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Clean Air Task Force - Comments in Response to 2025 SB 100 Joint Agency Report Draft Results

Please find attached for Clean Air Task Force's comments in response to the 2025 SB 100 Joint Agency Report draft results. Thank you for your consideration of these comments, we welcome further dialogue with the Joint Agencies and look forward to continuing our engagement in the SB 100 process.

Additional submitted attachment is included below.

CLEAN AIR TASK FORCE

March 20, 2026

RE: Docket No. 23-SB-100 Comments of Clean Air Task Force in Response to 2025 SB 100 Joint Agency Report Draft Results

About CATF

Clean Air Task Force ("CATF") respectfully submits these comments in response to the 2025 SB 100 Joint Agency Report Draft Results (Docket No. 23-SB-100).

CATF is a nonprofit organization dedicated to advancing the policy and technology changes necessary to achieve a zero-emissions high-energy planet at an affordable cost. With more than 25 years of internationally recognized expertise on environmental policy and law, and a commitment to exploring all potential solutions, CATF is a pragmatic, non-ideological advocacy group with the bold ideas needed to address climate change and air pollution. CATF has offices in Boston, Washington, D.C., and Brussels, with staff working remotely around the world. CATF has long been engaged on SB 100 and its implementation, including through comments on the inputs and assumptions workshop for this report[1] and multiple comments on the initial 2021 SB 100 joint agency report.[2]

Executive Summary

Last month, California presented draft results for the ongoing SB 100 Joint Agency Report ("SB 100 report").[3] The SB 100 report draft results make clear that a significant amount of new solar, wind, and storage is necessary to achieve California's targets under any scenario. However, the SB 100 report lacks key scenarios necessary to illuminate the potential of California policy to significantly reduce the cost of achieving SB 100's goals.

CATF recommends that the Joint Agencies address two important gaps in the SB 100 report. First, the scenarios presented do not reflect the significant impacts of recent changes to federal energy subsidies. Consequently, to increase study durability, we recommend developing additional scenarios that not only account for these changes but focus more comprehensively on the impact of different state, regional, or federal policy futures on the state's clean energy strategy.

Second, current scenarios also fail to assess how advanced clean energy technology, which California policymakers could enable, can make California's clean energy targets more achievable. Because the SB 100 report is designed to

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[1] Clean Air Task Force. "Comments in Response to SB 100 Inputs and Assumptions Workshop." California Energy Commission Docket No. 23-SB-100, TN #255258. March 25, 2024. https://efiling.energy.ca.gov/GetDocument.aspx?tn=255258&DocumentContentId=90931.

[2] Clean Air Task Force. "SB 100 Filings." Clean Air Task Force. Accessed March 16, 2026. https://www.catf.us/resource/sb-100/; Clean Air Task Force. "Comments on SB 100 Draft Results." California Energy Commission Docket No. 19-SB-100, TN #234778. September 15, 2020. https://efiling.energy.ca.gov/GetDocument.aspx?tn=234778.

[3] California Energy Commission, California Public Utilities Commission, and California Air Resources Board. "Hybrid Workshop on 2025 SB 100 Joint Agency Report Draft Results." CEC Docket No. 23-SB-100. February 19, 2026. https://www.energy.ca.gov/event/workshop/2026-02/hybrid-workshop-2025-sb-100-joint-agency-report-draft-results.

inform policymakers, it should aim to help identify key policy solutions that would address a wide range of realistic future needs. As we show with our own power system modeling, enabling deployment of additional technologies in California beyond the set considered in the SB 100 report can have substantial impacts on ratepayer costs. Going forward, SB 100 reports should investigate additional technology availability scenarios,[4] especially scenarios that include clean firm generation technologies,[5] to provide the information necessary to form a robust energy policy. We encourage the Joint Agencies to include these scenarios in the final results and future SB 100 reports.

To showcase the magnitude of potential technology breakthroughs that are not examined in SB 100 report draft results, this comment presents new power system modeling to illustrate the potential impact of clean firm generation technology availability on the achievability of California's electricity sector climate targets. We examine two scenarios: one focused on enhanced geothermal systems (EGS) and the other on nuclear power.

CATF modeling illustrates that enhanced geothermal or nuclear power could reduce the cost of achieving SB 100 targets by $5 billion-$44 billion per year. These savings would likely far exceed the investment that the state would need to put towards enabling development of these technologies. Deploying these technologies would also reduce the infrastructure buildout requirements of decarbonization in California. The modeling finds that these impacts are consistent across a wide range of resource cost assumptions.

Based on these results, we encourage California policymakers to increase their support for clean firm generation technologies in parallel with greater deployment of already-available solar, wind, and storage.

Response to SB 100 Report Draft Results

The Joint Agencies' draft results for the latest edition of the SB 100 report present a clear conclusion: a very large amount of new solar, wind, and storage development will be necessary to achieve California's clean electricity standard.[6] Baseline scenario modeling indicates that between 2025 and 2045 CAISO needs to deploy solar resources at a sustained rate of roughly 5 gigawatts per year (GW/yr), storage at 2.5 GW/yr, and wind at 2 GW/yr.[7] An additional 1.6 GW of carbon capture and storage (CCS retrofits on gas plants) are also included. Even under such an impressive buildout, the state would still be reliant on significant out-of-state electricity imports, over 40 GW of unabated natural gas backup, and expensive hydrogen-fueled generation.[8]

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[4] Technology availability scenarios (especially those that can be enabled via California policy) should fall under Cal. Pub. Utils. Code § 913.11(b)(5) that notes "alternative scenarios in which the policy described in subdivision (a) of Section 454.53 can be achieved and the estimated costs and benefits of each scenario."

[5] Clean firm generation technologies are those that can generate low- or zero-carbon electricity whenever called on and for as long as needed.

[6] California requires renewable energy and zero-carbon resources supply 90% of all retail electricity sales to end-use customers by 2035 and 100% of such sales by 2045. California Public Utilities Code § 454.53.

[7] To place these numbers in context, California is currently deploying solar power at a rate of roughly 3 GW/yr: California Energy Commission. "Electric Generation Capacity and Energy." Energy Almanac. Accessed March 16, 2026. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy.

[8] The use of hydrogen for clean electricity generation, even when produced only from surplus electricity and used infrequently for load following, is likely to remain very costly. Moreover, generating hydrogen for power generation is highly inefficient, exacerbating clean energy buildout needs. Low-carbon hydrogen should be prioritized for use in industry and heavy transportation, starting with the decarbonization of existing hydrogen production. For more information, please see CATF's paper on the subject: https://www.catf.us/resource/hydrogen-power-sector/

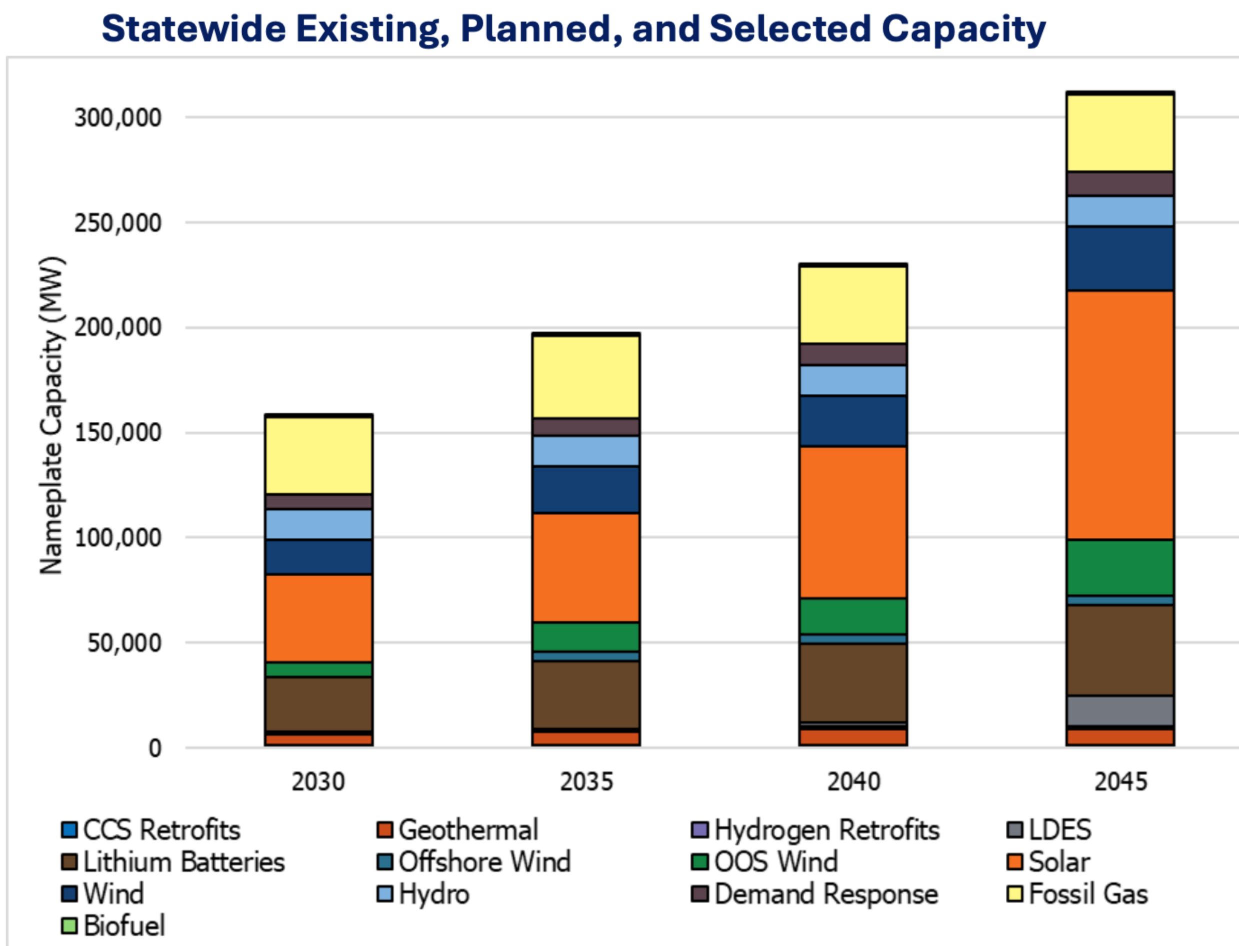

Figure 1. SB 100 draft results for the baseline scenario, showing the evolution of the CAISO resource mix.

These results do not reflect the latest changes to federal clean energy subsidies under the One Big Beautiful Bill Act.[9] The loss of federal subsidies for wind and solar projects placed in service after 2027 and phase-out for all clean technologies that begin construction after 2032 will change the competitive landscape of technologies that could contribute to meeting California's clean electricity goals. While the SB 100 study draft results acknowledge that they do not capture the latest federal policies, they are still rendered less useful to California policymakers unless updated to reflect the current outlook.

Of the scenarios included in the SB 100 report draft results, the "15 GW Carbon Capture" scenario is most reflective of the current policy environment. This scenario assumes that federal tax credits are extended to natural gas with carbon capture and storage (CCS) through 2045,[10] creating a level, universally subsidized playing field across low-carbon technology options that is in some ways similar to the current subsidy-free outlook. In this scenario, 15 GW of gas plants are retrofitted with CCS, which reduces system costs by nearly $5 billion (inclusive of CCS costs) by replacing 75 GW of the most expensive and least frequently utilized solar, wind, and storage resources. The inclusion of 15 GW of gas with CCS also reduces the required buildout of new resources to achieve climate targets by 4 GW/yr.

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[9] Pub. L. No. 119-21

[10] Under the baseline federal policies modeled in the draft SB 100 results, as well as current policy, all natural gas plants with CCS that begin construction before January 1, 2033 are eligible for the Section 45Q carbon sequestration tax credit. Gas with CCS is not by default eligible for the carbon-free electricity 48E investment tax credit or 45Y production tax credit because it has nonzero carbon emissions. Under the "15 GW CCS" scenario, gas with CCS is assumed to receive investment tax credits through 2045 alongside other clean technologies.

This scenario demonstrates the potential system cost upside of gas with CCS and implicitly provides modeling demonstrating the directional impact that clean firm generation technologies could have in California. However, the SB 100 draft results leave it unclear how much of a role clean firm generation technology options, most of which with different techno-economic profiles, could play in meeting California's clean energy goals.

Exploring Technology Availability Scenarios for Policymakers

California policymakers have tools at their disposal to support the deployment of new technologies, which could in turn reduce costs for California ratepayers and make the state's climate targets more achievable. While the SB 100 draft results explicitly note the need for clean firm generation alongside large amounts of renewables and storage, they do not examine the suite of clean firm generation technology options potentially available to California and their system impacts. This leaves policymakers with little data regarding their potential value for Californians.

Two key potential clean firm generation candidates that remain unexamined are nuclear power and enhanced geothermal power. Both generation candidates encompass a range of technology approaches at varying readiness levels and have significantly different supply chain and enabling infrastructure needs than those of gas with CCS (i.e., CO_2 pipelines and storage).

Nuclear power is already a key contributor to California's clean energy supply, and it could continue to play a similar or expanded role if operations at the existing Diablo Canyon nuclear plant – which is currently set to retire before the SB 100 study window begins in 2030 – were to be extended. Recently, the Nuclear Regulatory Commission determined the Diablo Canyon nuclear plant could safely operate for another 20 years,[11] while a California Public Utilities Commission analysis indicated extending its life to 2045 would reduce system costs by $15 billion.[12] Additional nuclear generation is limited by the statewide moratorium on new nuclear construction, as noted in the SB 100 report inputs and assumptions document.[13] Because both of these barriers are rooted in policy, it would be valuable for California legislators to understand the potential impacts of changes to the relevant policies.

Enhanced geothermal power, meanwhile, is currently undergoing commercial demonstration at the 100 MW scale and has received offtake interest from a number of California utilities.[14] California's geothermal resources are among the highest-quality in the world, with significant hot, shallow enhanced geothermal potential surrounding conventional geothermal sites and enough deep superhot rock resource to power the state grid hundreds of times over. However, further development faces barriers related to regulatory uncertainty and well exploration risks.[15]

All clean firm technologies have the potential to lower costs for Californians and reduce the infrastructure buildout requirements of achieving climate targets, but most technologies, often with different characteristics and impacts, remain unexplored in the current SB 100 report.

CATF Modeling of California Electricity Decarbonization Pathways with Clean Firm Options

To illustrate some of the key information missing from the SB 100 report draft results, CATF has performed high-fidelity electricity system modeling that replicates the structure of the SB 100 report while incorporating up-to-date

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[11] U.S. Nuclear Regulatory Commission. *Safety Evaluation Related to the License Renewal of Diablo Canyon Nuclear Power Plant, Units 1 and 2.* Docket Nos. 50-275 and 50-323. ADAMS Accession No. ML25153A508. June 2025. https://adamswebsearch2.nrc.gov/webSearch2/main.jsp?AccessionNumber=ML25153A508.

[12] On a net-present value basis, including the cost of continued operations. California Public Utilities Commission, Energy Division Staff. "26-27 Transmission Planning Process RESOLVE Modeling Results." Attachment to Administrative Law Judge's Ruling, R.25-06-019. September 30, 2025. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/ruling_26-27_tpp_results.pdf.

[13] California Energy Commission. "Senate Bill 100 Modeling Inputs and Assumptions Staff Workshop." February 16, 2024. https://www.energy.ca.gov/event/workshop/2024-02/senate-bill-100-modeling-inputs-and-assumptions-staff-workshop.

[14] Akindipe, A. et al. "2025 U.S. Geothermal Market Report." National Laboratory of the Rockies, 2025. https://docs.nlr.gov/docs/fy26osti/91898.pdf

[15] Rogers, T. et al. "Unlocking California's Geothermal Potential: A Strategic Opportunity for Clean, Firm Power." Clean Air Task Force, 2025. https://www.catf.us/resource/unlocking-californias-geothermal-potential/

federal policies and exploring the potential contributions of two advanced technologies that were missing from the SB 100 analysis: enhanced geothermal and nuclear.[16]

Figure 2 below shows cost-optimal 2045 electricity supply portfolios for California[17] under scenarios where these technologies are made available at high cost or low cost or are not available at all. To ensure that our results are not predicated on a single set of future resource cost assumptions, we show outcomes under “Low Electricity Cost” and “High Electricity Cost” scenarios where the costs of renewables, energy storage, and natural gas power plants and fuel are all either significantly lower than or higher than baseline projections used in the SB 100 report, respectively.

These results indicate that successful deployment of either enhanced geothermal or nuclear power in California would drastically reduce the amount of total installed generating capacity necessary to achieve the state’s 2045 clean energy targets, notably reducing the required pace of solar installation from almost 10 GW/yr[18] to 3 GW/yr, which is closer to the state’s current rate of solar buildout and more likely achievable.[19]

The availability of enhanced geothermal or nuclear also reduces the annual cost of California’s electricity supply by $5 billion-$44 billion[20] compared to scenarios without these technologies across the modeled results (see Figure 3 below), primarily by reducing reliance on the highest-cost renewable resources like in-state onshore and offshore wind, and by reducing the amount of infrequently-utilized storage capacity necessary to meet demand during periods of peak system stress. The marginal cost of greenhouse gas abatement in California’s electricity system also falls dramatically when these clean firm generation options are available, suggesting that the path to further emission reductions beyond the 2045 target would be much more achievable in these scenarios. Importantly, these results hold even when the costs of other technologies fall even more than expected (the “Low Electricity Cost” scenario), and the costs of enhanced geothermal or nuclear are relatively high.

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[16] See the appendix for an overview of modeling methods.

[17] Note that these results also include supply for California regions outside of CAISO.

[18] CATF’s modeling deploys significantly more solar than the SB 100 baseline because it covers demand for all of California, not just CAISO, and uses demand forecasts from the National Lab of the Rockies that are significantly higher than those used in the SB 100 reference scenario. SB 100 projects a 2045 peak electricity demand of ~70 GW in CAISO and ~85 GW statewide. The NLR demand forecast projects 2045 peak demand of 112 GW statewide. Recent CPUC transmission planning process modeling has used a demand forecast closer to the NLR value, with a 2045 peak electricity demand of ~85 GW in CAISO. These demand forecasts were created using similar methodologies but different underlying assumptions, and all are subject to significant uncertainty. Additionally, our modeling uses a 19 GW limit on out-of-state wind adopted from the transmission planning process assumptions, which leads to a greater need for in-state solar power. California Public Utilities Commission, Energy Division Staff. "26-27 Transmission Planning Process Proposed Decision RESOLVE and SERVM Analysis." 2025. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/26-27-tpp-pd-resolve-and-servm-analysis.pdf.

[19] California Energy Commission. "Electric Generation Capacity and Energy." Energy Almanac. Accessed March 16, 2026. https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy.

[20] Cost savings compare total supply costs between scenarios where clean firm resources are available and scenarios where they are not. Annual savings are presented in real 2024 dollars.

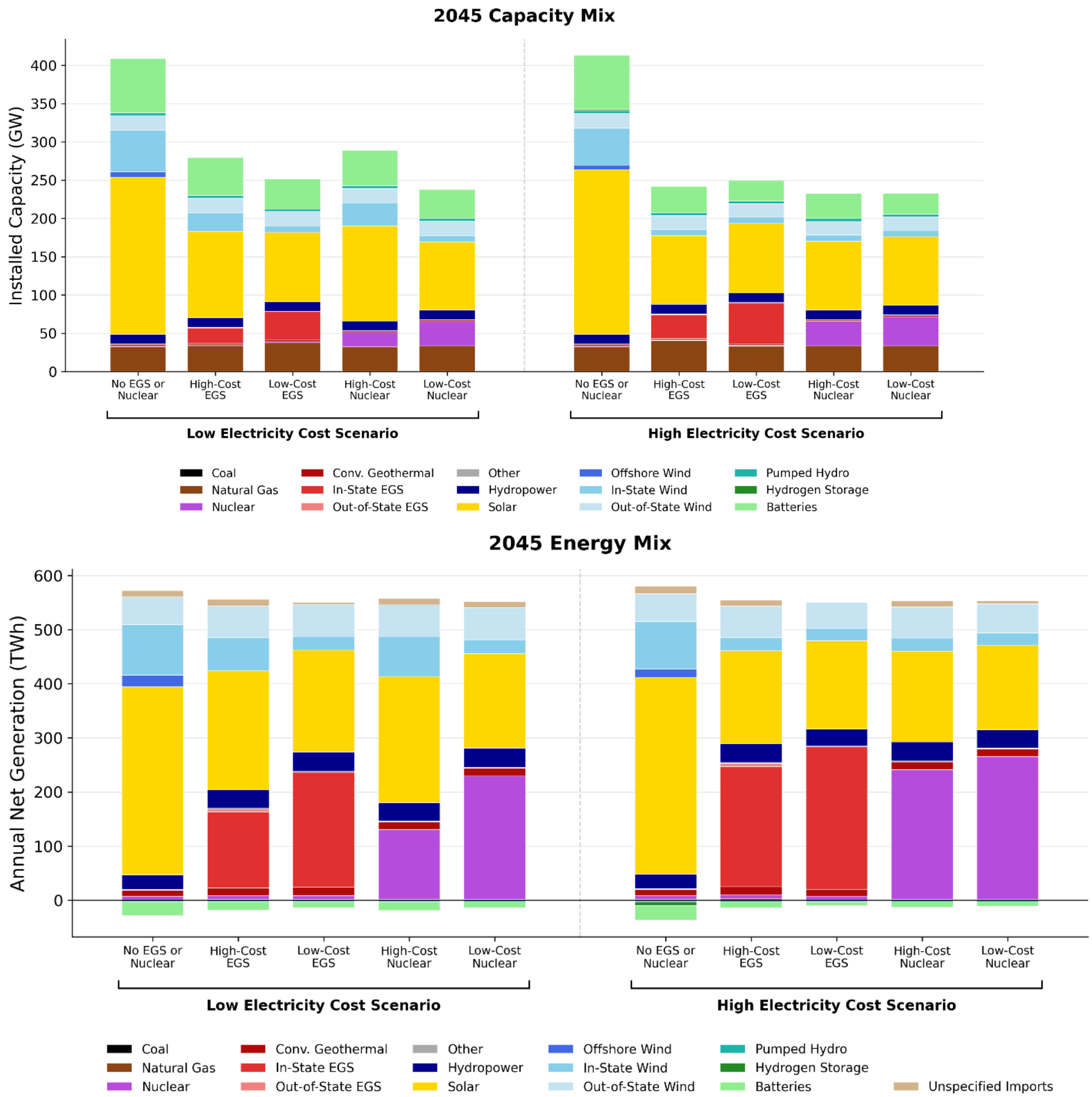

Figure 2: Optimized capacity (top) and energy (bottom) mixes for California's 2045 electricity supply portfolio under different resource cost and availability scenarios

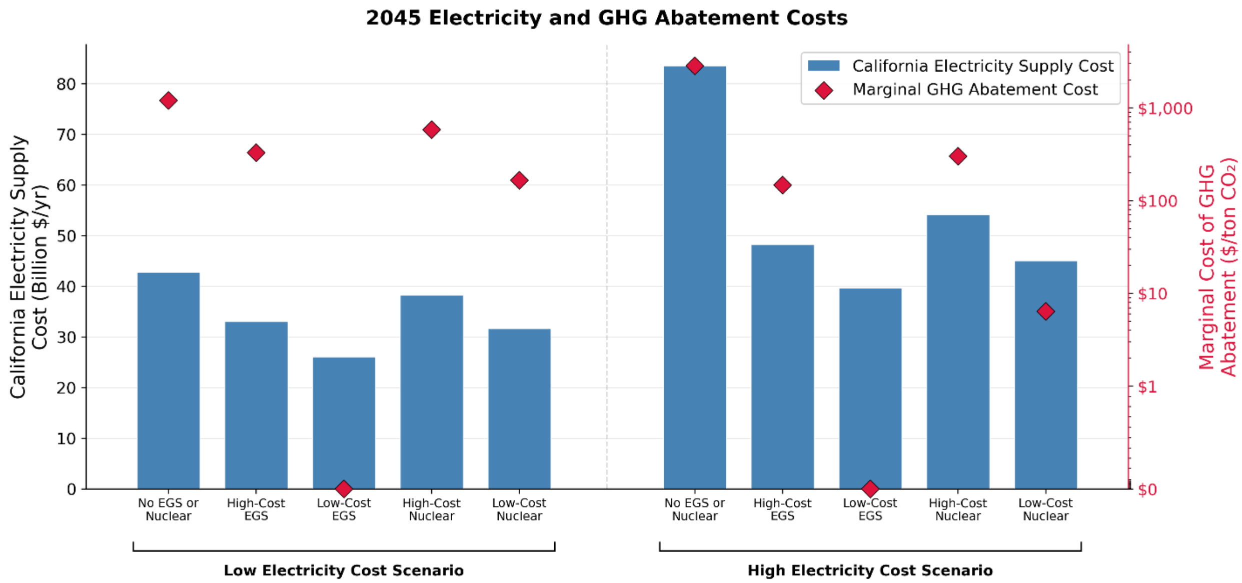

Figure 3: Total 2045 annual electricity supply costs and marginal greenhouse gas abatement costs for the California electricity sector under different resource cost and availability scenarios. Electricity supply costs include the full annualized costs of all resources in the California portfolio, including annuitized investment costs, operations and maintenance, and fuel costs, plus transmission costs and the net value of electricity imports and exports. Marginal GHG abatement costs reflect the cost of removing one more ton of CO_2 beyond California's 2045 emissions target from the state's physical electricity supply.

Conclusion

Given deep uncertainties about the future trajectories of technology costs, load growth, and federal policy, and the significant potential impacts of unexpected developments in these areas on California's decarbonization strategy, future SB 100 reports should explore a wider range of plausible scenarios and associated decarbonization pathways. Technology and policy landscapes are evolving, and the SB 100 report will be most useful if it contains a wide enough variety of scenarios to remain relevant even in the face of these changes. By illustrating the impacts of changes to a wider array of assumptions (for example, whether or not enhanced geothermal or nuclear power are available), it can serve as a better roadmap toward the outcomes that policymakers wish to achieve.

The results of CATF's modeling illustrate the advantage of incorporating additional scenarios. They illustrate that California could significantly reduce the costs and infrastructure buildout necessary to achieve its goals via clean firm generation technology.

Our analysis indicates that California policymakers have a significant opportunity to unlock cost savings for ratepayers. Many policies exist that could better support clean firm generation technologies in California. Some require no financial commitment, whereas others offer bill and emission savings potential that are multiples of up-front costs, such as state funding to reduce the cost risk of geothermal exploration and development. Examples of such policies include, but are not limited to:

- Extending the life of the Diablo Canyon nuclear plant;[21]
- Lifting the moratorium on new nuclear development in California;
- Removing barriers to in-state geothermal development;[15]
- Supporting exploration drilling and de-risking for next-generation geothermal projects; and
- State-led procurement of advanced energy technologies.

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[21] CPUC modeling for the latest Transmission Planning Process already indicates $0.6-1.2 billion per year in savings from extending Diablo Canyon through 2045: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2024-2026-irp-cycle-events-and-materials/assumptions-for-the-2026-2027-tpp/ruling_26-27_tpp_results.pdf

CATF appreciates the opportunity to comment on the 2025 SB 100 Joint Agency Report draft results and welcomes further dialogue with the Joint Agencies on how expanded scenario analysis and clean firm generation pathways can strengthen California's clean energy strategy.

Sincerely,

Kasparas Spokas
Director, Electricity Program
Clean Air Task Force

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Appendix: Modeling Methods

The preliminary modeling results presented in this comment were produced using GenX,[22] a state-of-the-art open-source electricity sector capacity expansion model developed at MIT and Princeton University. The model optimized electricity system expansion across a 34-zone representation of the Western Interconnection (see Figure 4) for planning years 2030, 2035, and 2045, minimizing system costs in each planning year while meeting physical and policy constraints. The representation of California's electricity supply portfolio and electricity sector climate policies was designed to replicate the SB 100 Joint Agency Report's RESOLVE modeling as closely as possible, including constraints on out-of-state resources, limits on GHG emissions from in-state generation and specified plus unspecified imports, and the SB 100 policy itself.

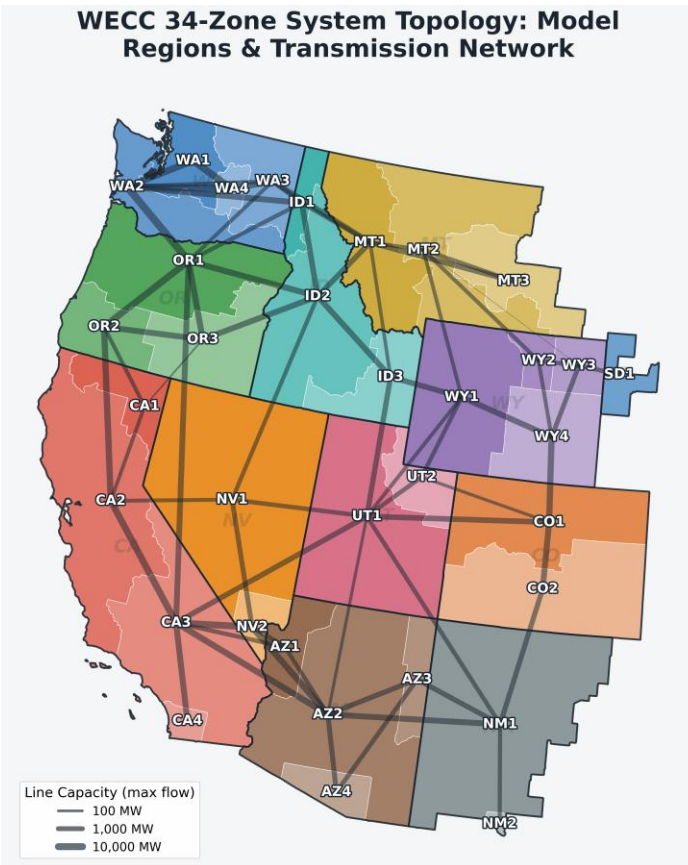

Figure 4: Visualization of the 34-zone WECC system model used in the GenX modeling presented here, including existing interregional transmission.

GenX inputs, including existing resource capacities, were compiled using PowerGenome.[23] We adopted future electricity demand projections from the National Lab of the Rockies' ReEDS model,[24] and future technology cost projections from the 2024 Annual Technology Baseline (ATB).[25] "Low Electricity Cost" and "High Electricity Cost" scenarios shown in this analysis increase capital costs for renewables, storage, and natural gas power plants by 50% or reduce them by 33% compared to the ATB baseline, respectively. The High Electricity Cost scenario also uses

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[22] https://github.com/GenXProject/GenX.jl

[23] https://github.com/PowerGenome/PowerGenome

[24] https://github.com/NatLabRockies/ReEDS-2.0

[25] https://atb.nrel.gov/electricity/2024/data

“Low Oil and Gas Resource” natural gas price projections from the EIA’s 2025 Annual Energy Outlook (AEO),[26] while the Low Electricity Cost scenario uses “High Oil and Gas Resource” projections. Because natural gas prices are highly volatile and, with increasing liquefied natural gas exports, can be sensitive to geopolitical market shocks, future gas price projections vary more significantly than the capital costs of electricity technologies. See Figure 5 for a comparison of cost assumptions in these modeled scenarios to the SB 100 report baseline. For nuclear power, this modeling uses ATB capital cost projections increased by 33% (to $8985/kW) in the high-cost scenario and reduced by 25% (to $5067/kW) in the low-cost scenario. For enhanced geothermal, the high-cost scenario uses near-term cost projections from Ricks & Jenkins (2025)[27] while assuming baseload operations, and the low-cost scenario uses CATF estimates of nth-of-a-kind superhot rock geothermal costs while assuming flexible operations.[28] Supply curves for in-state and out-of-state enhanced geothermal resources are shown in Figure 6, and are based on temperature-at-depth datasets from the Stanford Thermal Earth Model.[29] Notably, we model EGS power plants as air-cooled to minimize water usage, meaning EGS power output is reduced when ambient air temperature is high and increased when air temperature is low.

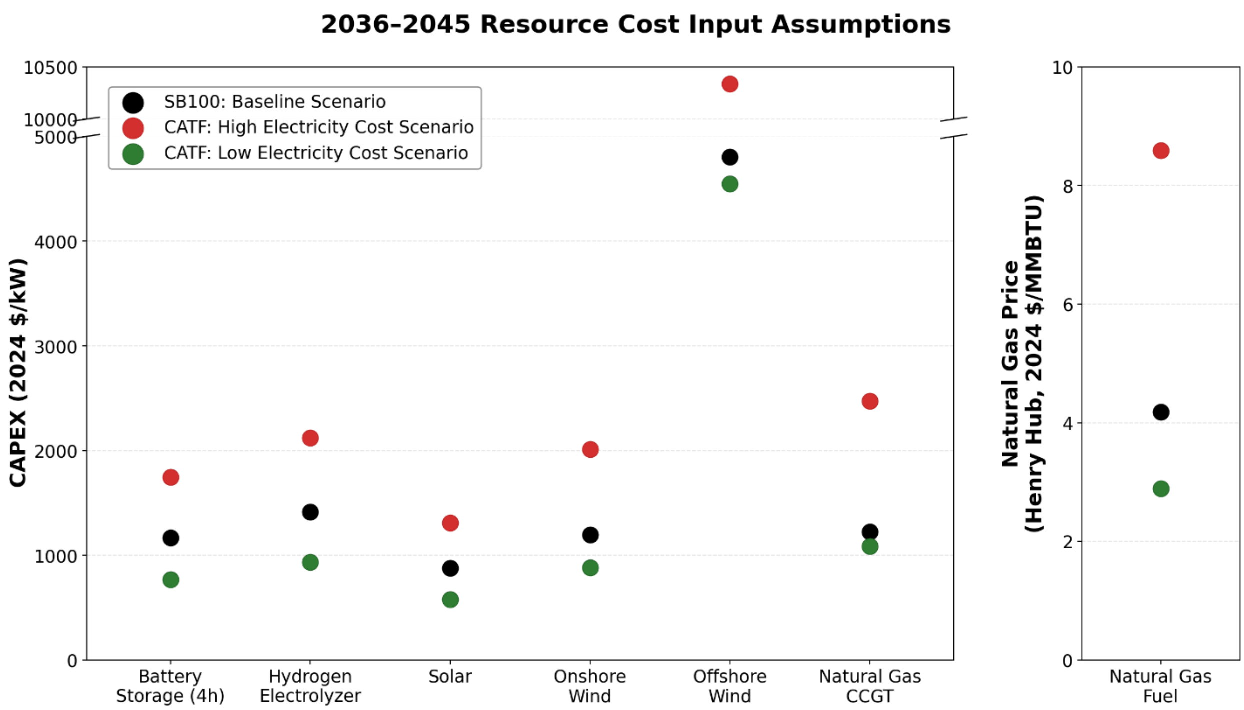

Figure 5: Technology cost input assumptions from the SB 100 report and the CATF modeling presented in this comment. CAPEX values compare average input capital costs over the 2036-2045 buildout period, while natural gas prices are for the year 2045. SB 100 report inputs come from the 2023 NLR ATB and EIA AEO, while CATF inputs come from the 2024 ATB and 2025 AEO.

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[26] https://www.eia.gov/outlooks/aeo/

[27] Ricks, W. and Jenkins, J.D. “Pathways to national-scale adoption of enhanced geothermal power through experience-driven cost reductions.” *Joule*, 2025. https://www.cell.com/joule/abstract/S2542-4351(25)00152-7

[28] Flexible operations allow wellfield capacity (and therefore cost) to be reduced to 77% of surface powerplant capacity while retaining the same maximum flow rate, subject to constraints on total annual heat extraction.

[29] Aljubran, M. and Horne, R. “Thermal Earth model for the conterminous United States using an interpolative physics-informed graph neural network.” *Geothermal Energy*, 2024. https://link.springer.com/article/10.1186/s40517-024-00304-7

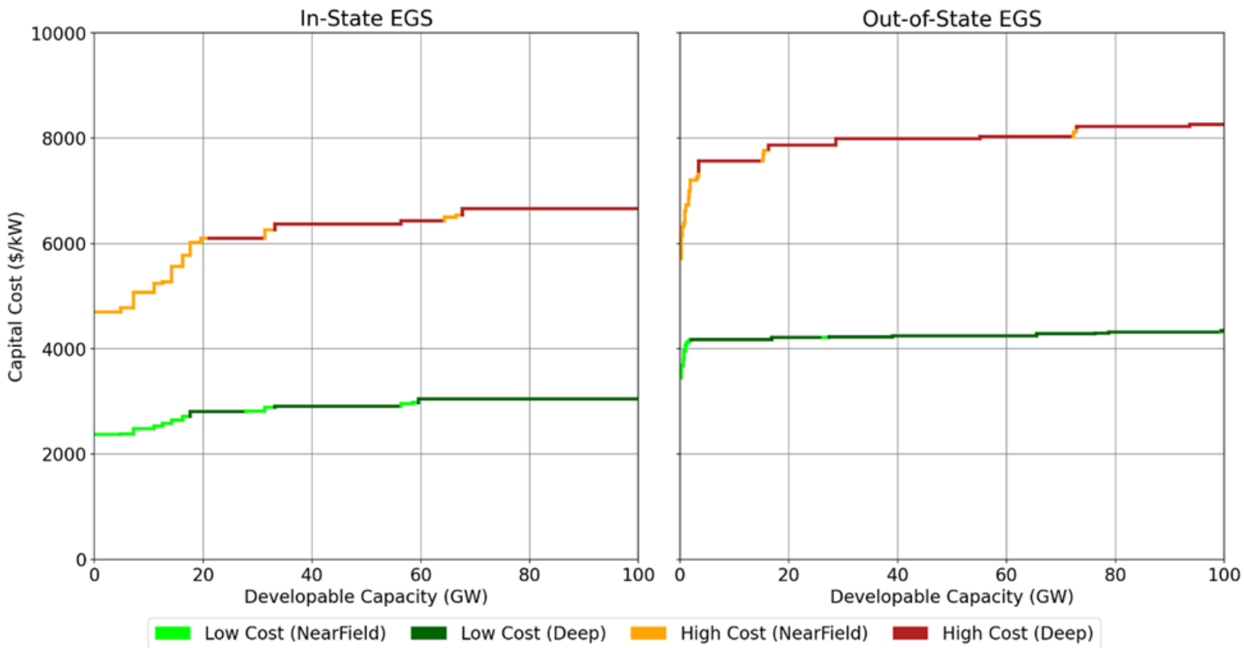

Figure 6: Enhanced geothermal supply curves used as model inputs for planning year 2045. Near-field resources located close to conventional geothermal sites are shown in lighter colors.