

California Energy Storage Update

By John Benson

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1. Introduction

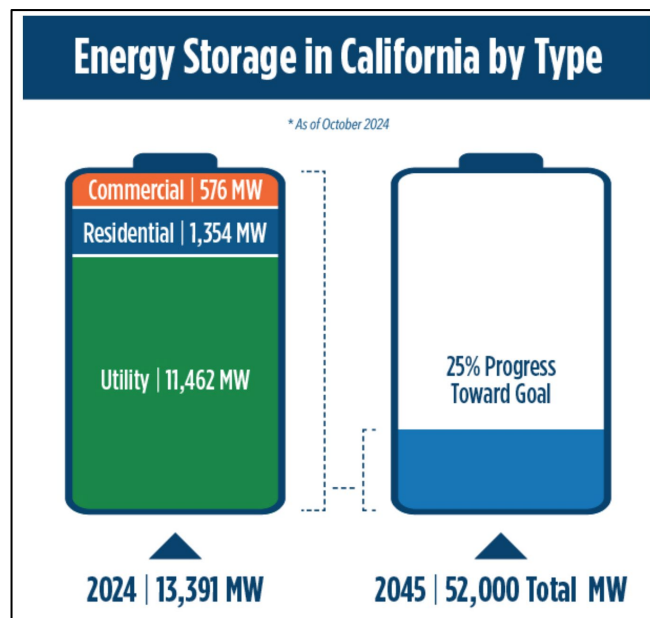
I've danced around the title subject recently, so I thought I would add this post which deals with the title subject directly. More specifically, for my home state:

- Current and projected future deployment status of utility-scale energy storage systems
- Potential barriers to future deployments
- Technical developments
- Estimates of likely future deployments

2. Current & Future Deployment Status

California is a world leader in energy storage with the largest fleet of batteries that store energy for the electricity grid. Energy storage is an important tool to support grid reliability and complement the state's abundant renewable energy resources. These technologies capture energy generated during non-peak times to be dispatched at the end of the day and into the evening as the sun sets and solar resources go offline, reducing dependence on fossil fuel generation to meet peak loads. See figure below.¹

The Public Utilities Code defines an energy storage system as a commercially available technology that absorbs energy, storing it for a specified period, and then dispatches the energy. From 2018 to 2024, battery storage capacity in California increased from 500 megawatts (MW) to more than 13,300 MW by the end on 2024.² The state projects 52,000 MW of battery storage will be needed by 2045.



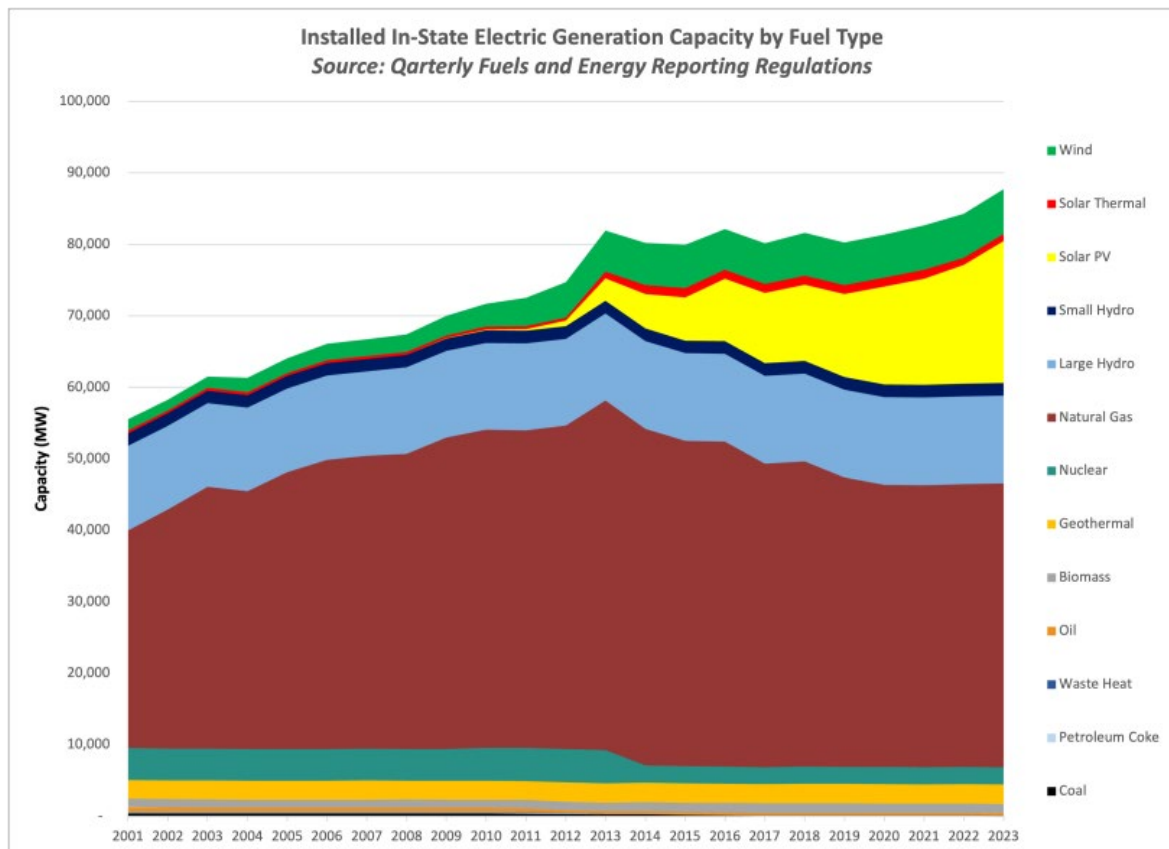
¹ Michael Nyberg, Data Integration Branch, California Energy Commission, October, 2024,

<https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/california-energy-storage-system-survey>

² The author edited this paragraph to avoid confusion. The 13,300 MW total battery capacity by the end of 2024 was widely reported, and I believe it is correct. But there were battery fires at the 300 MW Vistra BESS at Moss Landing in Jan & Feb 2025, and this facility is a total loss. Go through link for more info: https://www.newsdata.com/california_energy_markets/regional_roundup/vistra-disconnecting-and-decommissioning-moss-landing-bess/article_913dadfc-00f8-11f0-a0ab-7f5c85081b69.html Also see section 3.1 in this paper.

Author's comment: As of the end of 2023, California had 20,871 MW of solar generation, and 6,284 MW of wind generation. Since these are both intermittent, and solar generation is ramping up, we need to also ramp up grid-scale battery energy storage systems (BESS) in lock-step to keep pace with this (see chart below). Wind energy is projected to hold steady for the next few years. The good news is that (1) we also have about 3,750 MW of long-duration (typ. 8-hr.) pumped storage hydro; (2) As can be seen by the figure on the bottom of page 1, we have about 13,300 MW of short-duration (typ. 4-hr.) battery energy storage, and we are ramping up battery energy storage to keep pace with the requirement to mitigate the intermittency of solar as this renewable resource continues to grow (see chart below), and dispatchable gas-fueled generation continues to shrink.³

Also, your author has a small battery energy storage system that is integrated into my residential PV. This is a Sonnen Evo rated at 4.8 kVA power and 10 kWh energy. Should I need to expand this, I can add one or more additional units, which can each be used to increase the power and/or energy by the above amounts.



³ <https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/electric-generation-capacity-and-energy>

3. Potential barriers to future deployments

The recent news on the battery energy storage fires at Vistra Energy's Moss Landing facility in Monterey County (south of the SF Bay Area) is the elephant in the room here, so we will cover that first.

3.1. Moss Landing Fire

A fire at the world's largest battery storage plant in Northern California smoldered Friday after sending plumes of toxic smoke into the atmosphere, leading to the evacuation of up to 1,500 people. The blaze also shook up the young battery storage industry.⁴

The fire at the Vistra Energy lithium battery plant in Moss Landing generated huge flames and significant amounts of smoke Thursday but had diminished significantly by Friday, Fire Chief Joel Mendoza of the North County Fire Protection District of Monterey County said. Vistra is based in Texas.

"There's very little, if any, of a plume emitting from that building," Mendoza said. Crews are not engaging with the fire and are waiting for it to burn out, he said. Letting lithium-ion battery fires burn out is not unusual because they burn very hot and are hard to put out.

No injuries have been reported but residents raised concerns about hazardous gases being released into the air.

The fallout from the fire at the battery storage facility about 100 miles (160 kilometers) south of San Francisco was just beginning.

"This is more than a fire, this a wake-up call for the industry. If we're going to be moving ahead with sustainable energy, we need to have a safe battery system in place," Monterey County Supervisor Glenn Church said at a Friday morning briefing.

Battery storage is considered crucial for feeding clean electricity onto the grid when the sun is not shining or the wind is not blowing, and it has been used in significant amounts only in the last couple of years. But the batteries are nearly all lithium, which has a tendency toward "thermal runaway," meaning it can catch fire and burn very hot, releasing toxic gases.

Vistra sells energy to Pacific Gas & Electric, one of the nation's largest utilities.

The blaze did not spread beyond the facility, according to Monterey County spokesperson Nicholas Pasculli. Evacuation orders for from 1,200 to 1,500 people were lifted Friday evening after officials confirmed there was "no threat to human health," the Monterey County Sheriff's Office said in a statement. But residents were advised to close their windows and turn off their air conditioning...

⁴ Olga R. Rodriguez and Isabella O'Malley, Associated Press, "Smoke from fire at California lithium battery plant raises concerns about air quality," January 17, 2025, <https://apnews.com/article/battery-storage-plant-fire-california-moss-landing-7c561fed096f410ddecfb04722a8b1f8>

Brad Watson, Vistra's senior director of community affairs, said the Environmental Protection Agency is testing air quality at the facility and that the company has hired an air consultant to check for pollution in nearby communities. Vistra will share the results when they are available, Watson said.

Kelsey Scanlon, director of Monterey County's Department of Emergency Management, told reporters that the release of hydrogen fluoride into the atmosphere from the blaze is a cause for concern.

The Centers for Disease Control and Prevention says hydrogen fluoride gas can irritate the eyes, mouth, throat, lungs and nose, and that too much exposure to the gas can be deadly...

"It doesn't appear that the fire department had the appropriate fire retardants to minimize this fire and have to resort to actually letting it burn, exposing all of the residents, including Watsonville in Santa Cruz County, and this is extremely disturbing," resident Silvia Morales said.

Monterey County Sheriff Tina Nieto said air quality monitoring systems had not detected any hazardous gases in the air.

Watson said two "overheating events" happened at the battery plant in 2021 and 2022 because the batteries got wet. A third incident happened in 2022 in the neighboring Elkhorn battery plant that is owned by PG&E, he said.

Lithium batteries make the power grid more stable and reduce the need for energy to be generated from fossil fuels, which release planet-warming gases. California was an early adopter of battery storage and leads the nation with more than 11 gigawatts of utility-scale storage online, which can meet nearly half of the demand on the state's main grid for four hours per day.

Experts say lithium batteries are a safe technology that are essential for lowering carbon emissions and making grids more reliable. But they are a significant fire risk if they are damaged or overheat.

Author's comment: I agree that "lithium batteries are a (relatively) safe technology, but when you stack megawatt-hours of them together, even a very low-probability event can eventually start a really large fire.

Continuing with Reference 4.

"We are not convinced that this incident could materially shift the national trend of growing grid scale battery deployment," said Timothy Fox, managing director of ClearView Energy Partners, a non-partisan energy research firm.

It was unclear what caused this latest fire. Vistra said in a statement that after it was detected, everyone at the site was evacuated safely. After the fire is out, an investigation will begin...Jodie Lutkenhaus, professor of chemical engineering at Texas A&M University, said safer batteries must be found that can be used on the grid.

Some improvements, such as more fire prevention measures, can be made to reduce fire risks with lithium batteries, Lutkenhaus said, "but the only way to really address the problem is to use a safer technology." Water-based and redox flow batteries are being developed by scientists but have not yet scaled commercially.

Lithium iron phosphate batteries are a possible alternative because they are highly stable, but they still carry some fire risk.

No matter what kind of lithium battery you use, “when you reach a certain size, it is inherently very dangerous and easy to catch fire,” said Yiguang Ju, engineering professor at Princeton University.

Author’s comment: I agree with Dr. Ju, but don’t worry, help is on the way.

3.2. Lithium-Ion Battery Energy Storage Pricing

There is no “typical” battery energy storage pricing, but I asked my Microsoft Bing AI assistant about this, and got the following answer with references thereafter.

Utility-scale lithium-ion battery energy storage systems (BESS) in the US have varying costs based on system and component. A 10-year price forecast shows storage costs of \$245/kWh in 2030 and \$159/kWh in 2050.

https://atb.nrel.gov/electricity/2024/utility-scale_battery_storage

<https://www.nrel.gov/docs/fy23osti/85332.pdf>

<https://www.energy-storage.news/li-ion-bess-costs-could-fall-47-by-2030-nrel-says-in-long-term-forecast-update/>

4. Technical Developments

OK, what if there were an emerging battery energy storage technology that potentially was significantly less expensive than lithium-ion, and also less prone to burst into flames? Good news: there is. Furthermore, I have a recent paper on this new technology that was posted on April 3. The title of this paper containing the new technology’s name is below. This battery technology is not ready for prime-time today, but is moving very fast on multiple fronts.

The Emergence of Sodium-Ion Batteries: *It was February 23, when I discovered my latest Issue of Science contained an excellent article on the title-subject of this paper, and I was two-days away from posting a paper, “Next-Gen Rechargeable Battery Designs,” a much broader subject, but one that included this title subject. I made a sensible decision, post “Next-Gen...” as planned, and continue with a paper for Early-April that focused on the title subject of this paper. I had been working on the earlier paper for several months, and its primary reference was almost a year old, and a year is an eternity in the development of leading-edge components like a new generation of rechargeable batteries.*

<https://energycentral.com/c/cp/emergence-sodium-ion-batteries>

5. Future Deployment Estimates

There is one estimate on Page 1. Whether this factors in the above sodium-ion emergence (52,000 MW by 2045), I don’t know. However, with this amount of growth (38,000 MW in 20 years), even hedging on sodium-ion vs. lithium-ion with its expense and pyromaniac tendencies, I would guess this is a conservative estimate. Also, there doesn’t appear to be any seriously competing technology to these two now, but who knows what (20 years’ worth of) the future will bring.