



Battery Storage + Renewables Are Driving California Grid Reliability

CLIMATE
ACCOUNTABILITY
PROJECT



Clean energy and battery storage are proving essential for California's grid reliability, despite efforts by the fossil fuel industry to undermine the transition and spread misinformation. The successful avoidance of blackouts during extreme heat waves in 2022 and thus far in 2024 demonstrates that clean energy is not only viable but crucial for a dependable power grid. However, to maintain and enhance this reliability, continued and increased investment in renewable energy and battery technology is essential. It is imperative to invest more in these technologies to ensure a resilient, reliable, and more affordable energy future for California.



California is moving toward a clean energy future. **SB 100** set California on a path to supply 100 percent of its electric retail sales with renewable and zero-carbon resources by 2045. Meanwhile, continued progress on state policies like SB 700, which extends funding for distributed energy resources, and SB 1339, which promotes microgrid development help us to power more of our lives with cleaner, cheaper energy.

The next decade will see major increases in renewables driven by these state policies, overwhelming public support for a clean energy transition, falling costs of solar and wind technologies, rapid EV adoption, and major breakthroughs in battery storage technology. California is already ahead of schedule in expanding battery storage and powering the grid with renewable energy, as evidenced by the **grid's reliability during**

recent extreme heat events across the state. This should be the focus going forward for a clean, reliable power supply.

The oil and gas industry is seeking to delay this transition to clean energy by opposing renewable energy generation.

Industry groups and fossil fuel media attempt to undermine our clean energy transition and focus their attacks on the reliability of a renewables-centered electric grid. For example, when the Texas grid went offline during a severe winter storm in 2021, industry groups blamed **frozen wind turbines**. **In reality, oil and gas infrastructure** was the primary cause of the outage and the delays in restoring power.

The intermittency of wind and solar power remains a challenge as we transform our grid.

However, **advancements in energy storage technology, including grid-scale batteries, smart grid systems utilizing AI for demand response, and improved weather forecasting methods have significantly enhanced our ability to manage and mitigate these fluctuations.** Addressing these issues is crucial and should not deter us from pursuing clean energy solutions. We are now better equipped than ever to ensure a reliable and sustainable energy future.

In California, the fossil fuel industry claims that grid reliability is threatened by renewables, and spreads the false argument that the state is attempting an immediate ban on fossil fuels in the electric grid, when in fact, it is a gradual transition. Solar, wind, and batteries now form a growing and complementary mix to power California across the day and across the seasons of the year, especially when combined with existing clean technologies like hydropower.

Transitioning to clean energy options will provide consumers with a **more reliable energy mix**, greater energy flexibility, and significant reductions in greenhouse gas emissions. The price of fossil fuels is **inherently volatile and is vulnerable to price gouging**. The cost of gas has skyrocketed in recent years while clean energy sources and storage options have become dramatically cheaper over the last decade. Reliance on fossil fuels perpetuates a damaging cycle: it generates pollution that accelerates climate change, leading to unpredictable weather and market instability, ultimately making the fossil fuel-dependent grid increasingly unreliable.

California's installed battery capacity reached **10 gigawatts** in 2024, meeting about 20 percent of peak electricity demand. The state **increased its battery capacity by 1250% since 2019**, up from 770 MW in 2019. **Between 2020 and 2024, 18,500 MW of new resources were added, with 11,000 MW of future resources in contract and under development.** In 2023, officials stated that **California was less likely to experience rolling blackouts** due to the increased storage supply. Due to advancements in grid management and increased storage capacity, California **has not experienced large rolling blackouts** since 2020.

The positive impacts can be especially robust in the decade ahead, as California seeks to reach majority renewables, setting the stage for its ultimate goal of 100 percent clean energy. If we stay focused on promoting the growth of battery storage both at home and at scale, and promote a diverse, balanced renewable energy portfolio — we will realize climate, public health, and economic benefits. If we allow the fossil fuel industry to alter our path, we will get a larger dose of the negative fossil fuels impacts such as price spikes, pollution, climate impacts, and fossil fuel's own reliability risks.

I. COMPLEMENTARY CLEAN ENERGY

Building out complementary clean energy sources and battery storage capacity should be California's focus for creating a reliable, renewables-based grid.

- » Diversified clean energy sources — including wind, rooftop and utility-scale solar, hydropower, and geothermal — and storage create a complementary energy mix that will reduce emissions, establish more flexibility in the power system, and maintain a reliable grid.
- » California can reliably reach **85 percent clean energy by 2030**, in-depth modeling has shown, by ramping up **offshore wind** and geothermal power production in addition to utility-scale solar.
- » In 2024, for the first time ever, battery storage discharge in California exceeded **6 GW**, and batteries were the largest source of supply to power the grid on that day. As technology rapidly progresses, batteries are becoming more useful and have greater storage capacity. This allows us to power our homes, cars, and economy with clean, renewable energy at all hours, making them key to increasing grid reliability.
- » Innovation in clean energy technology and battery storage is revolutionizing California's energy grid. **“Vehicle to grid” (V2G)** uses electric vehicles to store energy and send it back to the grid. Some school districts already use electric school buses to improve local grid reliability.

II. ELECTRIC VEHICLES

Electric vehicles (EVs) are not only a climate game changer, they will also help improve grid reliability.

» California's transition to a clean vehicle future is well underway, with **nearly 2 million electric vehicles (EVs)** on the road as of July 2024. This milestone highlights EVs' potential to enhance the state's electric grid and drive economic and technological advancements. The California Energy Commission (CEC) projects a substantial increase in the number of EVs, forecasting that the light-duty plug-in electric vehicle population will grow to **7.1 million by 2030 and 15.2 million by 2035**.

» **Charging EVs during off-peak hours helps balance the electrical load and reduces costs for consumers, supporting grid stability.** Bidirectional charging technologies (V2G) further enhance grid resilience by allowing EVs to return stored electricity to the grid during peak demand periods, reducing reliance on fossil fuels. Additionally, EVs could store renewable

energy during low demand and release it during high demand, stabilizing the grid during extreme heat events.

» **California is experiencing more extreme heat events due to climate change, and residents are increasingly encouraged to conserve electricity during those times.** In the near future, EV batteries can store excess renewable energy and pull it back into use exactly when needed — such as during periods of high electricity demand.

» The expansion of EV charging infrastructure will require widespread investment in California's grid and effective management to reduce potential impacts. **Improving charger and vehicle technology along with grid upgrades will make it possible to accommodate charging in ways that will minimize the grid impact.**

III. CLEAN ENERGY

In many instances, solar, wind, and other clean energy sources are now cheaper than fossil fuels, including gas.

- » **It is now cheaper to build new solar plants than it is to operate existing coal plants.** Due to the price volatility of gas and the decreasing price of renewables and battery storage, it's now cheaper to switch from coal to clean energy than from coal to natural gas.
- » **In many scenarios, solar and wind are now cheaper than gas.** As solar and wind manufacturing continues to get more efficient, clean energy costs continue to fall, with battery storage costs set to drop dramatically as well. Once wind and solar installations are deployed, their **maintenance costs are minimal**, making them an even more compelling and economically superior choice for sustainable energy. The same cannot be said for gas or other fossil fuels.
- » **As of 2024, wind and solar prices were the cheapest options for new electric generation almost everywhere.** From January to April, Federal Energy Regulatory Commission data showed that renewables accounted for ninety-nine percent of new power added to America's grid.
- » **The price of utility-scale solar decreased approximately 12 percent from 2020 to 2021.** Both solar and storage costs have fallen over the past decade. The price of residential solar (which also saves on transmission infrastructure) was reported at \$2.65/W in 2021, down from \$7.53/W in 2010. Utility-scale solar cost \$0.89/W in 2021 compared to \$5.66/W a decade prior.

IV. CLIMATE CHANGE-RELATED EVENTS

Climate change-related heat events are increasing in intensity and frequency.

Over the past five years, California has faced several extreme heat waves, with notable events in September 2022 and July 2024. September 2022 saw record-breaking temperatures across the state. However, these records were surpassed in July 2024, when Californians experienced even more extreme **jaw-dropping record highs**, including Palm Springs reaching 124 degrees over the Fourth of July weekend. Despite these intense conditions, California avoided major blackouts due to significant investments in solar and battery storage, as well as improvements in grid stability.

- » California avoided blackouts during extreme heat waves in 2022 and 2024, demonstrating significant improvements in grid management. Notably, **during the July 2024 heatwave, the grid operated without the need for Flex Alerts, showcasing further progress from 2022.** CAISO President and CEO Elliot Mainzer credited investments in clean energy and battery storage for grid reliability. CAISO VP of Systems Operations Dede Subakti noted that new clean energy resources were crucial. Enhanced battery storage, conservation efforts, and better coordination even allowed California to send excess power to neighboring states. These improvements highlight the need for continued vigilance, expanded battery storage, and demand response capabilities, avoiding a return to fossil fuels.
- » During the 2022 heat waves, California narrowly avoided rolling blackouts thanks to battery storage and effective demand response measures. **Batteries provided 2.4% of evening power generation, preventing blackouts.** On September 5, 2022, batteries supplied over **3,360 megawatts**, outperforming the state's largest generator. By April 2024, California held about 55% of the U.S. power storage capacity, the **most installed battery storage capacity** of any state
- » Projections show that diversifying renewable energy and increasing battery storage capacity are long-term solutions to manage unprecedented heat waves and reduce blackout risks.

V. RENEWABLES & STORAGE

It's projected that by 2030 the U.S. storage capacity will grow tenfold.

The global energy storage market almost **tripled in 2023**, the largest one year gain ever. In the U.S., battery storage capacity is expected to increase by **89% by the end of 2024**.

» The state's focus on expanding renewable energy and storage remains crucial. By mid-2024, California's installed battery capacity had reached **10 gigawatts**, meeting about 20% of peak electricity demand. This is a significant increase from 770 MW in 2019, marking a **1,250% growth since the start of the Newsom Administration**.

» The Department Of Energy's new \$10.5 billion "Grid Resilience and Innovation Partnerships" (GRIP) Program aims to improve grid flexibility and resilience. In April 2024, a consortium, including key California energy stakeholders, **submitted a GRIP proposal** for up to \$1 billion in

grants and \$1.1 billion in matching funds. These Grid Enhancing Technologies (GETs) could boost transmission capacity 5000 MW, enhance grid safety, and reduce maintenance costs.

» California achieved a milestone with solar energy in April 2024, **meeting a record 97.5% of the state's electricity demand**. The state has drafted a strategy to enhance grid reliability while meeting the 2045 climate goals.

What the Experts Are Saying



California—the fifth-largest economy in the world—has experienced a record-breaking string of days in which the combined generation of wind, geothermal, hydroelectric, and solar electricity has exceeded demand on the main electricity grid for anywhere from 15 minutes to 9.25 hours per day. These clean, renewable electricity sources are collectively known as wind-water-solar (WWS) sources. It is impossible to understate how monumental this clean, renewable energy milestone is and how quickly WWS supplies have ramped up.

Mark Jacobson,

Professor of Civil and Environmental Engineering at Stanford University and author of *No Miracles Needed: How Today's Technology Can Save Our Climate and Clean Our Air*



In reality, it is entirely possible to sustain a reliable electricity system based on renewable energy sources plus a combination of other means, including improved methods of energy management and storage.

Amory B. Lovins and M. V. Ramana,
(Yale Environment 360)

What the Experts Are Saying



Decarbonizing the power system is a necessary step if the worst effects of climate change are to be avoided. The benefits of a zero-carbon grid outweigh the costs in each of the more than 100 scenarios modeled in [the 100% Clean Energy by 2035] study, and accelerated cost declines for renewable and clean energy technologies could lead to even larger benefits.

Patrick Brown,

NREL analyst and co- author of the 100% Clean Electricity by 2035 Study, released by The National Renewable Energy Laboratory (NREL)



Solar technology has advanced rapidly over the past decade ... and the costs of solar electricity have fallen by roughly 80 percent. These advances provide confidence in our ability to rapidly innovate to meet the nation's climate goals. At the same time, it is critical that we bring increased focus to reducing soft costs and ensuring equitable access to the environmental, economic, and societal benefits of increased solar deployment.

Becca Jones-Albertus,

Director of the US Department of Energy Solar Energy Technologies Office

Conclusion

Maintaining grid reliability hinges on our commitment to clean energy and advanced battery storage. By prioritizing renewables and storage technologies, we create a more resilient, cost-effective, and sustainable energy system. This approach not only benefits ratepayers but also aligns with our commitment to protecting our climate and our communities. The outdated operations of the fossil fuel industry threaten progress, but by staying focused on innovative clean energy solutions, we ensure a stable, prosperous, and environmentally responsible energy future for California.



California's future energy security and environmental health depend on protecting and strengthening our clean energy policies, accelerating the adoption of renewable technologies, and ensuring grid resilience against climate-induced challenges.