water from oil and gas operations is commonly handled as a waste product requiring treatment and/or disposal at considerable cost. Successful implementation of thermally driven forward osmosis (FO) would reduce water disposal costs, and produce a purified water having market value in industrial, agricultural, or potable applications. The objective of this project is to demonstrate that it is technically viable to utilize low temperature geothermal resources to provide the energy necessary for FO water treatment, and to assess the economic feasibility of doing so.

Southern Research Institute (Southern)
Working to develop an innovative Geothermal Thermoelectric Generation (G-TEG) system specially designed to both generate electricity and extract high-value lithium from low-temperature geothermal brines. The proposed system will provide large quantities of previously inaccessible baseload renewable electricity to the grid, with a disruptively low-power, generation-specific capital cost of < $2,000/kWe, as well as a high-value lithium recovery system that could decrease costs 20-50% over current state-of-the-art.

SRI International
Preparing new advanced ion-exchange resins chemically designed to selectively bind lithium and manganese ions. The resins will be based on ion-imprinted polymers chemically designed to mimic the recognition properties of biological receptors. The objective of this project is to develop a new generation of highly selective low-cost ion-exchange resins that will separate metals from geothermal fluids more efficiently than current processes.

Lawrence Berkeley National Laboratory
Combining emerging capabilities in synthetic biology and materials science with expertise in geothermal systems to innovate a new technology that could address the most critical aspect of material extraction from geothermal brine: the ability to selectively bind the strategic metal of interest. This approach has the potential to overcome previous limitations by using engineered microbes as a low-cost, selective, and reversible metal adsorbent. More broadly, if the technical goals of this proposal are successfully achieved, this technology will have broad-ranging implications including extraction of critical materials from on-shore fields and remediation of contaminated sites.

University of California
Providing critically needed, quality data quantifying the concentration and chemical speciation of REE in fluids from a range of U.S. geothermal fields. The research focuses on sampling sites within distinctive end-member geothermal systems (e.g., basin and range type, sediment-hosted, volcanic associated, magmatic) to elucidate the dominant controls on REE concentration in geothermal fluids (i.e. temperature, pH, salinity, complexing agents, and phase separation history). This will allow industry to better target geothermal systems for pilot plant development and will stimulate investment by reducing risk and quantifying reward.

Pacific Northwest National Laboratory
Developing a new type of biphasic working fluid for subcritical geothermal systems that utilizes microporous metal-organic solids as the primary heat carrier and heat transfer medium to support an Organic Rankine Cycle (ORC). This technology could increase the efficiency of binary-cycle plants and consequently increase geothermal power output.

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

Visit geothermal.energy.gov or email geothermal@ee.doe.gov.

DOE/EE-0853 • February 2016
Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 10% post consumer waste.