California Energy Commission - Identifying Priorities on Flexibility & Other Operational Needs for Existing Geothermal Plants

EPIC Pre-Solicitation Workshop: January 28, 2016

Derek Benson
Vice President of Business Development
EnergySource
February 4, 2016

EnergySource is the only company to build a new flash geothermal power plant in California over the last decade. Our state of the art geothermal facility is located on the Salton Sea in Imperial County, selling its output to the Salt River Project in Arizona.

Geothermal power is the workhorse of renewable power choices operating typically as baseload facilities with capacity factors in excess of 90 percent and providing the most greenhouse gas reductions of any new energy generation resource. Geothermal plants are traditional synchronous machines that include all of the voltage and frequency response features including inertia and governor response capabilities. California's geothermal resources are diverse. Clean steam is available in the Geysers where geothermal plants have demonstrated some ability to be flexible. In the Salton Sea area, the highly mineralized and corrosive geothermal brine limits dispatchability. California enjoys a portfolio of varying geothermal resources that can provide increased essential reliability services for the gird, balance the state's energy generation mix, reduce greenhouse gas emissions, with the smallest footprint in terms of habitat and wildlife protection of any energy generation technology.

To meet California's energy sector goal of 40% greenhouse reduction by 2030, the state's existing geothermal plants must continue their operations and new geothermal plants to balance the portfolio will reduce the need for flexibility[1]. Post 2030 when electricity demand starts to significantly increase due to electrification of the transportation sector and other end uses, a balanced energy portfolio that includes geothermal as a baseload resource is essential. The post 2030 grid must increasingly rely on renewables for their essential reliability services. Greenhouse gas emissions could actually increase over time if we are not careful to balance the grid with a diverse set of renewables while we increasingly rely on them for their essential reliability services, post 2030.

EPIC's efforts to address the current need for flexibility are important. Geothermal provides significant grid reliability benefits today, but the resource and technology can do more to be a good citizen of the grid. In addition to EPIC's efforts in RD&D, California's energy procurement process and/or market must recognize geothermal capacity and grid reliability benefits. Ultimately all energy resource options (fossil and renewable) will need to be evaluated on a level playing field for their varying benefits

[1] Slide numbers 18, 27, 36 titled "Steepest Ramp Day Dispatch (Winter)", "Highest Curtailment (Spring)", and "Highest Peak Load (Summer)" from "Low Carbon Grid Study Phase II Results – February 2016", from Low Carbon Grid Study (LCGS) www.lowcarbongrid2030.org.

and costs to ensure a balanced portfolio and continued progress on GHG emission reductions.

1. What are the main barriers and opportunities to operating geothermal power plants in flexible or load following mode? What are the main operational and maintenance cost drivers of geothermal power plants running in flexible or load following mode? What research and development activities should be conducted to address these barriers and cost drivers?

EnergySource is open to exploring partial dispatchability through governor response and curtailment options in future projects as long as the tradeoff between lost energy and added ancillary services is appropriately quantified and compensated. We can explore the technical ability to back off output, activate the governor, provide spinning reserve but only when a mechanism/tariff, business practices or contract provisions are put in place. Geothermal provides significant grid benefits that are unrecognized today, as an industry we could provide more in the future under a framework that considers and/or rewards grid reliability benefits.

New geothermal development across the State has stymied because many regulators view it as "out of market" in terms of price. Some of geothermal power's higher cost is due to tax treatment (state property and federal investment/production) but also because there is no consideration of capacity values, grid reliability benefits, integrations costs, GHG emission reductions, jobs, royalty and lease payments, fuel price hedge, or the smallest footprint in terms of habitat and wildlife protection compared to any other energy generation technology. EnergySource is hopeful that resource acquisition metrics are improved and that SB 350's return to integrated resource planning (IRP) results in new geothermal purchases across California.

While flexibility is important given increasing inverter based electricity purchases, lowering the cost of geothermal power should be a high priority for EPIC's next general solicitation because it reduces GHG emissions more than any other generation resource per MW of capacity and it balances the portfolio reducing the state's need for increased flexibility.

2. What other operational issues are limiting the success of geothermal power plants and what research and development activities should be conducted to address these issues?

The most significant operational cost driver of geothermal development at the Salton Sea is the highly mineralized and corrosive nature of the geothermal brine. EnergySource supports other's recommendations to evaluate lower cost chemicals / inhibitors to reduce scaling and to evaluate lower cost materials of construction that can provide adequate service in this corrosive environment.

EnergySource is focused on cost reduction through valuable co-product recovery. As EPIC's 2015-2017 Triennial Investment Plan finds "there are also opportunities in

managing brine and in cost-effective recovery of valuable co-products while addressing environmental concerns related to emission and water use".[2] The most significant opportunity to reduce the cost of geothermal power at the Salton Sea is to recover valuable co-products that help offset the high cost of construction and operation. EnergySource proposes that EPIC consider a phased demonstration and commercialization approach at its existing Featherstone Plant at Hudson Ranch. EnergySource has determined a process pathway that will enable the commercial recovery of world scale lithium resources present at the Salton Sea. However, this pathway is predicated on the recovery and beneficial use of silica and metals present in the brine. These steps must be integrated within the geothermal power operations and satisfactorily demonstrated to the commercial lending market. Demonstrated success would result in significantly lower cost geothermal and lower GHG emissions from integrated geothermal power facility and minerals/metals operation. Commercial deployment would result in billions of dollars in capital investment and associated property taxes, significant job growth, and increases to royalty and lease payments.

In advance of a potential EPIC geothermal cost reduction solicitation, EnergySource has partnered with the Colorado School of Mines (COS) and the National Renewable Energy Laboratory (NREL) and is currently working on a research application within the Department of Energy (DOE). This application would complement EPIC funding as it is focused on post recovery material upgrading efforts, not a pilot and commercial demonstration of metal and lithium recovery units. Please find the attached summary of our COM, NREL and EnergySource team.

3.What specific geothermal generation technologies or enabling technologies have significant potential to succeed in the California market and why? What further research and development is needed, if any, to accelerate the market adoption of these technologies or strategies?

As noted in question 2 above, EnergySource believes mineral extraction and recovery technology has the most significant potential to reduce the cost of geothermal power at the Salton Sea. While not specifically a "geothermal generation technology" it is an essential set of complementary technologies that has the potential to fundamentally change the market potential of both geothermal and lithium markets. EPIC funding in this space would greatly aid efforts to commercialize technologies under consideration.

4.What is the current potential or opportunities for expanding power generation from geothermal and boosting its role in meeting California's renewable energy goals? What are the main barriers preventing more geothermal power from being added to the grid in California?

[2] Page 85, "Application of the CEC for Approval of the Electric Program Investment Charge: Proposed 2015 through 2017 Triennial Investment Plan" dated April 28, 2014, Chapter 3: Applied Research and Development.

EnergySource efforts to reduce the overall cost of geothermal are focused on the recovery and processing of valuable minerals and metals from the Salton Sea's brine. As previously mentioned, the most significant opportunity to reduce the cost of geothermal power at the Salton Sea is to recover valuable co-products that help offset the high cost of construction and operation. Aside from lowering the cost of geothermal, unlocking a new sustainable minerals/metals industry on the Salton Seal will provide significant economic benefits, highly skilled jobs, GHG emission reductions and serve as a foundation for an energy storage industry in Imperial County.