

California may build 11.5GW of almost all carbon-free resources to replace its last nuclear plant

Regulators have decided that adding 7.5 GW by 2026 won't be enough after the Diablo Canyon nuclear plant closes. Can California build so much clean and reliable grid capacity in time?

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California regulators have proposed adding 11.5 gigawatts of almost completely carbon-free capacity to its grid in the next five years. This ambitious target will require a massive build-out of batteries to shift solar power to cover the state's grid peaks as natural-gas plants close and gigawatts of long-duration energy storage and dispatchable zero-carbon resources to make up for the loss of the state's last nuclear power plant.

Friday's proposals from the California Public Utilities Commission mark a dramatic increase from the [7.5 GW of resources](#) by 2026 proposed earlier this year to ensure grid reliability after the closure of the Diablo Canyon nuclear plant.

Clean energy groups say the expanded target will lessen the risk of relying on natural gas to cover the gap that Diablo Canyon will leave in the state's peak electricity supply, which could increase carbon emissions in a state [under mandate](#) to reach 60 percent renewable energy by 2030 and 100 percent carbon-free energy by 2045.

"The commission has finally recognized that we're behind on adding much-needed renewable capacity and that it needs to be diverse," said V. John White, executive director of the nonprofit Center for Energy Efficiency and Renewable Technologies, in a Tuesday interview.

Mohit Chhabra, senior scientist for The Natural Resources Defense Council's climate and clean energy program, agreed that the CPUC's proposal "correctly connects capacity needs with clean energy goals, and set us on the stage" to reach the state's carbon reduction targets.

Determining a mix of resources that can replace nuclear power's round-the-clock carbon-free energy is difficult, "but this decision gets very, very close to it," he said.

CPUC also included an option for the state's big three investor-owned utilities to procure between 1,000 and 1,500 megawatts of natural-gas power plant capacity. This would be a stopgap measure to ensure grid reliability in case the zero-carbon additions CPUC is calling

for can't be secured in time. Understandably, some clean energy stakeholders are balking at this.

In a nod to these concerns, CPUC Commissioner Cliff Rechtschaffen has submitted an alternative plan to the one proposed by Administrative Law Judge Julie Fitch that would reduce this capacity to 500 megawatts, plus 300 megawatts of generation using at least 30 percent green hydrogen by 2026 and 50 percent green hydrogen by 2031. Both proposed decisions will be considered at the CPUC's June 24 meeting.

"The gas has turned into [a question of] how much of an insurance policy do you want to buy," White said. "But the fact that [Rechtschaffen] wanted to pull it back means they're listening" to clean energy advocates' concerns.

A rush to meet grid reliability and climate targets

At the same time, California regulators are striving to ensure adequate capacity to cover the summer evening "net peaks" in statewide grid demand that led to rolling blackouts last August and could [threaten more blackouts](#) later this year. California's large and growing share of solar power drops away in the evening, making it ineffective to cover those peaks.

With about 3,700 megawatts of natural-gas power plants set to close over the next few years to protect coastal ocean habitat, California will need batteries that can store and shift four to five hours of solar power to cover those evening peaks. While the CPUC's proposals do not specify which resources are to be procured, it's likely that batteries paired with solar will make up the majority of it.

The pace of the deployment — 3,000 MW by 2023, another 4,500 MW by 2024, and another 2,000 MW in both 2025 and 2026 — will put pressure on California utilities Pacific Gas & Electric, Southern California Edison and San Diego Gas & Electric, as well as the community choice aggregators (CCAs) responsible for securing electricity supplies for an [increasing share](#) of the state's electricity customers.

That's a much more rapid pace of procurement than the one set forth in the CPUC's 2019 decision ordering utilities, CCAs and the state's retail electricity providers to procure 3,300 MW of capacity by 2023 to secure the grid against capacity being lost to gas-plant closures. Most of that procurement has been met with [battery and solar-battery](#) projects, with nearly 2 gigawatts of four-hour batteries set to be active on the grid by this summer alone.

CPUC stakeholders proposed a wide array of targets for 2026, ranging from Southern California Edison's target of at least 5,400 MW to the Sierra Club's call for 20,000 MW, 14,000 of it wind and solar. State grid operator CAISO, which has long criticized the CPUC for failing to order more capacity to secure the grid, called for at least 10,000 MW.

The proposed decisions will allow utilities and CCAs to secure out-of-state resources to meet their individual requirements, but it's unclear whether California will be able to rely on such imports as much as it has in the past. The state's emergency planning to forestall more rolling blackouts this summer has highlighted the risk that regionwide heat waves, like the one that led to the August 2020 grid emergency, will also stretch neighboring states' power supplies to the brink.

"We need to plan for more extreme weather events and potential higher peak demand during those extreme weather events," Ed Randolph, CPUC deputy executive director for energy and climate policy, said in a Tuesday interview on the [AirTalk news program](#) on radio station KPCC.

Long-duration storage and "firm, dispatchable" clean capacity

The CPUC is also [under state mandate](#) to replace the 2,200 megawatts of capacity that Diablo Canyon provides with zero-carbon power. To accomplish this, the CPUC's new proposals call for at least 2,500 MW of "firm, zero-emitting resources" to be brought online by 2026.

The specific types of resources that can be tapped to fit this need are more broadly defined in the CPUC's latest proposals than in its earlier one, which specified 1,000 MW of long-duration storage and 1,000 MW of geothermal power capable of round-the-clock generation.

The new proposal keeps the target of 1,000 MW of long-duration storage, defined as being able to provide continuous energy for eight hours or longer. But it replaces the geothermal mandate with a broader call for "either firm (at least 85 percent capacity factor) or dispatchable (between hours 17 and 22) zero-emitting resources."

That change was made after multiple stakeholders argued that California might not be able to develop enough geothermal capacity to meet the 2026 mandate or that it could leave geothermal project developers in a position to demand higher prices for their power at ratepayer expense.

This 2,500 MW of resources "in combination will meet the operational characteristics of Diablo Canyon," Randolph told KPCC on Tuesday.

But just what those resources will be — and how California's utilities and CCAs will create procurement and contracting structures to meet the requirement — remains unclear.

Some of the state's largest CCAs joined forces last year to seek out 500 MW of long-duration energy storage resources. This spring they formed a joint procurement authority to combine their buying power and seek out larger-scale resources than would be needed from individual members.

Girish Balachandran, CEO of CCA Silicon Valley Clean Energy and head of the joint procurement authority, said in a March interview that last year's request for proposals for long-duration storage yielded a broad mix of technologies for consideration, though he wouldn't disclose the companies involved.

The proposals included "chemical flow batteries, compressed air, fuel cells with hydrogen, mechanical gravity storage, pumped hydro and a variety of thermal energy storage," from compressed liquid gases to molten salt, he said. "We've got it for eight-, 10- and 12-hour discharge durations."

Some of these technologies are closer to commercialization than others. Flow batteries from companies like Primus Power and ESS that can store energy for eight hours or longer have been deployed at pilot scale; secretive startup Form Energy plans to pilot a battery chemistry that can provide a megawatt of output for up to 150 hours. Whether these technologies will be ready to provide the scale of resources being targeted by the CPUC's proposal is an open question.

Geothermal energy, which can provide carbon-free power around the clock, and pumped hydro storage, the world's only gigawatt-scale long-duration energy storage resource, are proven technologies, but they are costly and constrained to sites with the natural features and resources they require.

California has about 2.5 gigawatts of geothermal capacity from the Geysers complex in Northern California, and developers are seeking to expand the existing 325-megawatt fleet in Imperial County in the southeast corner of the state. But it's unclear if those projects could be built and connected via adequate transmission capacity in time to meet the 2026 deadline.

California also has two projects that could add gigawatts of pumped hydro storage to its grid, but those will cost billions of dollars and take years to develop. The 2-gigawatt, \$2.5 billion Eagle Mountain project, backed by NextEra Energy, also faces environmental opponents that have defeated efforts to pass state laws to provide incentives to pumped hydro developments over the past few years.

Ed Smeloff, director of grid integration at advocacy organization Vote Solar, believes some of the concentrated thermal solar projects built in the Mojave Desert region of California, Nevada and Arizona over the past two decades could be outfitted with thermal storage, such as molten salt systems that capture their heat for nighttime use.

"I think there's acknowledgement that there are big challenges" to meeting the CPUC's target for bringing on novel carbon-free resources, he said. Under the CPUC's proposals, California's utilities and CCAs will be asked to report their progress on this front in 2023 and could secure an extension to deliver on it until 2028.

Still, he commended the proposals for their ambitious goals. "They've adopted a mindset that just-in-time procurement [and] middle-of-the-road procurement are too risky," he said.

(Article image courtesy of [Marya](#))

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