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Clean Air Task Force - Response to EPIC 5 Research Concept Proposal

Please find attached for Clean Air Task Force's response to the EPIC 5 Research Concept Proposal form. We look forward to the development of EPIC 5 and working with the CEC throughout this process. Thank you for your consideration.

Additional submitted attachment is included below.

Electric Program Investment Charge 2026–2030 (EPIC 5) Research Concept Proposal Form

The California Energy Commission (CEC) is currently soliciting research concept ideas and other input for the Electric Program Investment Charge 2026–2030 (EPIC 5) Investment Plan. For those who would like to submit an idea for consideration, please complete this form and submit it to the CEC by **August 8, 2025**. More information about EPIC 5 is available below.

To submit the form, please visit the e-commenting link: https://efiling.energy.ca.gov/EComment/ECommentSelectProceeding.aspx and select the Docket **25-EPIC-01**. Enter your contact information and then use the "choose file" button at the bottom of the page to upload and submit the completed form. Thank you in advance for your input.

1. Please provide the name, email, and phone number of the best person to contact should the CEC have additional questions regarding the research concept:

   Ashley Arax, Senior California Policy Manager
   aarax@catf.us
   (530) 750-6943

2. Please provide the name of the contact person's organization or affiliation:

   Clean Air Task Force

3. Please provide a brief description of the proposed concept that you would like the CEC to consider as part of the EPIC 5 Investment Plan. What is the purpose of the concept, and what would it seek to do? Why are EPIC funds needed to support the concept?

There are two concepts which we would like to propose for CEC consideration as part of the EPIC 5 Investment Plan: (1) a next-generation geothermal testbed and (2) statewide geothermal mapping and resource characterization.

(1) **An in-state next-generation geothermal testbed**. The U.S. Department of Energy (DOE) funded FORGE testbed in Utah has been remarkably successful. The site published essential data and analyses that reduced technical risk and improved subsurface characterization,

and these breakthroughs enabled a private company to move forward with a commercial project directly adjacent to the FORGE site that will produce at least 500 MW of power (most of which will be delivered to California utilities). Creating a similar testbed in California could have a similarly catalytic effect on in-state geothermal development – ideally focused on higher-temperature geothermal energy in order to capture opportunities to drive down costs through novel applications and higher energy output.

(2) **Statewide geothermal mapping and resource characterization**. Led by the CA Geological Survey, this work would develop a comprehensive statewide map of geothermal potential (including potential at temperatures in excess of 400˚C, often found at depths greater than 7km and in dry rock conditions). The research should include as much information as can practicably be gathered on subsurface characteristics (temperature gradient, rock type and permeability, fault structures and stress regime, and hydrology and fluid chemistry) and might also include surface-level considerations such as proximity to grid infrastructure to better site future transmission corridors to upcoming electricity demand centers, local workforce capacity, and industrial capabilities. This combined geoscientific and logistical assessment would help determine which areas of the state are best suited for geothermal energy development, derisking geothermal development throughout California and encouraging private companies to site projects in the state.

The proposed concepts are independent of each other and could be included in the EPIC 5 Investment Plan individually or as a group, but both concepts address the collective action problem related to data collection and sharing. Gathering data about geothermal technologies and the subsurface benefits the entire geothermal community. However, precisely because the benefits are spread across the geothermal industry, private companies are not incentivized to invest in comprehensive efforts of this type. EPIC is well-positioned to support this type of initiative, which would help unlock geothermal energy – one of the lowest-cost clean firm resources available – across California, increasing energy reliability and affordability for ratepayers (as discussed in more detail below).

The geothermal testbed concept would be the most impactful use of EPIC funds for next-generation geothermal energy development in California, but it would cost more than the statewide mapping work. CATF encourages EPIC 5 Investment Fund administrators to consider the testbed concept, but we have proposed concept (2) as an additional or alternate lower-cost option.

4. In accordance with Senate Bill 96[i], please describe how the proposed concept will "lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals." For example, what technical and/or market barriers or customer pain points would the proposed concept address that would lead to increased adoption of clean energy technology or innovation? Where possible, please provide specific cost and performance targets that need to be met for increased industry and consumer acceptance. For scientific analysis and tools, provide more information on what data and information gaps the proposed concept would help fill, and which specific parties or end users would benefit from the results, and for what purpose(s)?

The two concepts proposed above are independent – either of them could be separately pursued through the EPIC 5 investment program – but they address the same fundamental barrier to geothermal development: limited information.

Geothermal projects require significant upfront capital, which makes site selection crucial. Developers and financers must have confidence, in advance of starting a project, that they will be able to generate revenue from the project. Unfortunately, because next-generation geothermal has historically been a small part of the energy system, there is not sufficient data about the subsurface across most of the US (including most of California) to give confidence in a project's success. And gathering this subsurface data uses a range of tools and in most cases requires drilling, which is costly.

The concepts suggested above would incentivize gathering and sharing more data, addressing one of the most critical barriers to geothermal energy development. By providing a clearer understanding of which locations are best for geothermal development and how to successfully generate geothermal energy at those locations, developers and financers will have greater certainty that their projects will produce a return, reducing the costs of financing and thus overall project costs. This creates a virtuous cycle, because more projects will lead to increased understanding of the subsurface through additional characterization, which informs more profitable project locations. Ultimately, these developments will make it more affordable to deploy geothermal energy at scale in California and meet the state's renewable energy procurement targets.

5. Please describe the anticipated outcomes if this research concept is successful, either fully or partially. For example, to what extent would the research reduce technology or ratepayer costs and/or increase performance to improve the overall value proposition of the technology? What is the potential of the innovation at scale? How will the innovation lead to ratepayer benefits in alignment with EPIC's guiding principles to

improve safety,[ii] reliability,[iii] affordability,[iv] environmental sustainability,[v] and equity?[vi]

The anticipated outcomes of all of the concepts described above are to increase the deployment of geothermal energy in California, creating numerous benefits for the state's grid and ratepayers – especially in the areas of reliability and affordability.

Academic research[1] and the 2021 SB 100 Joint Agency Report[2] indicate that complementing variable renewables like solar and wind with clean, firm power – resources that provide high-capacity factor, on-demand electricity regardless of weather and without carbon emissions – will reduce overall system costs and improve grid reliability. Next-generation geothermal energy offers zero-carbon, always-available electricity that supports reliability and reduces dependence on fossil fuels during periods when solar and wind are unavailable, which improves reliability as California moves towards deep decarbonization in 2045.

Especially when considering the grid benefits it provides as a clean, firm resource, geothermal energy also has an important role to play in an affordable energy system. For instance, Lazard's 2025 Levelized Cost of Energy+ (LCOE+) report finds that geothermal energy is already cost-competitive with gas peaking, nuclear, coal, and utility-scale solar with storage.[3] Geothermal energy is also dropping quickly in cost,[4] which will make future geothermal development increasingly affordable for ratepayers and competitive with additional energy sources. Further, geothermal's LCOE and value to ratepayers will increase over time as technology innovations unlock access to hotter, higher-energy-density geothermal resources.

Finally, geothermal energy is an environmentally sustainable form of renewable energy with a small land footprint. The tools, technologies, and workforce used for oil and gas projects can also be directly used in next-generation geothermal with little to no modification required. This means that with new geothermal energy projects, oil and gas workers can keep their jobs and local economies are not disrupted, supporting EPIC's guiding principle of equity.

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[1] Long, Jane C.S., Ejeong Baik, Jesse D. Jenkins, Clea Kolster, Kiran Chawla, Arne Olson, Armond Cohen, Michael Colvin, Sally M. Benson, Robert B. Jackson, David G. Victor, and Steven P. Hamburg. "Clean Firm Power is the Key to California's Carbon-Free Energy Future." Issues in Science and Technology (March 24, 2021).

[2] Pages 12-13

[3] https://www.lazard.com/research-insights/levelized-cost-of-energyplus-lcoeplus/ page 8

[4] Akindipe, D. and Witter, E. "2025 Geothermal Drilling Cost Curves Update." PROCEEDINGS, 50th Workshop on Geothermal Reservoir Engineering (February 2025). https://pangea.stanford.edu/ERE/db/GeoConf/papers/SGW/2025/Akindipe.pdf?t=1740084555.

6. Describe what quantitative or qualitative metrics or indicators would be used to evaluate the impacts of the proposed research concept.

The ultimate indicator of success of the proposed research concepts would be a larger amount of in-state geothermal energy production. Intermediate metrics would include:

- For concept (1), a geothermal testbed: Creation of a geothermal testbed; The number of private companies participating in the testbed research
- For concept (2), subsurface mapping and characterization: Creation of a public database of geothermal potential and subsurface resource characterization across California; The percentage of California's subsurface that is mapped through the program; The depth in the subsurface that the mapping reaches

7. Please provide references to any information provided in the form that supports the research concept's merits. This can include references to cost targets, technical potential, market barriers, equity benefits, etc.

For a more detailed description of the opportunities and challenges related to next-generation geothermal energy in California, please refer to CATF's report "Unlocking California's Geothermal Potential: A Strategic Opportunity for Clean, Firm Power."[5]

Additional references have been included throughout the form to illustrate the benefits, technical potential, and barriers to adoption for next-generation geothermal energy. The DOE's next-generation geothermal liftoff report also provides a good overview of the potential of next-generation geothermal energy.[6]

8. The EPIC 5 Investment Plan must support at least one of five Strategic Goals:[vii]
    a. Transportation Electrification
    b. Distributed Energy Resource Integration
    c. Building Decarbonization
    d. Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas
    e. Climate Adaptation

[5] Rogers, T., Garth, A., Arax, A. "Unlocking California's Geothermal Potential: A Strategic Opportunity for Clean, Firm Power." CATF. https://cdn.catf.us/wp-content/uploads/2025/06/23162128/california-geothermal-report.pdf.

[6] Gertler, C., et al. "Pathways to Commercial Liftoff: Next-Generation Geothermal Power." DOE. https://cdn.catf.us/wp-content/uploads/2025/06/09154348/doe-liftoff-nextgen-geothermal.pdf

Please describe in as much detail as possible how your proposed concept would support these goals.

The proposed concepts would support the “Achieving 100 Percent Net-Zero Carbon Emissions and the Coordinated Role of Gas” goal.

Advancing next-generation geothermal through testbeds and data gathering directly supports California’s goal of achieving 100 percent net-zero carbon emissions and clarifying the coordinated role of gas. By enabling geothermal technologies that can provide firm, zero-emissions power around the clock, these activities help fill the state’s critical clean reliability gap and offer a pathway to decarbonize sectors that are difficult to fully electrify with intermittent renewables alone. This is especially relevant for the “last 10 percent” challenge, where reliable, non-combustion-based electricity is essential to replace fossil fuels without increasing air, water, or land impacts.

The proposed activities would also generate independent, California-specific data on the subsurface and on the performance and siting needs of emerging geothermal technologies. This data would support better-informed decisions by utilities, regulators, and policymakers about where and how next-generation geothermal fits into the state’s decarbonization portfolio. It would also fill a key gap identified in the EPIC framework around the need for independent assessments of enhanced geothermal systems and other emerging clean firm technologies.

As discussed above, the proposed concepts of a geothermal testbed and improved subsurface data would also support affordability by helping reduce the high upfront capital costs and development risks that currently limit in-state deployment. Demonstrating success in California’s regulatory and geologic context can lower the cost of capital, improve investor confidence, and help unlock private sector financing.

About EPIC

The CEC is one of four EPIC administrators, funding research, development, and demonstrations of clean energy technologies and approaches that will benefit electricity ratepayers of California’s three largest investor-owned electric utilities.

EPIC is funded by California utility customers under the auspices of the California Public Utilities Commission.

To learn more about EPIC, visit: https://www.energy.ca.gov/programs-and-topics/programs/electric-program-investment-charge-epic-program

EPIC 5 documents and event notices will be posted to:
https://www.energy.ca.gov/proceeding/electric-program-investment-charge-2026-2030-investment-plan-epic-5

Subscribe to the EPIC mailing list to stay informed about future opportunities to inform the development of EPIC 5:
https://public.govdelivery.com/accounts/CNRA/signup/31897

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i See section (a) (1) of Public Resources Code 25711.5 at: https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=PRC&sectionNum=25711.5.

ii EPIC innovations should improve the safety of operation of California's electric system in the face of climate change, wildfire, and emerging challenges.

iii EPIC innovations should increase the reliability of California's electric system while continuing to decarbonize California's electric power supply.

iv EPIC innovations should fund electric sector technologies and approaches that lower California electric rates and ratepayer costs and help enable the equitable adoption of clean energy technologies.

v EPIC innovations should continue to reduce greenhouse house gas emissions, criteria pollutant emissions, and the overall environmental impacts of California's electric system, including land and water use.

vi EPIC innovations should increasingly support, benefit, and engage disadvantaged vulnerable California communities (DVC). (D.20-08-046, Ordering Paragraph 1.) DVCs consist of communities in the 25 percent highest scoring census tracts according to the most recent version of the California Communities Environmental Health Screening Tool (CalEnviroScreen), as well as all California tribal lands, census tracts with median household incomes less than 60 percent of state median income, and census tracts that score in the highest 5 percent of Pollution Burden within CalEnviroScreen, but do not receive an overall CalEnviroScreen score due to unreliable public health and socioeconomic data.

vii In 2024 the CPUC adopted five Strategic Goals to guide development of the EPIC 5 Investment Plan. A description of the goals can be seen in Appendix A of CPUC Decision 24-03-007 available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M527/K228/527228647.PDF