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Fervo Energy Comment on the SB 100 Analytical Framing Workshop



14 November 2023

California Energy Commission
Energy Assessment Division
Docket Number 23-SB-100
715 P Street
Sacramento, CA 95814

Re: Senate Bill 100 Analytical Framework Workshop Comments

Fervo Energy (Fervo) appreciates the opportunity to comment on the California Energy Commission's October 31st SB 100 Analytical Framing Workshop. The workshop provided a great overview and opportunity to learn about Commission's approach to modeling SB 100 pathways. In response to the Analytical Framework presented at the workshop, Fervo is concerned that the Scenario Components omit consideration of expanding geothermal energy which is already being developed to enhance California's energy security, resource diversity and carbon-free grid reliability. Recent innovation and deployment of next-generation geothermal technology position geothermal to provide a key role in meeting SB 100's goals and should be included in the Commission's SB 100 analysis.

I. ABOUT FERVO ENERGY

Fervo is a developer of utility-scale enhanced geothermal systems (EGS) projects with lease holdings across the west, including California, and is actively developing projects to support the California grid, including the 400-megawatt Cape Station project in Beaver County, Utah. Cape Station will deliver its first phase of carbon-free electricity to the California grid in 2026 to support power purchase agreements (PPAs) with several California Load Service Entities (LSEs) in response to the California Public Utility Commission's order D. 21-06-035.

Fervo is at the forefront of utilizing advanced subsurface technologies and drilling techniques for the development of next-generation geothermal energy. With the successful completion of our utility-scale pilot project earlier this year, Fervo confirmed that EGS is commercially viable.¹ EGS opens access to a massive set of new subsurface heat resources and increases the capacity of projects to harness them. Larger projects and more abundant resources mean that EGS is rapidly increasing the geothermal industry's ability to deliver reliable power across the west.

The geothermal industry is currently undergoing a revolution of innovation. In part due to California's leadership on reliability and grid decarbonization, the next-generation geothermal technologies are available to play a critical role in supporting a reliable and affordable carbon-free grid. Fervo is excited to work with the Commission to integrate these new clean firm technologies and resources into the SB100 planning process to ensure a smooth and cost-effective pathway to a fully decarbonized grid.

II. INTRODUCTION

Fervo Energy commends the Commission's dedicated focus on planning for a zero-emission energy future. Despite this great effort, the Analytical Framework's approach to geothermal energy planning fails

¹ Norbeck, Jack; Latimer, Tim (2023): Commercial Scale Demonstration of a First of a Kind Enhanced Geothermal System. EarthArXiv. <https://doi.org/10.31223/X52X0B>

to capture the radical improvement in technical performance and resource availability accomplished with EGS technology. Over the last few years, major advances in EGS have put California on the threshold of a geothermal revolution. Utilizing tools and techniques deployed with great success by the oil and gas industry, EGS takes a modular and replicable approach which benefits from learning curves and deployment-led cost declines. Fervo is already experiencing these improvements with projects under development today, demonstrating that EGS is ready for large-scale deployment today and needs to be recognized for its ability to be the clean-firm foundation of the California grid.

III. DISCUSSION

Fervo seeks to collaborate with the Commission to incorporate technological advances in geothermal into the electricity system modeling in support of achieving SB100. Namely, Fervo is concerned that the omission of EGS from the scenario components will result in inadequate resource portfolio planning given the major developments in EGS. To reflect the innovation and availability of next-generation geothermal technologies, the Commission should update the Resource Diversification and Combustion Resource Retirement scenarios to include an increased role for geothermal energy from in-state and imported sources.

1. EGS is being deployed at scale today and demonstrating learning curve cost improvements and access to huge new potential resources.

One of the important innovations of EGS is the use of replicable well designs over large resource basins. This modular approach reduces resource risk and allows EGS to unlock cost and speed improvements previously unavailable to geothermal development. Geothermal drilling costs have often represented more than half of total project costs, so drilling performance improvement is critical to achieving durable cost reductions. The learning curves evidenced by Fervo’s development already (see Figure 1) indicate that EGS resources are different in kind from traditional hydrothermal resources and require an updated and separate modeling approach.

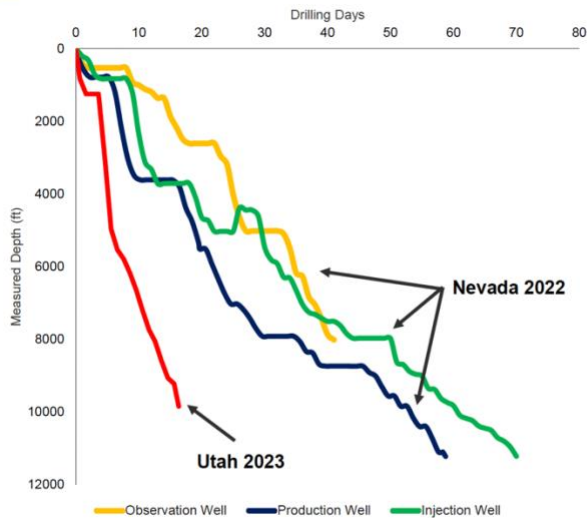


Figure 1: Drilling Days vs Depth Observed at Fervo’s EGS Projects

The learning curves experienced at Fervo’s projects, an 18%-20% reduction in drilling days between wells, are in line with, or ahead of, the projections set by the Department of Energy’s (DOE) Enhanced Geothermal Shot Initiative which anticipates EGS to become a crucial component of the United States’ clean energy portfolio. While the DOE supports a wide range of research and development in EGS, the

industry is already demonstrating progress ahead of schedule. EGS deployment and performance is exceeding DOE Earthshot expectations and indicate the need for more aggressive deployment forecasts which should be included in the SB 100 Analytical Framing.

The ability to access higher flow rates and heat capture from previously inaccessible subsurface thermal resources introduces a new paradigm in geothermal resource potential. Historically, geothermal resources have been limited to only the most favorable geologic hot spots. The challenge of tapping these specific subsurface reservoirs led to a high rate of “dry holes” and poses a challenge commercial geothermal development. Fervo’s EGS technology overcomes these barriers by significantly improving the repeatability and predictability of geothermal projects.

The cost declines experienced through project deployment, and the massive new resources available for EGS development put California on the cusp of a geothermal boom. The Analytic Framework presented in the October 31, 2023 workshop ignores this progress and excludes consideration of the role that expanding geothermal energy will play in California’s decarbonization efforts. Omitting geothermal across scenarios greatly undervalues the significant growth seen from EGS deployment and fails to give California a robust framing to meet clean electrification goals by 2045.

2. EGS is benefitting from technology transfer which has greatly catalyzed the commercialization of this emerging technology.

Despite recent progress, EGS is still considered an early-stage technology. However, unlike many nascent technologies, EGS does not rely on the invention of a new and unproven widget. Instead, EGS applies a suite of technologies already proven and perfected in other subsurface applications. This approach dramatically reduces technology risk, and as shown by Fervo’s successfully operating commercial pilot, means that EGS has achieved a Technology Readiness Level 8.² EGS is ready to provide clean-firm capacity at scale and on a timeline relevant to the PSP. With no significant fundamental technical risks remaining, the focus must now be on consistency, replicability, and cost reduction which are all significantly bolstered by accurate modeling and procurement.

Fervo’s learning journey in demonstrating EGS has drawn on the vast reservoir of knowledge accumulated in the oil and gas industry. Drawing insights from the experiences, innovations, and techniques honed by the huge portfolio of wells drilled by oil and gas sector, Fervo identified opportunities to adapt these learnings to the unique challenges presented by geothermal energy. Fervo’s approach to geothermal energy development relies on many of the same technologies that enabled the North American shale revolution including 1) horizontal drilling to increase the contact area with the geothermal reservoir; 2) multistage completions to increase flow rates and heat transfer efficiency; and 3) distributed fiber optics for monitoring, characterization, and downhole flow control. These techniques have proven successful when applied and optimized in higher-temperature geothermal wells and more challenging geologies.

Fervo’s approach serves as a compelling testament to the potential that arises from the strategic merger of knowledge across industries. By transposing innovations from the oil and gas sector into the geothermal landscape, Fervo Energy is orchestrating a dynamic interplay of technological transfer and transformation. California’s long history with subsurface development has built a skilled workforce and

² The Department of Energy’s Technology Readiness Level Scale defines TRL 8 as an “actual system completed and qualified through test and demonstration.” Fervo’s commercial scale pilot, Project Red, is online, producing energy and satisfies those real-world conditions at scale. <https://www.directives.doe.gov/directives-documents/400-series/0413.3-EGuide-04/@@images/file>

robust supply chain available to support the rapid deployment of new geothermal. Fervo looks forward to collaborating with the Commission to better integrate our learnings with modeling in the future. In a rapidly evolving energy landscape, where EGS is poised to play a pivotal role in achieving clean and sustainable energy goals, Fervo Energy's approach sets a precedent for adapting and optimizing technology transfer to accelerate the growth of emerging technologies like EGS in California.

3. Fervo is developing clean firm resources to meet California's pre-2030 resource needs today and encourages continued support for long lead time resources to meet the needs of the coming decades.

Fervo is rapidly scaling-up its development of next-generation geothermal projects to serve the California grid. The first greenfield EGS project in the world, called Cape Station and located in Beaver County, Utah, will provide 400-megawatts of energy and will start phase one operations in 2026. All of Cape Station's capacity will be used to power Californian customers. Next-generation geothermal technology is quickly reaching widespread commercialization and is poised to expand through the next two decades. As the Commission studies the optimal pathways to achieve SB100's goals, it must include the resource diversification and clean firm reliability benefits from geothermal – especially in modeling scenarios that highlight the need for new technologies and faster fossil energy retirements.

The need for clean firm resources will only increase into the next decade, and the state must start planning for them today to ensure their availability. SB 100 increases the need for clean firm generation and geothermal projects are ready to provide it. The geothermal industry has long provided clean, reliable power in California and with modern technology, unprecedented innovation and a new wave of project development, geothermal energy is deserving of a prominent role in the Commission's SB 100 planning framework.

IV. CONCLUSION

Fervo Energy recognizes that the EGS field is rapidly developing and will take time to fully integrate into California resource planning. However, as currently proposed, the Commission's approach to SB100 analysis does not include material consideration of new geothermal resources at all. With already proven EGS technology, the resource potential of geothermal is considerably larger than previously thought, and should be reflected in the SB 100 Analytical Framing scenario design. We appreciate the Commission's prior leadership in supporting and incorporating new clean energy technologies, and we are excited to continue that work with next-generation geothermal. We welcome open communication and coordination on these important issues and look forward to working together with the Commission to achieve an affordable, reliable, and carbon-free future.



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