

California Renewable & Storage Milestones

By John Benson

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1. Introduction

My home state has set some aggressive long-range goals for clean energy, specifically we must have 60% renewable and zero-carbon electricity by 2030, ramping up to 100% by 2045. By the way, California has clear definitions of renewables and these include solar, wind, geothermal and small hydro. “Zero-carbon” (or “carbon-free”) sources include nuclear and large hydro. Both of the latter sources have long-build-out times, and potential environmental issues. However, our one remaining nuclear plant (Diablo Canyon) is needed, mostly in the next five years, and existing large hydroelectric plants are needed for the foreseeable future.

We also need ever-increasing battery energy storage system (BESS) capacity.

California has given America a glimpse at what running one of the world’s largest economies on renewable energy might look like.¹

The state recently hit a milestone: 100 days this year with 100% carbon-free and renewable electricity for at least a part of each day, as tracked by Stanford University engineering Professor Mark Z. Jacobson.²

The state notched the milestone while — so far — avoiding blackouts and emergency power reductions this year, even with the hottest July on record.

That progress is largely due to the substantial public and private investments in renewable energy — particularly batteries storing solar power to use when the sun isn’t shining, according to energy experts.

“California has made unprecedented investments in our power grid in recent years — and we’re seeing them pay off in real time,” Gov. Gavin Newsom said in a statement to CalMatters. “Not only is our grid more reliable and resilient, it’s also increasingly running on 100% clean electricity.”

2. Future Goals

The state faces a huge challenge in coming years: A series of mandates will require carbon-free energy while also putting more electric cars on roads and electric appliances in homes...

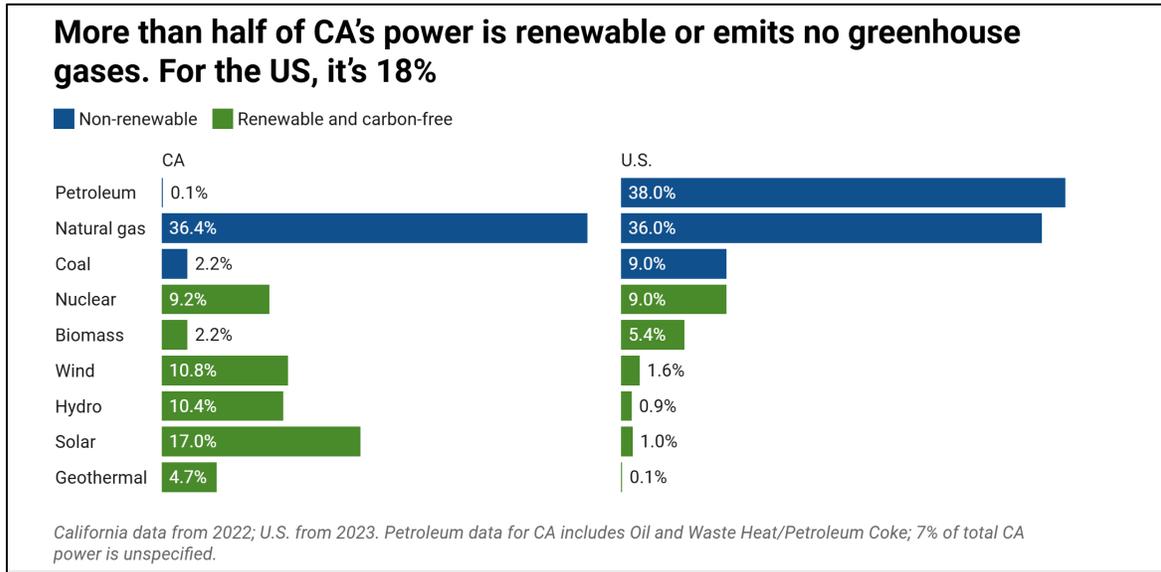
Signs of progress are emerging. From January to mid-July of this year, zero-carbon, and renewable energy exceeded demand in California for 945 hours during 146 days — equivalent to a month-and-a-half of 100% fossil-fuel-free electricity, according to the California Energy Commission, the state agency tasked with carrying out the clean energy mandates.

¹ Alejandro Lazo, CalMatters via LAist, “California hits milestones toward 100% clean energy — but has a long way to go,” Aug 19, 2024, <https://laist.com/news/climate-environment/california-hits-milestones-toward-100-clean-energy-but-has-a-long-way-to-go>

² <https://electrek.co/2024/07/29/california-achieves-100-days-of-100-electricity-demand-met-by-renewables/>

But California still has a long way to go to stop burning fossil fuels for electricity. Natural gas, which emits greenhouse gases and other air pollutants, remains its single largest source of electricity.

Just over half of power generated for Californians in 2022 came from solar, wind, other renewables and nuclear power, while 36% came from natural gas plants.



Reliability of the power grid is a top concern as the state switches to solar and wind energy. Unpredictable events like wildfires and winter storms also cause outages, while hot summer months, with air conditioners whirring, strain the supply.

In August of 2020 California experienced its first non-wildfire blackouts in nearly 20 years, and in late August and September of 2022, a severe heatwave forced regulators to ask consumers to voluntarily reduce power for 10 days.

Since September 2022 — when California teetered on the edge of those blackouts and the governor pleaded for conservation — nearly 11,600 new megawatts of clean energy have been added to the state's grid, said Elliot Mainzer, chief executive of the California Independent System Operator, which manages the grid. (That's enough to power around 9 to 12 million homes although it's not available all at one time.)

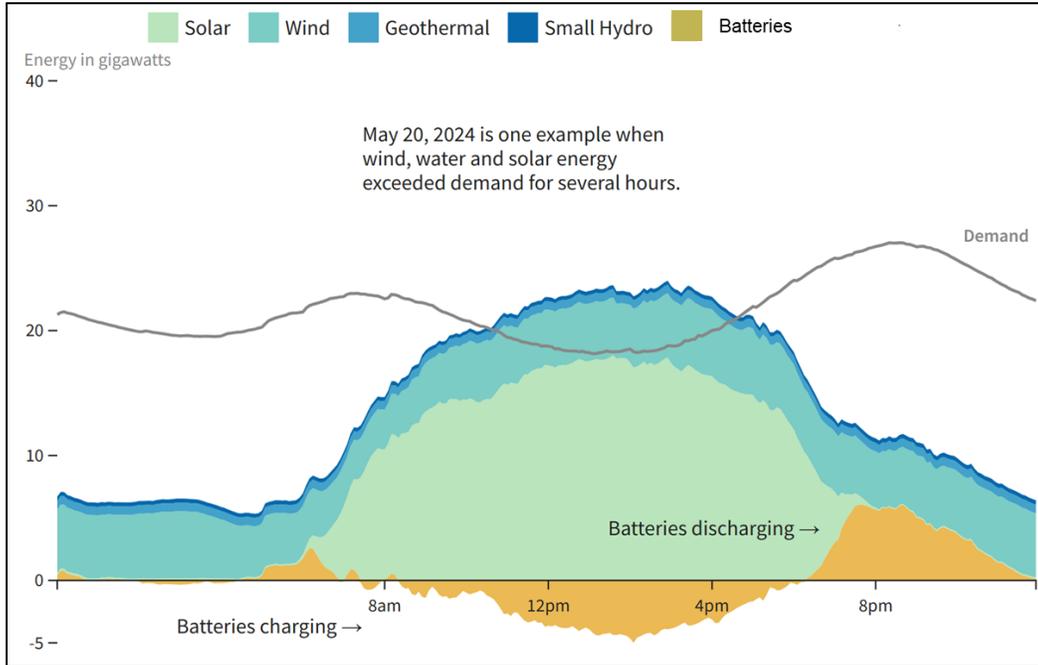
2.1. Energy Storage

California also now has more than 10,000 megawatts of battery capacity, making it the largest supply outside of China. Battery power from large commercial facilities proved its worth during last month's heat wave, Mainzer said.

Batteries “were a major difference-maker,” Mainzer said. “The batteries charged during the day, when solar energy is abundant, and then they put that energy back onto the grid in the afternoon and evening, when solar production is rolling off the system.”

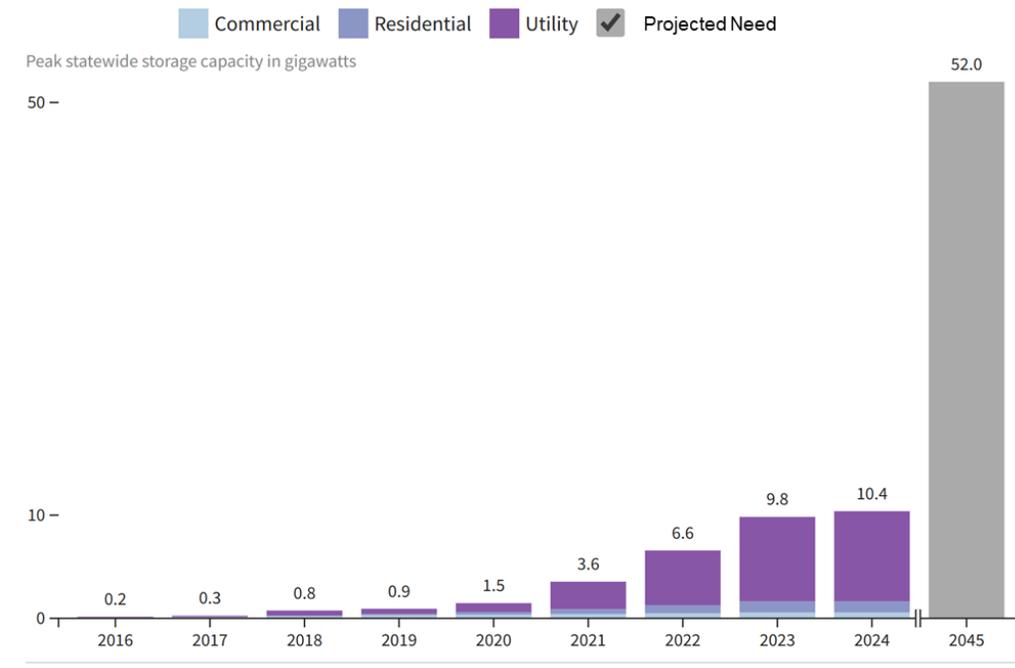
California relies heavily on four-hour duration lithium-ion batteries, which come in large, centralized facilities and hybrid facilities paired with solar energy projects. More homes also are installing batteries with their rooftop solar installations, but they supply a small amount of power.

One day of California's renewable energy supply



Author's comment: I recently installed a PV+storage system on my home, so I too contribute to my states' storage. My tiny BESS (10 kWh) also follows the above curve, charging during peak solar production, and discharging in the early evening. The latter is driven by a Time of Use Rate with peak-period from mid-afternoon until early evening.

California needs more big batteries



Planning and practicing various emergency scenarios have also helped immensely, Mainzer said.

“Our grid operators are now increasingly experienced at managing these extreme heat events,” Mainzer said. “Our forecasters also did an excellent job of reviewing the next day’s conditions so that the market could respond effectively.”

California may need to more than double its energy generation capacity by 2045 to meet the 100% clean energy target while adding electric cars, appliances and other technologies, said Siva Gunda, who sits on the California Energy Commission.

Author’s comment: Appliances, most notably, include converting HVAC systems to Heat Pumps to avoid burning natural gas. Also, many prefer using gas for cooking. Although I do, I now use all electric cooking appliances. I adjusted to these long ago.

To do that, California aims to build about 6,000 to 8,000 megawatts of new energy resources each year. The state hit a record last year, adding more than 6,000 megawatts, Gunda said. Each megawatt is enough to serve between 750 and 1,000 homes.

“The table is set,” Gunda said. “The pieces are there for success, and it’s about executing it, together with a common vision and collaboration.”

The commission is closely monitoring a new concern: Artificial intelligence technology, which uses large data centers that consume power. “We’re carefully watching where the loads are going to grow,” Gunda said.

Stanford’s Jacobson said running on 100% renewable energy is becoming more common.

Over the July 28 weekend, California marked the 100th nonconsecutive day within a 144-day stretch in which 100% of electricity came from renewable sources for periods ranging from five minutes to more than 10 hours, he said.

On April 8, a solar eclipse reduced solar power generation and increased demand on the grid, which was met by batteries. On May 5, wind, hydroelectric and solar energy reached more than 160% of demand for a significant portion of the day.

California continues to debate ending its reliance on natural gas and nuclear power.

Fearing emergency rolling blackouts like the one in 2020, Newsom and the Legislature in 2022 allowed some natural gas plants that were supposed to go offline to keep operating.

And the Diablo Canyon nuclear power plant will continue operating while Pacific Gas & Electric pursues federal permission to stay open past 2025. Nuclear power is considered carbon-free but it creates radioactive waste.

State officials and private investors aim to create an entirely new industry — giant floating ocean wind platforms — to produce 13% of California’s power, enough to power 25 million homes, by 2045. The massive projects will cost billions of dollars.

Author's comment: See the earlier post summarized and linked below.

California's Plan for Offshore Wind: The format of this post will be unusual for your author. I usually like to use multiple information sources and interject my own analysis. Herein there will be one source, reference 1 in this post. You will note that the source of this in the California Energy Commission (CEC). Since I have worked with this state agency in the past, I know they will bring a degree of rigor and inclusion, that I cannot match, so a large part of this post hereafter will be from the primary reference. My work will be compressing the relevant excerpts from the primary reference to keep the length of this paper within reasonable bounds while retaining the most important content.

Offshore wind energy developed in federal ocean waters off California's coast is poised to play an important role in diversifying the state's portfolio of resources as it complements the generation attributes of other clean energy resources. Offshore wind can support grid reliability and help California achieve its 100 percent renewable and zero-carbon energy goals, as well as the electrification of other sectors, such as transportation.

<https://energycentral.com/c/cp/california%E2%80%99s-plan-offshore-wind>

Some Democratic legislators are hoping to make it easier to build wind and solar projects, since sometimes local obstacles and permitting take years. They are negotiating an end-of-session package of proposed laws that could streamline construction, CalMatters reported earlier this month.³ California's legislative session ends Aug. 31.

Jacobson said the cost of large-scale solar power projects has "dropped substantially" in recent decades largely because of "economies of scale — just the huge growth of solar on a worldwide scale."

"There's no miracle technology that was developed," he said. "It's just subtle improvements in existing technologies and deployment, deployment, deployment."

Author's comments: The "package of proposed laws" in the California Legislature described in the third paragraph above are called "California Made." I don't believe that these passed.

See the post summarized and described below.

Federal Reforms and The Interconnection Problem: Although fossil fuel-generated electricity production has historically vastly outweighed production from wind and solar, that is changing. However, in many countries, there is a substantial and growing waiting list for connecting new generation projects to the electrical grid. In the United States. For example, the number of applications has increased rapidly since 2010 to more than 3000 projects in the various interconnection queues as of 2021 (see this post's main image). The median time from interconnection request to interconnection agreement was 35 months in 2022, with wait times even longer for wind and solar. In response to this growing bottleneck, the US Federal Energy Regulatory Commission (FERC) issued two recent orders aimed at improving the generation interconnection process and long-term transmission grid planning.

<https://energycentral.com/c/cp/federal-reforms-and-interconnection-problem>

³ <https://calmatters.org/environment/2024/08/california-legislature-governor-energy-package-solar-wind/>