BEFORE THE PUBLIC SERVICE COMMISSION OF UTAH

PacifiCorp's 2021 Integrated Resource Plan	Docket No. 21-035-09

COMMENTS OF FERVO ENERGY COMPANY

Introduction

Pursuant to the Scheduling Order issued by the Public Service Commission of Utah ("Commission") in this proceeding on September 20, 2021, Fervo Energy Company ("Fervo") is pleased to submit comments on the Integrated Resource Plan filed by PacifiCorp d/b/a Rocky Mountain Power ("PacifiCorp") on September 1, 2021 ("2021 IRP"), as amended by the errata filed on September 15, 2021. Fervo is a utility-scale geothermal energy developer working to build, own, and operate geothermal energy assets that provide 24/7, zero-emission power to Western grids.

Fervo commends PacifiCorp for the steps it is taking to reduce the greenhouse gas emissions of its portfolio over time, especially through the inclusion of increased renewable energy capacity. Fervo also recognizes the complexities of prioritizing clean energy while maintaining reliability, resiliency, and affordability for customers. While the 2021 IRP takes aggressive steps to increase clean energy generation, storage, and transmission in Utah, by excluding geothermal energy, PacifiCorp's IRP misses a meaningful opportunity to fulfill PacifiCorp's customer-centered vision of delivering affordable, reliable, clean power.

Fervo believes that this exclusion has been made unwittingly. While PacifiCorp endeavored appropriately to include geothermal generation in its supply side analysis, it did so using outdated information on the cost and resource potential of geothermal energy development in Utah. With that said, compliance with the Standards and Guidelines for Integrated Resource Planning before the Public Service Commission of Utah requires "[a]n evaluation of all present and future resources, including future market opportunities (both demand-side and supply

side), on a consistent and comparable basis."[1] Based on those principles, PacifiCorp should undertake an updated assessment of the geothermal resource in Utah, including an up-to-date review of the costs to produce geothermal.

As an increasing number of states accelerate coal retirements and grow renewable energy penetration on their grids, the value of firm, clean generating resources as a complement to variable renewable energies is becoming more and more clear.[2] As one of the resources best suited to provide a substantial amount of firm, clean capacity on a reasonable development timeline, geothermal energy's role is rapidly evolving.

With massive geothermal resources at reasonable depths across the state, well-established supply chains, and a plethora of oil and gas workers well-suited to work on geothermal development with limited reskilling, there is no better place for geothermal energy to play a meaningful role than in Utah. Acknowledging this, the U.S. Department of Energy chose Southwest Utah as the location for its Frontier Observatory for Research in Geothermal Energy ("FORGE") - a dedicated site where scientists and engineers are developing, testing, and accelerating breakthroughs in enhanced geothermal systems ("EGS") technologies and techniques.

In the following comments, Fervo provides details on updated cost and resource potential estimates for geothermal energy in Utah. With this information, PacifiCorp can more accurately model geothermal energy in future planning scenarios.

Geothermal energy can be provided at lower cost than modeled in the 2021 IRP

Greenfield capital expenditures

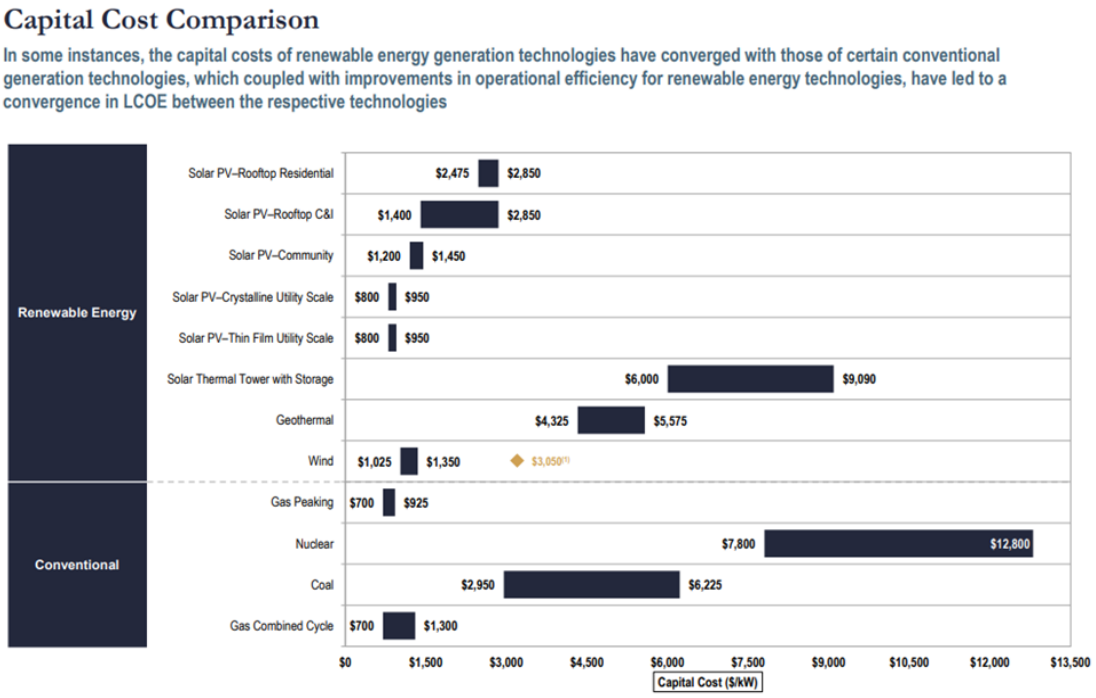
Per PacifiCorp's responses during the technical conference held on January 19, 2022, the 2021 IRP analysis utilized capital costs for both dual flash and greenfield binary geothermal plants derived from a 2011 study examining the feasibility of expanding production at the Blundell geothermal plant. While these capital costs may

[1] Public Service Commission of Utah. In the Matter of Analysis of an Integrated Resource Plan for PacifiCorp. Docket No. 90-2035-01. Report and Order on Standards and Guidelines. June 18, 1992. https://pscdocs.utah.gov/electric/90docs/Report%20and%20Order%2090-2035-01%206-18-92.pdf

[2] See, e.g., Long *et al*., Clean Firm Power is the Key to California's Carbon-Free Energy Future, *Issues in Science and Technology*, National Academies, March 24, 2021. See also California Energy Commission (CEC), California Public Utilities Commission (CPUC), and California Air Resources Board (CARB), "2021 SB 100 Joint Agency Report Achieving 100 Percent Clean Electricity in California: An Initial Assessment," March 2021, CEC-200-2021-001, available at https://www.energy.ca.gov/sb100#anchor_report

have appropriately characterized the cost to develop geothermal energy in 2011, there have been significant technological advances in the 10+ years since that study, substantially lowering these costs.

Despite deploying different approaches to geothermal energy development, companies across the industry generally agree on the accuracy of financial advisory and asset management firm Lazard's levelized cost of energy ("LCOE") estimates published in 2021:[3]



The capital expenditure numbers cited in PacifiCorp's Supply Side Resource Table[4] are significantly higher than Lazard's estimates. In the most glaring scenario, the current capital required for a greenfield binary geothermal plant could be nearly 40% lower than modeled in the 2021 IRP (See Table 1).

[3] Lazard. Lazard's Levelized Cost of Energy Analysis—Version 15.0 Capital Cost Comparison. https://www.lazard.com/media/451905/lazards-levelized-cost-of-energy-version-150-vf.pdf

[4] PacifiCorp. Table 7.1 – 2021 Supply-Side Resource Table. 2021 Integrated Resource Plan. Page 172. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume%20I%20-%209.15.2021%20Final.pdf

Table 1. LCOE Estimate Comparison

Resource Description	PacifiCorp 2021 IRP Estimate		Lazard LCOE Estimate		Percent Difference	
	Total Capital Cost ($/kW)	O&M	Minimum ($/kW)	Maximum ($/kW)	Minimum ($/kW)	Maximum ($/kW)
Blundell Dual Flash 90% CF	$5,708	$1.16	$4,325	$5,575	-32%	-2%
Greenfield Binary 90% CF	$5,973	$1.16	$4,325	$5,575	-38%	-7%
Generic Geothermal PPA 90% CF	$0	$77.34	-	-	-	-

Capital costs for geothermal facilities are decreasing for a multitude of reasons, including, but not limited to, massive increases in drilling productivity caused by the shale boom and increased federal policy support for geothermal energy.

Geothermal PPA pricing

PacifiCorp's "Generic Geothermal PPA" price of $77.34/MWh[5] is also higher than an average of recently signed PPAs. Table 2 compiles geothermal PPAs with public pricing signed since 2019, with an average price of $68.63.

Table 2. Recent Geothermal Power Purchasing Agreements (PPAs)

Start Year	Power Purchaser	Producer	Plant	State	Price	Years	Capacity	Type	Source
2022	SCPPA (City of Glendale)	Open Mountain Energy	Whitegrass No1	NV	$67.5	25	3	New	[6]
2022	SCPPA (City of Glendale)	Open Mountain Energy	Star Peak Geothermal Energy Project	NV	$70.25	25	12.5	New	[7]
2022	Hawaii Electric Light Company	Ormat	Puna	HI	$70	30	46	Existing	[8]
2021	Monterey Bay Community Power	Ormat	Casa Diablo (CD4)	CA	$68	10	7	New	[9]

[5] PacifiCorp. Table 7.1 – 2021 Supply-Side Resource Table. 2021 Integrated Resource Plan. Page 172. https://www.pacificorp.com/content/dam/pcorp/documents/en/pacificorp/energy/integrated-resource-plan/2021-irp/Volume%20I%20-%209.15.2021%20Final.pdf

[6] Seidman, Lila. Geothermal energy contract set to boost Glendale's renewable portfolio by 11%. Glendale News-Press. February 27, 2020. https://www.latimes.com/socal/glendale-news-press/news/story/2020-02-27/geothermal-energy-contract-glendale-open-mountain-energy

[7] Seidman, Lila. Geothermal energy contract set to boost Glendale's renewable portfolio by 11%. Glendale News-Press. February 27, 2020. https://www.latimes.com/socal/glendale-news-press/news/story/2020-02-27/geothermal-energy-contract-glendale-open-mountain-energy

[8] Richter, Alexander. Ormat and local utility share details on new PPA for geothermal plant in Hawaii. Think Geoenergy. January 6, 2020. https://www.thinkgeoenergy.com/ormat-and-local-utility-share-details-on-new-ppa-for-geothermal-plant-in-hawaii/

Start Year	Power Purchaser	Producer	Plant	State	Price	Years	Capacity	Type	Source
2020	Silicon Valley Clean Energy (SVCE)	Ormat	Casa Diablo (CD4)	CA	$68	10	7	New	[10]
2019	SCPPA (Colton Electricity)	Ormat	Casa Diablo (CD4)	CA	$68	25	16	New	[11]
				Average	**$68.63**				

In future modeling scenarios, PacifiCorp should use pricing more reflective of current market conditions in order to compare geothermal's potential to other technologies "on a consistent and comparable basis",[12] in accordance with guidance from the Commission.

Geothermal resource potential in Utah is vast

In future modeling scenarios, PacifiCorp should consider the vast potential of geothermal energy in Utah to extend beyond producing hydrothermal resources like Roosevelt Hot Springs, currently powering the Blundell plant. Utah already has three generating geothermal plants in three separate basins and generates the third most geothermal power in the nation.[13]

While Roosevelt Hot Springs has long been considered Utah's leading geothermal resource, new technologies and drilling techniques have unlocked the development of a far wider range of resources. The FORGE has taken meaningful steps to prove the feasibility of extracting heat and producing power from reservoirs with lower natural permeability than traditional hydrothermal reservoirs. This approach to extracting geothermal energy from unconventional resources is unlocking massive resource potential across Western Utah.

[9] Geothermal Rising. Geothermal Power Purchase Agreements on the Rise. https://geothermal.org/our-impact/stories/geothermal-power-purchase-agreements-rise
[10] Geothermal Rising. Geothermal Power Purchase Agreements on the Rise. https://geothermal.org/our-impact/stories/geothermal-power-purchase-agreements-rise
[11] Ormat Technologies. Ormat Signs a 25-Year PPA With SCPPA for Its Casa Diablo-IV Geothermal Power Plant in California. Globe Newswire. March 20, 2019. https://www.globenewswire.com/news-release/2019/03/20/1757706/26372/en/Ormat-Signs-a-25-Year-PPA-With-SCPPA-for-Its-Casa-Diablo-IV-Geothermal-Power-Plant-in-California.html
[12] Public Service Commission of Utah. In the Matter of Analysis of an Integrated Resource Plan for PacifiCorp. Docket No. 90-2035-01. Report and Order on Standards and Guidelines. June 18, 1992. https://pscdocs.utah.gov/electric/90docs/Report%20and%20Order%2090-2035-01%206-18-92.pdf
[13] U.S. Energy Information Administration. Geothermal Explained. 2020. https://www.eia.gov/energyexplained/geothermal/use-of-geothermal-energy.php

Based on the new data points derived by FORGE and the robust contracting for geothermal resources in the West, PacifiCorp should consider recent advances in geothermal technology and evaluate its potential when compared to other resources "on a consistent and comparable basis",[14] in accordance with guidance from the Commission.

Additionally, the Utah Geological Survey ("UGS") has documented the presence of "hot sedimentary aquifer" style resources in Utah, the largest of which is the Great Basin Thermal Regime. The UGS has noted these resources are ripe for horizontal drilling and other enhanced permeability techniques. There is also lower drilling risk in these reservoirs compared to traditional hydrothermal reservoirs as a result of their homogeneous geology. Conservative estimates suggest the power potential in this basin is on the order of hundreds of MW.[15]

Overall, the U.S. Geological Survey (USGS) has estimated, with a 95% level of confidence, that Utah's undiscovered hydrothermal geothermal resource is 334 MWe, and its enhanced geothermal systems potential is 32,600 MWe.[16]

Conclusion

The cost of geothermal energy is declining, and new technology is unlocking greater geothermal potential than ever before. In addition to its ability to provide 24/7 clean power to Utah, there are clear economic and job creation benefits to geothermal energy development. A vast majority of quality geothermal resources in Utah exist on state and federal lands, and lease and royalty payments would provide financial benefit to the government. Also, geothermal energy development requires the drilling and completion of a substantial number of wells, so the construction workforce needed by the geothermal industry has a nearly identical skillset to that of oil and gas.

The geothermal resource potential exists. New innovation and technology are driving unprecedented cost reductions across the industry. Private investment is flocking to companies across the geothermal energy value chain as commercial and industrial customers increasingly demand clean energy solutions that more closely align

[14] Public Service Commission of Utah. In the Matter of Analysis of an Integrated Resource Plan for PacifiCorp. Docket No. 90-2035-01. Report and Order on Standards and Guidelines. June 18, 1992. https://pscdocs.utah.gov/electric/90docs/Report%20and%20Order%2090-2035-01%206-18-92.pdf

[15] Allis, Rick et al. Characterizing the Power Potential of Hot Stratigraphic Reservoirs in the Western U.S. PROCEEDINGS, Thirty-Eighth Workshop on Geothermal Reservoir Engineering. 2013. https://geology.utah.gov/docs/geothermal/ngds/supplemental/reports/Stanfordv38_Allis_etal.pdf

[16] U.S. Geological Survey. Assessment of Moderate- and High-Temperature Geothermal Resources of the United States. 2008. https://pubs.usgs.gov/fs/2008/3082/pdf/fs2008-3082.pdf

production and consumption of procured clean energy. Similarly, the policy landscape is changing in favor of 24/7 clean energy solutions: President Biden's December 2021 Executive Order targets 100 percent carbon-free energy for federal infrastructure by 2030, with half of that energy procured on a 24/7 basis.[17] This procurement in particular is expected to catalyze significant development of new clean energy sources. There has never been a better time to capitalize on geothermal energy development in Utah, and PacifiCorp should include geothermal in its future integrated resource planning.

Thank you for your consideration of these comments. We would be happy to discuss further at any point.

Dated this 4th day of March 2022.

Respectfully submitted,

/s/ Laura Singer

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Laura Singer
Fervo Energy Company
609 Main Street
Houston, TX 77002

Telephone: (917) 648-3929
laura.singer@fervoenergy.com

[17] The White House. FACT SHEET: President Biden Signs Executive Order Catalyzing America's Clean Energy Economy Through Federal Sustainability. December 8, 2021. https://www.whitehouse.gov/briefing-room/statements-releases/2021/12/08/fact-sheet-president-biden-signs-executive-order-catalyzing-americas-clean-energy-economy-through-federal-sustainability/