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Comment on behalf of World Resources Institute

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WORLD RESOURCES INSTITUTE

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Washington, DC 20002

Dear Commissioners,

Thank you for the opportunity to provide comments on the California Energy Commission's Integrated Energy Policy Report (IEPR) update and the role that geothermal energy can play in California's energy mix. The following comment is submitted on behalf of the World Resources Institute (WRI), a nonprofit research organization focused on global challenges at the intersection of climate change and sustainable development. This comment focuses on the potential for geothermal energy to provide important grid services while building a clean, affordable, and reliable energy system in California, and on priority steps the Commission and other California entities can take to responsibly scale the development of geothermal.

We are grateful for the Commission's decision to explore strategies to leverage geothermal's enormous potential to provide reliable, clean energy to California's people and businesses. By including geothermal in the Commission's medium and long-term energy resource planning, utilities, project developers, and local policymakers will benefit from greater predictability at the state-level and will be able to plan their investment and policy decisions accordingly.

Geothermal energy already plays an important role in California's electricity grid, accounting for 5% of California's annual in-state electricity generation. And, with the advent of next-generation geothermal technologies like enhanced geothermal systems (EGS) and closed-loop geothermal, California is sitting on gigawatts of clean firm power. Given geothermal energy's grid resilience benefits, its low land use footprint, the economic and workforce transition opportunities, and the massive amount of energy that next-generation geothermal technologies can unlock in California, geothermal energy should be prioritized as a key pillar to helping California meet its ambitious climate mitigation and clean energy transition goals.

Benefits of Geothermal

Geothermal provides important grid services

As a dispatchable source of around-the-clock electricity, geothermal energy can provide an important supplement to other important clean energy resources. These benefits in providing both local and system reliability were documented in depth in the Commission's 2025 and 2026 SB 243 reports on firm, zero-carbon resources. Independent modeling by the Clean Air Task Force[1] and

[1] See the presentation by Wilson Ricks, Clean Air Task Force, at the July 9th workshop.

Stanford researchers[2] demonstrate that developing EGS in California reduces state electricity costs, transmission needs, and the total grid system size. It is important to note that beyond providing baseload power, geothermal can provide critical grid services such as frequency response and black start capability that other clean resources cannot (see figure below). Geothermal can also be used for important storage applications that can further bolster grid resilience.[3]

Figure 2. **Reliability services provided by clean firm power and other energy technologies**

	Voltage control	Frequency control					Other	
	Voltage control	Inertial response	Primary frequency response	Regulation	Load following	Spinning reserve	Black start capability	On-site fuel inventory
Next-generation geothermal	●	●	●	●	●	●	●	N/A
Natural gas CT	●	●	●	●	●	●	●	●
Natural gas w/ CCS	●	●	●	●	●	●	●	●
Coal w/ CCS	●	●	●	●	●	◐	●	●
Hydropower	●	●	●	●	●	●	●	◐
Nuclear	●	●	○	○	○	○	○	●
Solar	●	◐	●	◐	◐	◐	○	N/A
Solar + battery	●	●	●	●	●	●	◐	N/A
Wind	●	●	●	◐	◐	◐	◐	N/A
Wind + battery	●	●	●	●	●	●	◐	N/A

● Exhibits attribute ◐ Partially exhibits attribute ○ Does not exhibit attribute

Notes: CCS = carbon capture and storage; CT = combustion turbine; N/A = not applicable. This is not an exhaustive list of such services.
Sources: WRI authors, adapted from NERC (2023) and EPRI (2015) and supplemented with personal communications with industry experts.

Source: WRI 2024, Next-Generation Geothermal: Considerations and Opportunities for Responsible Development

Geothermal utilizes existing domestic supply chains and workforces

Geothermal energy projects can also leverage skills, workforces, and supply chains that have historically served the oil and gas industries, making use of robust domestic workforces and supply chains and potentially providing future employment and economic benefits for communities that are dependent on the fossil fuel sector for employment.

California has taken commendable steps to facilitate geothermal electricity production

[2] See the presentation by Dimitri Saad, Stanford University, at the July 9th workshop.
[3] See the presentation by Eva Schill, Lawrence Berkeley National Laboratory, at the July 9th workshop for examples of pilots underway on thermal energy storage.

California has long been the geothermal powerhouse of the U.S. and the world, thanks in large part to The Geysers. California facilities make up 72% of all currently installed U.S. geothermal capacity.

Building on this geothermal legacy, California has taken significant steps in recent years to further geothermal development. California procurement orders have been perhaps the single largest policy action catalyzing the current next-generation geothermal project pipeline. The California Public Utilities Commission (CPUC) issued the 2021 Mid-Term Reliability Order calling on load-serving entities to procure 11.5 GW of new generation, 1 GW of which must be "firm resources with zero on-site emissions" defined as having a capacity factor of 80% or higher. Geothermal developers were the primary sources used to fulfill this mandate (for example, Southern California Edison is the largest offtaker at Fervo's Cape Station project in Utah). CPUC issued another procurement order in February 2026 requiring 6 GW of new generating capacity, one-quarter of which (1.5 GW) must be met by clean firm resources.

The California legislature has also enacted significant legislation on this topic. This includes AB 1373 (2023) which gives the Department of Water Resources (DWR) centralized procurement authority up to 1 GW of energy from enhanced geothermal systems as well as AB 1359 (2024) which allows geothermal drilling permit applicants to request that county governments serve as the lead agency for CEQA review. In the 2026 state budget, the legislature approved $10M in funding for the "exploration, mapping, characterization, and development of geothermal resources."

Other actions to improve California's ability to build clean energy projects to meet climate goals impact geothermal. This includes giving the Commission the authority to serve as the sole permitting authority for thermal power plants over 50 MW, small power plant exemptions for plants under 100 MW, and as the lead agency for CEQA.

Challenges to Scaling Next-Generation Geothermal in California

This recent leadership is laudable, but key barriers remain and more can be done to bring expanded geothermal development to California.

Developing large-scale geothermal projects in California is currently hindered by a number of policy, regulatory, financial, and technical barriers. Some of these are not unique to California — for example, project financing is the key barrier facing next-generation geothermal developers — but others, like permitting and interconnection, are particularly acute in California.

1. **Permitting complexity and bottlenecks**

Developers intending to construct and operate geothermal wells in California will need to obtain approximately 12 permits from several different government agencies and utilities to discover, explore, and utilize geothermal resources — the approval of which can take more than two years in many cases.[4] While the purpose of these rigorous permitting requirements — to minimize and

[4] The number of permits estimated for geothermal projects as well as the timeline for permitting approval comes from Caity Smith's presentation on behalf of XGS Energy during the Commission's July 9th workshop, This timeline is roughly in

avoid adverse negative environmental and human health impacts — is essential, the long project development timelines caused by the current permitting process may be one factor inhibiting the growth of the geothermal industry in California.

The National Renewable Energy Laboratory (now the National Laboratory of the Rockies) estimated permitting delays could result in losses between $64 million to $227 million in potential revenue per project.[5] Additionally, the long timelines associated with the permitting process are not necessarily related to improving the rigor of the environmental protections. Analysis by the National Renewable Energy Laboratory (now the National Laboratory of the Rockies) partially attributed the long timelines to non-substantive issues with geothermal permitting such as the number of permitting authorities in California, the lack of staff capacity at these permitting authorities, and the costs of coordination throughout the permitting process.[6]

2. High upfront costs of exploratory well-drilling

Geothermal projects are long-lead time, capital intensive projects which have unique financing challenges due to the multiple drilling campaigns needed. The geothermal project development process has multiple distinct stages that each carry their own challenges in securing necessary approvals and financing. These include: lease and resource right acquisition, geothermal resource confirmation drilling, exploration drilling, appraisal drilling, development drilling, and power plant construction and interconnection.[7] These challenges are exacerbated by the upfront nature of these costs with uncertain, long payback periods. Targeted funding instruments can help bridge these financing challenges by reducing risks, particularly during the appraisal drilling stage, by offering loans and drilling insurance programs.[8]

3. Transmission and interconnection

One large challenge to geothermal energy development is the sequencing and delays for grid interconnection. This is a challenge for energy development in general, but is particularly challenging for geothermal energy, given the high upfront costs of exploration and resource development combined with the uncertainty of individual wells. According to the Center for Public Enterprise in a recent report, "access to transmission and interconnection is the most likely reason that an EGS project would come online more slowly than projected."[9] Given the long queues for

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line with other estimates of permitting timelines for California geothermal projects conducted by the Idaho National Laboratory and the National Laboratory of the Rockies.

[5] Neupane and Adhikari. 2022. Economic Impact of Permitting Timelines on Geothermal Power in California, Nevada, and Utah. Idaho National Laboratory.

[6] Levine et al. 2022. Non-Technical Barriers to Geothermal Development in California and Nevada. National Renewable Energy Laboratory.

[7] Mike O'Connor, Mountain West Geothermal Consortium, elaborated on these stages and risks in further detail during the July 9th workshop. We agree with the recommendations laid out in that presentation to address these challenges, including publicly funded risk sharing programs to de-risk appraisal drilling.

[8] Patrick Mirick, Pacific Northwest National Laboratory, identified financing as the primary barrier to scaling geothermal and elaborated on actionable steps to address these barriers. We found these conclusions insightful and recommend the Commission explore especially the action to "use government-backed loans to lower discount rates", which was found to have high benefits.

[9] Smith et al. 2026. The Firm Frontier. Center for Public Enterprise.

grid interconnection, requests to connect must be submitted early in the development process — often during the exploratory phase. This sequencing presents challenges for both geothermal developers and grid planners and can be improved by identifying priority sites with surplus transmission capacity.

Recommendations

To ensure California can fully seize the opportunity presented by next-generation geothermal technologies, there are key actions that policymakers and regulators in California can take.

1. **Finalize California Geological Energy Management (CalGEM) regulations for geothermal wells**

CalGEM has released two discussion drafts, in 2018 and 2022, proposing updates to regulations for geothermal wells. A legislative bill, AB 527 (2025), passed the Legislature but was vetoed by the Governor in 2025 that would have required issuance of final regulations by January 1, 2029. The discussion drafts and required actions in AB 527 provide a solid starting point for finalized regulations covering seismic risks, well construction standards, well stimulation fluid composition, fracture propagation, and groundwater protection. Finalizing these CalGEM regulations can provide needed regulatory certainty for developers and build public trust that geothermal activities are conducted according to updated, best-fit regulatory practices that reflect current industry practices and next-generation geothermal development characteristics.

The Nevada Division of Minerals issued proposed regulation amendments to geothermal injection procedures in 2026. These regulations can be informative on how other states are updating their regulations to reflect next-generation geothermal practices.[10]

2. **Streamline environmental permitting and create a unified state strategy for geothermal**

A unified geothermal resource management plan can address barriers across these challenges, including by conducting coordinated subsurface resource assessments,[11] priority site identification, grid planning and interconnection, and environmental protections and permitting. A

[10] These proposed regulations cover a number of topics similar to those in CalGEM discussion drafts, including: updated fees; additional information disclosures for stimulation and injection activities; updated water quality monitoring; requirements on seismicity monitoring and use of an Induced Seismicity Monitoring Plan with a "traffic light" (green, amber, red) system; and updating well integrity and casing standards including the installation of intermediate casing and conducting pressure testing of production casing.

[11] Comments by Jeremy Lancaster, California Geological Survey, at the July 9th workshop elaborated on existing efforts underway and the potential for data digitization of existing subsurface data to advance geothermal resource characterization.

previously introduced bill – AB 526 (2025) – would have required a strategic plan for in-state geothermal energy and provides examples of potential agency activities.[12]

More streamlined, consolidated permitting could improve timelines and increase predictability for geothermal developers. The Commission's SB 243 reports have documented specific permitting barriers and recommendations to consolidate environmental reviews, and provide a guidebook of potential actions to take (see especially Table 40, Appendix E in the 2025 report). Previously mentioned analyses by NLR have recommended consolidating the disparate permitting authorities and permit applications into a more "holistic, integrated" environmental review process that includes interagency memoranda of understanding or geothermal regulatory working groups. California has made progress toward this objective recently, with the advent of the CEC opt-in permitting program through the passage of AB 205 and the classification of geothermal power plants as environmental leadership development projects through AB 531, both of which allow for streamlined and consolidated permitting.

Carefully considered exemptions can reduce redundant regulatory burdens while not sacrificing environmental protections. At the federal level, the Bureau of Land Management (BLM) has issued two categorical exclusions under the National Environmental Protection Act (NEPA) for geothermal resource confirmation activities and exploration operations. These administrative categorical exclusions were built on substantiation reports that included retrospective reviews of past agency exemptions, and confirmed findings of no significant impact for the covered activities. These actions provide examples of how data-driven, agency-led approaches to reduce redundant environmental reviews can streamline permitting timelines while ensuring environmental protection standards are met.

Further actions that the state could take to streamline permitting of geothermal wells include producing a roadmap for geothermal environmental permitting, increasing staff capacity for processing permit applications, and creating a centralized permitting committee or point of contact for permitting coordination.[13]

[12] These include identification of priority sites, establishment of a state lands leasing goal, development of a permitting roadmap, assessment of transmission needs and inclusion of geothermal as a long lead time resource in interconnection and transmission planning, and other items.

[13] This latter approach is being implemented by New Mexico's Energy Conservation and Management (ECAM) division of the state's Energy, Minerals, and Natural Resource Department. ECAM manages the development and permitting of geothermal wells and serves as the liaison to the U.S. Department of Energy.