County Of Santa Cruz

COMMISSION ON THE ENVIRONMENT

701 OCEAN STREET, ROOM 400, SANTA CRUZ, CA 95060-4073

(831) 454-2580 FAX: (831) 454-2131 TDD/TTY: Call 711

October 13, 2025

Santa Cruz County Board of Supervisors
701 Ocean Street, Room 500
Santa Cruz, CA 95066

Regarding: Commission on the Environment Battery Energy Storage Recommendation

Dear Chair Hernandez and Members of the Board:

On September 1, 2025, the Commission on the Environment submitted a signed informational letter to your board detailing a series of informational workshops hosted by this commission that focused on Battery Energy Storage System (BESS) technologies and safety issues.

Based on these workshops, the Commission on the Environment found that Battery Energy Storage Systems are essential infrastructure for meeting Santa Cruz County's 2022 Climate Action and Adaptation Plan. Policymakers should prioritize BESS as a cross-cutting solution that delivers on emissions reduction, environmental resilience, lower energy costs, and grid scale stability. Further, based on additional learning of BESS implementation in the state, public comment, and potential policy implications, we urge the Board to act now to ensure Santa Cruz County retains land use authority for BESS technologies that incorporate the highest standards for public and firefighter safety, and ecosystem integrity.

This commission respectfully recommends the following:

1.Integrate Battery Energy Storage Systems (BESS) into County Energy Policy

Integrate (BESS) into County energy policy and ensure (BESS) are formally included in renewable grid scale projects, building electrification programs, and resilience hub development as long as there is commensurate adoption of beyond gold standard safety protocols and regimen for proposed and future projects described in detail below.

A. <u>Alignment with Codes and Standards</u>
   i. Require compliance with NFPA 855 and SB 283.

ii. Embed UL 9540/9540A certification requirements and reference IFC/NEC for permitting consistency.
iii. Embed in CAAP; add (BESS) deployment and NFPA 855 adoption as measurable objections in 2026-2027 CAAP cycle advancing:
- Mitigation Objective 5: Achieve 100% clean energy by 2030.
- Mitigation Objective 6: Develop the "microgrid of the future".
- Adaptation Objective 22: Retrofit and build resilient Country infrastructure for extreme weather.
- Adaptation Objective 23: Support climate-impacted communities at risk of disasters.

B. Safety, Emergency Response, and Monitoring
i. Fire Prevention & Emergency Response Planning:
- Require Hazard Mitigation Analysis (HMA).
- Require Fire Risk Analysis (FRA)
- Require Failure Modes & Effects Analysis (FMEA)
ii. Documentation Standards:
- Mandate inclusion of UL 9540A burn test results, site specific Emergency Response Plans (construction through decommissioning), and triggers for fire authority notification if safety systems go offline.

C. Facility Infrastructure Requirements:
i. Dedicated Incident Command Post location.
ii. Adequate fire water tank capacity and accessible location.
iii. Auxiliary backup power design and refueling logistics.
iv. Site layout ensuring enclosure spacing based on burn test results.

D. Fire Detection and Suppression Best Practices:
i. Prioritize early gas/smoke detection and concentration reduction systems (per NFPA 69) over container suppression.
ii. Fire alarms must be monitored 24/7 by a UL Central Station.

E. Training and Drills:
i. Require annual multi-agency incident response drills with local Fire Departments, with semi-annual contact updates and staff training in Incident Command System protocols.

2. Environmental Impact Assessment (EIA) and Ongoing Monitoring

A. Pre Assessment Requirements:
i. Before project approval, the facility must prepare a clear Environmental Impact Assessment plan including:

- Detailed fire safety, toxic byproduct containment, and air quality risk evaluation, including a plume assessment.
- Monitoring baselines of air quality, water quality (of surface water ways adjacent to the facility and groundwater), surface soil chemistry, and biota at multiple trophic levels (i.e. plants and algae, filter feeders, mid-level consumers, and higher level predators) to determine the impact of chemicals of concern on the entire food web, including possible bio amplification at higher trophic levels.
- Assessment of cumulative impacts if co-located with other infrastructure.

B. <u>During Operations:</u>
   i. Routine environmental monitoring of air quality, water quality, surface soil chemistry, biota at multiple trophic levels, and hazardous byproducts.
   ii. Transparent public reporting of test results from the environmental monitoring to County officials and community stakeholders.
   iii. Clear incident reporting procedures accessible to the public.

3. Adaptive Technology Updates:

A. Require adoption of emergent safer, industry scale battery storage technologies as they become commercially available, viable, and certified. Those technologies may include sodium or flow battery technology.

4. Community Protections and Equity Based on Summary of Public Comment:
(see informational letter dated September 1, 2025)

A. <u>Resident Accommodations:</u>
   i. Ensure local residents are informed about risks, safety measures, and compensation protocols should an incident occur.

B. <u>Liability:</u>
   i. Developers must maintain clear liability insurance and communicate processes for neighbors to file liability claims clearly and in a timely fashion in the event of an accident or fire.

C. <u>Public Engagement:</u>
   i. Require regular community briefings, accessible documentation and dedicated points of contact for local residents.

5. Grid Resilience & Strategic Deployment

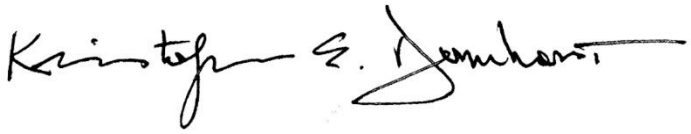
A. <u>Critical Infrastructure Focus:</u>
   i. Prioritize (BESS) backed grid scale projects for affordable housing, hospitals, emergency centers and disaster shelters.

B. Microgrid Deployment:
   i. Expand support for microgrids that combine (BESS) with renewable generation to reduce regional grid vulnerability.

Conclusion:
The COE's unanimous decision to inform the Board regarding BESS reflects the significance of this issue and the shared understanding of the need for both widespread BESS deployment and rigorous safety standards.

Please let me know if the COE can be of further assistance.

Sincerely,



Kris Damhorst, Chair
Santa Cruz County Commission on the Environment- 5th District Appointee
Kris.damhorst@gmail.com

cc: Commission on the Environment
Office of Response, Recovery, and Resilience

Attachments:
Commission on the Environment BESS Informational Letter dated September 1, 2025

County Of Santa Cruz

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(831) 454-2580 Fax: (831) 454-2131 TDD/TTY: Call 711

September 1, 2025

Santa Cruz County Board of Supervisors
701 Ocean Street, Room 500
Santa Cruz, CA 95066

Regarding: Commission on the Environment Battery Energy Storage Report

Dear Chair Hernandez and Members of the Board:

As your Board is aware, the Commission on the Environment (COE) has been hosting a series of informational workshops focused on Battery Energy Storage System (BESS) technologies and safety issues.

Workshop Dates:
The three workshops, which were requested by both members of the Board and the public, were well publicized and took place on June 25th, July 30th and August 20th.

Four Subject Matter Expert Presentations:
Four subject matter experts provided a wealth of information on climate change, the role of the electrical grid, battery technology and public safety considerations. The experts generously made themselves available to address comments and questions from members of the COE and the public.

Land Use Planning:
Land use planning, zoning decisions and specific project proposals were not part of the expert testimony in recognition of your Board's directions to the Planning Department and the ongoing process regarding those topics.

Public Attendance:
While technical in nature, the sessions were intended to be accessible to the general public and were well attended, with an average of 22 in person attendees and 11 online attendees at each workshop.

Commission on the Environment Ad Hoc Vote:
On 8/20/25, the COE voted unanimously to form an ad hoc committee to write this informational report to your Board summarizing the expert testimony received, responsive public input and the ensuing discussions. Given the length of the expert information attached here and discussed over almost eight hours of meetings, the summary of public input and significant general discussion appears first.

Summary of Public Input and General Discussion:
A considerable amount of public comment was beyond the scope of the COE workshops or was simply not the purview of the COE. Those comments largely centered on land use issues and questions for staff and Board members who will be evaluating BESS projects. Our Commission received differing opinions at each meeting with organized public groups opposing BESS projects. Links to recorded meetings of public comments and presentations can be found at the following link. **https://www.santacruzcountyca.gov/Government/Commissions,CommitteesAdvisoryBodies/CommissionontheEnvironment/CommissionontheEnvironmentMeetings.aspx**

Safety:
The remaining bulk of public testimony centered on the safety elements of BESS projects and the health effects of BESS projects that had caught fire, understandably so given the events at Moss Landing. Although there was general acknowledgement that the health concerns were a complicated topic that needed to be addressed elsewhere, the safety standards directly related to building a BESS project were discussed in length.

Senator John Laird's – Clean Energy Safety Act of 2025 (SB 283)
We received an update from Khalida Sarwari, Santa Cruz District Representative and Policy Analyst for Senator Laird's office on the latest progress on this bill. Additional information can be found at this link.

Moss Landing vs Current Innovations:
The expert speakers provided data to show that the battery technology and building standards used for the Moss Landing facility were sorely outdated as compared to current innovations in battery technology, especially large-scale lithium vs sodium batteries, battery management systems to keep batteries safe, BESS safety design and practices, and the likely bipartisan enactment of Senate Bill 283 to ensure statewide codes and standards.

Risks and Benefits, Public Comments:
The experts provided extensive evidence to show the urgent need to analyze the risks and benefits together if we are to address the calamitous impacts of climate change in time. Despite extensive conversation regarding the evidence presented, some public comments continued to be skeptical, even questioning the "balance" of the information received at the workshops given that it did not comport with their viewpoints. Other members of the public were very supportive of siting BESS projects with appropriate safety standards given the urgency of climate change impacts and the dire need to create better resiliency for our community.

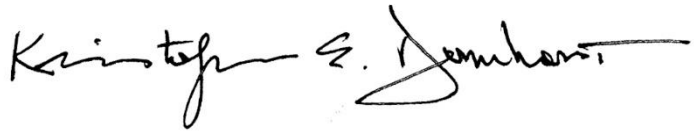
Commissioners Discussion:
Significant discussion among the COE Commissioners, the experts and the public attendees concluded with the consensus that although the COE aligned with the evidence-based, data driven information on which the highly qualified experts concurred, they also aligned with the public's concerns that future BESS projects must be built with a robust level of safety codes and standards.

Losing Local Land Use Authority:
At the 8/20 session, there was also public testimony regarding your Board's decision on 8/19 to defer consideration of a local BESS zoning ordinance until August 2026. The concern expressed was the danger of the County ceding its local land use authority to the California Energy Commission (CEC) to permit BESS projects here due to the fact that the County has been unable to enact a local ordinance that sets codes and standards. It was noted in public testimony that nothing prevents BESS project developers from using the legislatively allowed process to directly submit permit applications to the CEC and completely circumvent any local County evaluative oversight. After this testimony, there was consensus expressed among attendees and COE Commissioners that the lack of a local ordinance is an urgent matter.

A summary is attached of the expert speaker qualifications and information presented over almost eight hours of workshop sessions. Also attached are the press releases used to promote the workshops and a recent *Lookout* opinion piece authored by a local resident who also happens to be a national expert on BESS fire safety.

On behalf of the Commission on the Environment, I respectfully submit this report and am available to answer any questions from Board members or County staff. Thank you for reviewing.

Sincerely,



Kris Damhorst, Chair
Santa Cruz County Commission of the Environment- 5th District Appointee

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cc: Commission on the Environment

Attachments:
Summary of Expert Qualifications and Information
Press Releases promoting COE BESS Workshops
Lookout Santa Cruz- Opinion From Community Voices

Summary of Expert Qualifications and Information:

Dr Mark Jacobson Stanford University – Climate Change and Energy Transition (Presented on June 25th, 2025)

BIO: *Dr. Jacobson has been a professor at Stanford University since 1994. Based on the impact of his research through citations to papers, Dr. Jacobson is ranked as the most impactful scientist in the world in the field of Meteorology & Atmospheric Sciences among those with their first publication past 1985. In the Energy field, he is ranked #6 among those with their first publication past 1980. Dr. Jacobson's career has focused on developing large-scale clean, renewable energy solutions. He has developed roadmaps to transition countries, states, cities, and towns to 100% clean, renewable energy for all purposes and computer models to examine grid stability in the presence of 100% renewable energy*.

1. What are the primary motivations for a rapid global transition to 100% Wind, Water, and Solar (WWS) energy?

A rapid global transition to 100% WWS is urgently needed due to severe problems caused by fossil fuels and bioenergy. These include approximately 7.4 million air pollution deaths annually worldwide, costing an estimated $30 trillion per year. Global warming is projected to cost a similar amount by 2050. Furthermore, the increasing scarcity of fossil fuels will lead to higher energy prices and contribute to economic, political, and social instability. The drastic nature of these problems necessitates immediate and comprehensive solutions like the WWS plan.

2. How does the WWS solution propose to meet global energy demands across all sectors?

The WWS solution aims to meet all energy demands by electrifying or providing direct heat for every sector (electricity/heat, transportation, buildings, industry) and supplying this energy with 100% wind, water, and solar sources. This involves a comprehensive set of technologies. For electricity and heat generation, it includes wind, solar PV/CSP, geothermal, hydro, tidal/wave, and solar/geo heat. For transportation, it focuses on battery-electric and H2 fuel cell vehicles. Buildings will utilize heat pumps, LED lights, insulation, and induction cooktops. Industry will adopt arc furnaces, induction furnaces, resistance furnaces, dielectric heaters, and electron beam heaters.

3. What types of energy storage are crucial for a 100% WWS system to ensure grid stability?

To ensure a stable grid with 100% WWS, various types of energy storage are crucial. These include:

- Electricity Storage: CSP with storage, pumped hydro storage, existing hydroelectric, batteries, flywheels, compressed air, gravitational storage, and grid hydrogen/fuel cells.
- Hot/Cold Storage: Water tanks, ice, underground storage, borehole storage, water pit storage, aquifer storage, and building materials like firebricks.
- Hydrogen Storage: Non-grid hydrogen storage. This diverse portfolio of storage solutions helps manage the intermittency of renewable sources and ensures

continuous energy supply.

4. What significant reductions in energy demand and costs are projected with a global transition to WWS by 2050?

A global transition to WWS by 2050 is projected to lead to a significant 54.2% reduction in end-use power demand compared to business-as-usual (BAU). This efficiency gain comes from:

- 19.8% from the higher efficiency of battery-electric (BE) and hydrogen fuel cell (HFC) vehicles versus internal combustion engines (ICE).
- 4.1% from the efficiency of electric industrial processes.
- 3.1% from the efficiency of heat pumps.
- 10.6% from eliminating the energy used in fuel mining, moving, and processing.

In terms of costs, WWS is projected to reduce annual energy costs by 61% and total economic (social) costs (including fuel, health, and climate) by 92% compared to BAU, saving trillions of dollars annually worldwide.

5. What is the estimated capital cost for the worldwide WWS transition, and what is its payback period?

- The estimated capital cost for a worldwide transition to 100% WWS for all purposes across 150 countries is $60.0 trillion.
- For the U.S., it's $6.5 trillion, and for California, it's $517 billion.
  Despite these significant upfront capital costs, the WWS plan offers substantial annual energy cost savings.
- For California, the capital cost of $517 billion is projected to be offset by annual energy savings of $129 billion, resulting in an energy cost payback time of approximately 4 years.

6. What is the land footprint required for a 100% WWS system globally and in specific regions, and how does it compare to current land use for biofuels?

The land footprint required for a 100% WWS system is remarkably small.

- For 150 countries globally, it would require 0.39% of land for onshore wind (spacing) and 0.18% for utility PV+CSP (footprint), totaling 0.57%.
- For the U.S., it's 0.36% for onshore wind and 0.69% for utility PV+CSP, totaling 1.05%.
- For California, it's 0.47% for onshore wind and 0.33% for utility PV+CSP, totaling 0.80%.
- This is significantly less than the 1.24% of U.S. land currently used for corn ethanol alone.

7. What progress has California made towards 100% WWS, and what specific examples demonstrate this progress?

California has made significant progress towards 100% WWS in its electric power sector. Examples include:

- On April 8, 2024, during a solar eclipse, batteries effectively filled the gap in electricity supply, demonstrating their role in grid stability.

- On May 5, 2024, WWS supply met 162.3% of demand for 5 minutes and exceeded demand for 9.9 hours.
- On May 25, 2025, WWS supply exceeded 100% for 10.5 hours, and 82% of the 24-hour demand was met by WWS, peaking at 158.3%.
- On June 9, 2025, a record battery discharge rate of 10.144 GW was achieved.
- From January 1 to June 12, 2025, 79% of days saw WWS exceeding 100% of demand, with significant increases in solar (18.4%) and battery (66%) capacity compared to the previous year.

8. Beyond energy benefits, what are the broader societal advantages of transitioning to 100% WWS?

Transitioning to 100% WWS offers substantial broader societal advantages:

- Job Creation: It is projected to create 28 million more jobs worldwide than are lost, and 300,000 more long-term, full-time jobs in California.
- Public Health: It avoids approximately 7 million air pollution deaths per year globally by eliminating fossil fuel emissions.
- Climate Change Mitigation: It effectively slows and then reverses global warming.
- Economic Savings: Annual energy costs are 61% less than those of fossil fuels, and annual total social costs (energy, health, climate) are 92% less, leading to massive global economic savings.
- Grid Stability: Stable electric grids can be maintained throughout the world with 100% WWS.

Dennis Dyc-O'Neal – Energy-Grid Function, Reliability, Resilience Strategies, Community Vulnerabilities, Equity Considerations (Presented on June 25th, 2025)

BIO: *Dennis Dyc-O'Neal is a power supply and grid specialist subject matter expert with more than 25 years of experience in renewable energy and grid infrastructure. Mr. Dyc-O'Neal is currently the Chief of Power Supply and a member of the Executive Team at Central Coast Community Energy. We are very lucky to have him speak to us this evening regarding our state and local electrical grid infrastructure.*

What is Central Coast Community Energy (3CE) and what is its mission?

Central Coast Community Energy (3CE) is a public community choice aggregator (CCA) that serves 30 cities and five counties from Santa Cruz to Santa Barbara, excluding King City, the city of Santa Barbara, and the city of Lompoc. As a CCA, 3CE's primary role is to source clean and renewable energy for its customers. They partner with Investor-Owned Utilities (IOUs) like Pacific Gas and Electric and Southern California Edison for energy delivery. Beyond just sourcing energy, 3CE also designs and implements dynamic electrification programs, aiming to empower customers to participate in the energy transition. Their long-term vision is to cease burning fossil fuels for energy due to their detrimental impacts on health and the environment. 3CE strives to provide reliable, affordable, clean electricity and innovative electrification

programs that reduce greenhouse gas emissions and strengthen local economies.

How does 3CE compare to traditional Investor-Owned Utilities (IOUs) in terms of operations and benefits?

Unlike IOUs, 3CE's rates are solely based on the cost of serving customers, aiming for fair and justifiable pricing. They commit about $15 million annually to community investment programs. A significant difference is their governance structure: 3CE is governed by elected officials on its policy board, not a board of shareholders, providing local control and direct engagement opportunities for the community with board members and staff. In Santa Cruz County, 3CE has consistently offered cheaper rates than incumbent IOUs and has invested over $5 million in local programs. 3CE is also on an aggressive path to 100% clean and renewable energy by 2030, 15 years ahead of California's statewide goal of 2045, and they achieve this by incrementally adding to the renewable mix without relying on carbon offsets or credits.

Why is battery storage crucial for achieving California's renewable energy goals?

Battery storage is essential because renewable energy sources like solar and wind are intermittent; solar generates electricity when the sun shines, and wind power when the wind blows, but not consistently. Batteries balance these intermittent renewables by storing excess energy generated during peak production times (e.g., midday for solar) and dispatching it during high-demand, low-generation periods (e.g., evening hours). This process helps stabilize the grid, reduces reliance on expensive and polluting combustion-based generation, and captures curtailed (wasted) solar energy, which would otherwise be lost. For California to meet its 100% renewable goal by 2045, it is estimated that 52,000 megawatts of battery storage will be needed. Without sufficient storage, the state cannot transition off fossil fuels affordably, as customers would revert to cheaper gas alternatives.

How does 3CE integrate battery storage into its operations and customer programs?

3CE actively invests in and contracts for battery storage projects. They have 110 megawatts of operational battery storage, including California's first solar-plus-storage project, and another 728 megawatts contracted. These projects include large-scale initiatives like the world's largest compressed air storage facility. 3CE is also strategically placing hybrid battery projects at existing combustion facilities, effectively taking over their interconnection capacity to reduce their run hours and associated emissions. Furthermore, 3CE has launched a residential battery program that incentivizes customers (with or without solar) to install batteries, offering $300 per kilowatt (up to 26 MW) and $500 for income-qualified customers. Participants commit to dispatching at least 50% of their battery's capacity during evening hours, which helps reduce overall energy costs for all customers by lessening the need to purchase expensive, gas-generated power.

What are the main challenges and safety considerations associated with battery storage?

Challenges include market complexities, regulatory delays, and federal policy changes.

A significant issue is the rapid increase in load due to 3CE's expansion, requiring them to constantly adjust their energy procurement to stay on target for their 2030 clean energy goal. From a safety perspective, the industry is addressing incidents, which EPRI defines as any need for emergency safety response. While there have been incidents, primarily involving older magnesium cobalt battery technology, the overall rate of incidents has dramatically reduced in the United States (97% drop). Key safety design changes include internally cooled systems, separate fire suppression within battery containers, the ability to derate individual modules to prevent thermal runaway, and increased spacing between outdoor battery modules (from 18 inches to 6.5-10.5 feet, with some new facilities opting for 28 feet). The industry has also largely shifted to more stable lithium iron phosphate batteries.

How has the regulation and technology of battery storage evolved to address safety concerns?

Following incidents, particularly at Moss Landing, the battery storage industry and regulators have implemented significant changes. The California Public Utilities Commission (CPUC) approved General Order 167C, bringing battery energy storage facilities under the same regulatory structure as other generating facilities, with additional requirements. This includes mandates for approved maintenance and operation plans, coordination with local fire response (as per SB 1383 and SB 38), comprehensive audits, and incident reporting. Technologically, the industry has moved away from less stable magnesium cobalt batteries towards lithium iron phosphate batteries, which are more stable even if less efficient. New installations are exclusively outdoor and incorporate design features like independent fire suppression systems, derating capabilities, and significant separation between modules to prevent thermal runaway and fire spread.

Beyond batteries, what other energy storage technologies are being considered or implemented?

While batteries are a primary focus, other forms of energy storage are also being explored. One notable alternative is pumped hydro storage, which involves using excess electricity during low-demand periods to pump water uphill into a reservoir. When electricity is needed, the water is released downhill through turbines to generate power. Another emerging concept is gravity storage, which functions similarly to an elevator, lifting heavy objects (like bricks or rocks) using cheap electricity and then slowly lowering them to generate electricity during high-demand times. 3CE itself has a contracted compressed air storage project, a large-scale facility located outside Bakersfield, which stores compressed air and releases it to generate electricity. The feasibility of these alternative technologies depends on their cost-effectiveness for customers and their ability to integrate into the grid.

How does battery storage contribute to community resilience and equity?

Battery storage significantly enhances community resilience by providing backup power during outages caused by power safety shutoffs, grid failures, or natural disasters. For individual residences, a battery coupled with solar ensures power during outages. For community facilities like cooling centers, on-site battery backup is critical. From an equity standpoint, 3CE prioritizes affordability, recognizing that electricity is a non-

negotiable expense for struggling families. By displacing expensive and polluting gas-fired "peaker plants"—which are often located in underserved communities and contribute to health issues like asthma and lung disease—battery storage provides significant health benefits to these populations. For example, 3CE's battery projects are curtailing emissions from high-polluting facilities, directly reducing the energy burden on environmental justice communities. Additionally, by capturing curtailed solar energy and making it available at lower costs, batteries help ensure that the benefits of renewable energy are broadly distributed.

Scott Murtishaw Long Duration Energy Storage and Emerging Technologies (Presented on July 30th, 2025)

BIO: *Scott Murtishaw is the Executive Director of the California Energy Storage Alliance and is a recognized leader in the energy industry, bringing extensive experience from two other leading energy generation and storage trade associations and at the California Public Utilities Commission (CPUC). Mr Murtishaw was previously the Energy Advisor to the President at the CPUC, where he led the development of the CPUC's policies on distributed energy resources, rate design, and several other issue areas.*

Why do lithium-ion batteries currently dominate the energy storage market?

Lithium-ion batteries currently dominate the energy storage market primarily due to significant advancements in their performance and durability, coupled with a dramatic 90% decline in costs between 2010 and 2023. This cost reduction was driven by massive investment and economies of scale fueled by demand from consumer goods, battery energy storage systems (BESS), and electric vehicles (EVs). They boast high round-trip efficiency (85%-90%), excellent energy density, improved durability, and fast response times. Currently, out of nearly 16,000 MW of operating energy storage in California, only about 10-20 MW are non-lithium technologies.

What are the main limitations of lithium-ion batteries that create a need for alternative storage technologies?

While lithium-ion batteries excel in many areas, their primary limitation is that they become less cost-effective at longer durations of energy discharge. This is where non-lithium energy storage technologies, often referred to as long-duration energy storage (LDES), become more competitive. As California's grid integrates higher shares of variable renewable energy and reduces reliance on dispatchable gas-fired resources, longer durations of storage are increasingly necessary to maintain grid reliability, which lithium-ion batteries are less suited for economically.

How is the increasing need for long-duration energy storage (LDES) being projected and addressed in California?

The need for LDES in California is being projected through various analyses aiming to meet the statewide 100% net-zero GHG target by 2045. The 2021 SB 100 Joint Agency Report projected a need for 4 GW of pumped hydro, while a 2023 CPUC analysis identified a need for 17 GW of 8-hour LDES for the CAISO territory. Further 2023 CEC reports modeled needs ranging from 5 GW to 37 GW of 12, 24, 48, and 100-hour

LDES, depending on assumptions about gas plant retirements and LDES costs. To address this, the CPUC has issued procurement orders, including reserving 1,000 MW for LDES in 2021 and, more recently in August 2024, recommending solicitations for 1,000 MW of 12+ hour ES and 1,000 MW of "multi-day" ES, specifically excluding lithium-ion technologies for these longer-duration procurements.

What are the different categories of non-lithium energy storage technologies?
Energy can be stored in four main ways, which encompass the various non-lithium technologies:

- Electrochemically: This includes non-flow (static electrolyte) chemical batteries, like those using iron or zinc, with durations from 6 to 100 hours and efficiencies of 50-85%. It also includes flow chemical batteries, where active material is in electrolyte fluid in large tanks, ideal for 4-24 hour renewable storage.
- Chemically: This involves producing synthetic fuels, such as hydrogen, for combustion or oxidation.
- Mechanically: This stores potential energy by elevating mass (e.g., pumped hydro, lifting solid mass on cables) or compressing gases (e.g., compressed air, liquid air, liquid CO2). These systems typically offer 8-24 hour durations, 50-75% efficiencies, and very long lifetimes of 40-60 years.
- Thermally: This involves heating salts, metals, or other materials to store energy.

How do flow batteries compare to lithium-ion batteries in terms of characteristics and ideal use cases?

Flow batteries and lithium-ion batteries have distinct characteristics and ideal use cases. Flow batteries utilize electrolyte fluid in large tanks as their active material, while lithium-ion batteries use nanoscale solid materials. Flow batteries are ideally suited for longer-duration applications, such as 4-24 hour renewable storage, ancillary services, peak shaving, and resiliency, with a battery lifetime of 20+ years and potential for domestic supply chains. Their installed cost is globally averaged at $444,000/MWh. Lithium-ion batteries, conversely, are ideal for shorter durations like 10 minutes to 4 hours, primarily for ancillary services, peak shaving, and frequency regulation, with a faster response time (microseconds vs. milliseconds for flow batteries). Their installed cost is lower at $304,000/MWh, and they typically last 15-25 years, relying on international supply chains.

What are some examples of recent procurement orders and projects for long-duration energy storage in California?

Following the 2020 blackouts, the CPUC ordered utilities to procure 1,000 MW specifically for LDES, initially assumed to favor non-lithium technologies. However, recent procurements have shown a strong presence of lithium-ion solutions, with a consortium of Community Choice providers executing contracts for over 100 MW of 8-hour lithium-ion batteries, and SCE securing 400 MW of 8-hour Li-ion capacity. Despite this, some non-lithium projects are emerging: Central Coast Community Energy signed a contract for 200 MW of 8-hour advanced compressed air energy storage from Hydrostor (designed for 500 MW), and SMUD executed an agreement with ESS (iron flow) for 4 MW, with an option to expand to 200 MW. Additionally, a 2023 law (AB 1373) and an August 2024 CPUC decision are driving future procurements of 1,000 MW of 12+ hour ES and 1,000 MW of "multi-day" ES, with Li-ion technologies specifically

deemed ineligible for these longer-term resources expected online between 2031 and 2037.

What is the long-term outlook for non-lithium energy storage technologies in California?

While lithium-ion batteries are expected to dominate energy storage deployment for the next 5 to 10 years, the long-term outlook for non-lithium energy storage technologies in California is very positive. As the state's grid incorporates higher shares of variable renewable energy, the increasing need for longer-duration storage becomes critical for maintaining reliability and achieving environmental goals. Legislative mandates and CPUC procurement orders, particularly those targeting 12+ hour and multi-day storage where lithium-ion is deemed ineligible, are specifically designed to foster the growth and deployment of non-lithium solutions. This indicates that in the medium to longer term, non-lithium energy storage technologies will play a significantly larger and more crucial role in California's evolving energy portfolio.

Mike Nicholas Battery Energy Storage Systems (Presented on July 30th, 2025) Battery Technology Fire Prevention, Safety and Emergency Response Planning

BIO: *Michael Nicholas serves as an Energy Storage Specialist & Fire Consultant with Hiller Companies. Prior to joining Hiller, he worked as a Captain and Assistant Fire Marshal for Kern County Fire Department for 26 years. During his fire service career, he led the development and implementation of their Battery Energy Storage program working closely with leaders in the industry. Currently Kern County has the largest active battery energy storage project in the world at 3.2GWh. He is working with the California Energy Storage Alliance on a campaign to help standardize the BESS submission, permitting and witness testing process in the State.*

What is Battery Energy Storage System (BESS) and why is fire safety a critical concern?

BESS refers to systems that store electrical energy in batteries for later use. Fire safety is a critical concern due to the potential for thermal runaway in batteries, which can lead to fires. While BESS failure rates have significantly decreased (by 97% between 2018 and 2023) due to improved codes and manufacturing, the inherent risks necessitate rigorous safety measures.

What are the key safety standards and codes that govern BESS installations?

Several key safety standards and codes govern BESS installations to ensure safety and prevent hazards:

- UL 9540: Covers integrated systems, battery management systems, inverters, and interconnection equipment.
- UL 9540A: A standard test method for evaluating thermal runaway fire propagation in BESS at cell, module, and unit levels.
- NFPA 855: Provides guidelines for the installation of stationary energy storage systems, including proper setbacks to prevent fire propagation.

- NFPA 69: Focuses on explosion prevention systems, often involving hydrogen sensors and active ventilation.
- NFPA 72: The National Fire Alarm and Signaling Code, which dictates fire alarm system design and monitoring.
- International Fire Code (IFC) and National Electrical Code (NEC): Provide broader safety requirements.

What information should developers include in a BESS submission to fire authorities?

To ensure a thorough review and approval, developers must include comprehensive documentation in their BESS submission to fire authorities. This includes a Hazard Mitigation Analysis (HMA) with a Fire Risk Analysis (FRA) specific to the chosen technology, a Failure Modes and Effects Analysis (FMEA), and details on NFPA 69 compliant systems, including their performance in large-scale fire tests. Crucially, burn test results from UL 9540A and other large-scale fire tests, along with technology listings, are required. Furthermore, the submission should encompass Emergency Response Plans for all phases (construction, commissioning, operations, decommissioning), incident reporting procedures, triggers for notifying fire authorities when safety systems are offline, and detailed Testing and Maintenance Plans for fire life safety systems, including auxiliary backup power. Site layout plans are also vital, showing the Incident Command Post location, fire water tank size and location, auxiliary backup power design and refueling considerations, and proper enclosure spacing based on burn test results.

What are the best practices for managing a BESS fire incident?

In the event of a BESS fire, industry best practices prioritize containment and monitoring rather than direct suppression of the involved unit. The recommended approach is to monitor adjacent exposures and allow the involved unit to consume itself safely. This strategy addresses concerns about stranded energy and helps safely consume many of the toxic byproducts of the fire. Current code direction emphasizes not including suppression systems within the battery
containers themselves, with water primarily used for cooling adjacent exposures. The primary fire safety emphasis is on early gas or smoke detection combined with integrated exhaust system activation. All fire alarm devices are monitored 24/7 by a UL Central Station, which then contacts fire dispatch upon detector activation.

How do first responders manage a BESS incident, and what information do they need?

Upon arrival, first responders will first seek site contact information at the entrance to establish direct communication with a site representative. Site representatives are crucial as they can provide valuable diagnostic information on the status of the involved and adjacent battery enclosures. Sites also have the capability to remotely disconnect the BESS from the grid to enhance safety. A multi-agency command post can be established once the site representative meets with emergency response personnel. The Large-Scale Fire Test data, which is a required part of the battery technology's code compliance, is vital for first responders. This test demonstrates that a fire in one

unit will not propagate to adjacent enclosures, providing critical insight for managing the incident within a finite fire area.

What ongoing testing and maintenance are required for BESS fire safety systems?

Maintaining operational readiness of BESS fire safety systems is crucial and often required for annual operational permit approval. This includes consistent documentation of maintenance reports for local Fire Departments. Recent regulations, such as those from the California Public Utility Commission (SB38 and General Order 167-C), mandate BESS operators to collect and submit documentation regarding ongoing fire system testing and maintenance. While fire codes specify intervals for many components, some, like louver maintenance, exhaust CFM output, and filter changes, rely on manufacturer-suggested intervals. However, due to environmental exposures, more frequent service schedules may be necessary. Specific requirements include testing all fire alarm initiation and notification devices, servicing and maintaining fire pumps per manufacturer and code requirements, and ensuring all concentration reduction system components (exhaust fans, louvers, air filters) are operational.

How often should BESS operators and fire departments conduct multi-agency incident response training?

Ongoing multi-agency incident response training is essential to ensure alignment between BESS operators and first responders, especially as new technologies are introduced or compound phases change. It is recommended that contact lists for operations staff are updated and shared with the local Fire Department at least semi-annually. Site staff must be trained on incident reporting procedures and prepared to provide critical information to first responders. An annual tabletop multi-agency drill with the local Fire Department and operations staff is crucial to keep emergency response procedures current and expectations clear. Additionally, it is beneficial for operations staff to be trained in the Incident Command System to ensure common terminology and a reliable organizational structure for safe and timely incident mitigation.

What role do concentration reduction systems play in BESS fire safety, and what standards apply to them?

Concentration reduction systems are critical in BESS fire safety for managing combustible gas concentrations, particularly hydrogen, to prevent explosions. These systems typically utilize hydrogen sensors in conjunction with active ventilation to purge any gas buildup, keeping the concentration below 25% of the Lower Explosive Limit (LEL). NFPA 69, the Standard on Explosion Prevention Systems, governs the design and performance of these systems. It's crucial that these systems are designed in conjunction with a site controller, and often include an Uninterrupted Power Supply (UPS) and a small generator to ensure they are not reliant on grid power for operation. The fire alarm design also needs to monitor key points within the concentration reduction system.

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NEWS RELEASE

Date: June 13, 2025

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ENVIRONMENT COMMISSION TO HOST BATTERY ENERGY STORAGE SYSTEMS TECHNICAL REVIEW WORKSHOPS

As California transitions toward a clean energy future, the Santa Cruz County Commission on the Environment (CoE) is convening a series of public technical workshops to examine the role and risks of Battery Energy Storage Systems (BESS) in modernizing the energy grid.

The workshops, scheduled for June 25, July 30, and August 27, will be held from 5–8 p.m. in the Board Chambers of the Santa Cruz County Governmental Center, 701 Ocean Street, 5th Floor, Santa Cruz, with remote participation available via Zoom.

BESS facilities are a critical component of California's shift away from fossil fuels, allowing excess energy — especially solar and wind — to be stored for use when renewable generation is unavailable. These systems can enhance grid stability and help utilities meet peak demand while reducing dependence on fossil fuels. However, as interest in BESS projects grows, so do community concerns about public safety, emergency response readiness, and long-term environmental impacts.

The June 25 workshop will feature presentations on the climate change context for energy storage and the role of BESS in the regional power grid. Key speakers include Dr. Mark Jacobson, Director of Stanford University's Atmosphere/Energy Program and a leading expert on clean energy systems, and a representative from Central Coast Community Energy (3CE), which has committed to achieving 100 percent renewable energy by 2030. Additional experts will be be featured as part of the review.

"These workshops are a chance for the community to engage with world-class experts and better understand the opportunities and risks associated with large-scale energy storage," said Kris Damhorst, Chair of the Commission on the Environment. "As we respond to the climate crisis, it's essential that we examine how new technologies align with our values, safety needs, and long-term environmental goals."

Subsequent workshops will explore battery technology innovations, fire prevention and emergency response, and evolving best practices. While technical in nature, the sessions are designed to be accessible to the general public. The workshops will not address land use planning, zoning decisions, or specific project proposals.

Community members, environmental stakeholders, and energy professionals are encouraged to attend. To join via Zoom, visit https://santacruzcounty-us.zoomgov.com/j/1614371967.

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NEWS RELEASE

Date: July 21, 2025

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ENVIRO COMMISSION NAMES ADDITIONAL TECHNICAL EXPERTS FEATURED IN UPCOMING BATTERY STORAGE WORKSHOPS

The Santa Cruz County Commission on the Environment has identified additional expert testimony to be included in upcoming workshops focusing on Battery Energy Storage System (BESS) technologies and safety issues.

On July 30th, the Commission welcomes Scott Murtishaw, Exeuctive Director of the California Energy Storage Alliance, who will examine the future and function of current and emerging battery technology innovations. Mike Nichols, an Energy Storage Specialist and Fire Consultant with Hiller Companies, will follow with a presentation on safety considerations including fire prevention, suppression strategies and emergency response planning.

"With the second of three workshops on Battery Energy Storage Systems, the Commission on the Environment is continuing its community outreach and education on this very important topic," Commission Chair Kris Damhorst said. "We are very lucky to have industry experts donate their time to help our community understand and answer some of the most important questions regarding this technology."

The workshop is scheduled for July 30th from 5 to 8 p.m. in the Board Chambers of the Santa Cruz County Governmental Center, 701 Ocean St., 5th Floor, Santa Cruz Community members, environmental stakeholders, and energy professionals are encouraged to attend. Remote participation availabile at https://santacruzcounty-us.zoomgov.com/j/1610056959.

BESS facilities are a critical component of California's shift way from fossil fuels with the potential to enhance grid stability and help utilities meet peak demand while reducing dependence on fossil fuels. Some community members have also raised concerns about safety, emergency response and long-term environmental impacts.

The final August 20, 2025 workshop will address questions and issues that have emerged from the June 25th and July 30th sessions. The featured expert will be Matt Paiss, a nationally recognized BESS expert with a focus on safety standards, risk mitigation, and regulatory compliance for utility-scale and distributed energy projects.

While technical in nature, the sessions are intended to be accessible to the general public. The workshops will not address land use planning, zoning decisions or specific project proposals. Sessions will be posted at youtube.com/@countyofsantacruzca.

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NEWS RELEASE

Date: August 18, 2025

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ENVIRONMENT COMMISSION TO HOLD FINAL BESS HEARING

The Santa Cruz County Commission on the Environment will hold its final Battery Energy Storage System (BESS) technical workshop on August 20th from 5-8 p.m.

The Commission will receive an update on Sen John Laird's Senate Bill 283 from Policy Analyst Khalida Sarwari. The bill aims to ensure that BESS facilities are designed, constructed, and operated with increased safety measures and local coordination, including inspections by fire officials and detailed emergency response plans. The hearing will also summarize the information previously presented by BESS experts and offer an opportunity to discuss issues and questions regarding that information.

BESS facilities are a critical component of California's shift away from fossil fuels with the potential to enhance grid stability and help utilities meet peak demand while reducing dependence on fossil fuels. Some community members have also raised concerns about safety, emergency response and long-term environmental impacts. The concerns expressed at the previous two workshops regarding these issues will be discussed more in depth at this final workshop.

"The BESS hearings have been an invaluable resource for our community, helping illuminate both the potential benefits and the risks associated with battery energy storage systems. By providing a shared baseline of accurate, fact-based information, these discussions have created space for informed dialogue and thoughtful consideration. We encourage everyone to join us for the final hearing to continue this important conversation," said Kris Damhorst, chair of Commission on the Environment.

Community members, environmental stakeholders, and energy professionals are encouraged to attend the meeting on August 20th from 5-8 p.m. in the Board Chambers of the County Governmental Center, 701 Ocean St., 5th Floor, Santa Cruz.

Remote participation is available via Zoom at: https://santacruzcounty-uszoomgov.com/j/1603665391.

OPINION FROM COMMUNITY VOICES

Do battery energy storage systems belong in our communities?

BY **MATTHEW PAISS**
6 hours ago

Matthew Paiss training firefighters in Washington on BESS technology in 2023. Credit: Matthew Paiss

Quick Take

January's fire at Moss Landing has fueled debate over whether battery energy storage systems belong in local communities. While safety concerns are real, national battery safety expert Matthew Paiss argues that modern BESS fires are rare in proportion to the numbers installed. The systems are engineered with strong protections and play a crucial role in stabilizing the grid by storing renewable energy and preventing blackouts. He cautions that blocking projects could increase reliance on fossil fuels and weaken energy reliability, urging higher safety standards and industry transparency instead of bans.

Have something to say? Lookout welcomes letters to the editor, within our policies, from readers. Guidelines here.

The **January 2025 fire at Moss Landing** ignited strong discussions across our community, with many calling to block future battery energy storage system (BESS) projects. While these concerns are valid, I feel it's important to weigh both the risks and the benefits before making decisions that could shape our power future.

I've worked with a passion for the environment, technology and public safety for decades — first in solar technology, then as a career firefighter for 23 years, and later leading national battery safety efforts at a Department of Energy national lab. Today, I chair the **National Fire Protection Association's NFPA 800 Battery Safety Code** and focus on safety standards for Sandia National Laboratories.

This experience gives me insight into both the hazards, emergency response and the protections built into modern BESS designs. To those who might think I promote the battery industry: I am technology-agnostic and make no money from battery manufacturers.

I do believe BESS can be designed and operated safely.

Any energy storage technology can be dangerous if suddenly released. The higher the energy density of a technology often means more intensity when that energy is released during a failure. For example, even lead-acid batteries, which are low energy density, have caused fires and explosions. This is not common, but can happen. Even "safe" options like hydro power have experienced dam failures resulting in hundreds of fatalities, even here in California.

Lithium-ion batteries dominate today's storage market. Most fires we hear about involve small consumer devices — vape pens, e-bikes, scooters — which are more vulnerable to misuse and poor manufacturing. Large utility-scale BESS are very different: They are housed in robust outdoor enclosures, tested to survive extreme fire conditions, and designed to prevent one failure from spreading to others.

One of the key safety design features we discuss in the codes considers “size and separation” for safety of outdoor battery enclosures, ensuring that a failure in one stays in that enclosure. This was not present in the indoor Moss Landing BESS, and contributed to the significant fire event. While a BESS fire does produce toxic smoke, so does every fire I’ve been to in 23 years as a firefighter. In fact, I have friends in the fire service who have retired out on disability from inhaling the smoke from a single car fire.

In my work while at the **Pacific Northwest National Laboratory** (PNNL), we found that utility-scale BESS fires are statistically quite rare. In fact, one major manufacturer reported over 50,000 operational units with only about 10 fires — an extremely low failure rate given the scale.

For those thinking even one fire is too many, you should know there is no electrical product with a zero-failure rate. It’s a dangerous narrative to say any single fire means the technology is unacceptable. Do we ban Home Depots because a couple have burned down, or ban all internal combustion vehicles because thousands burn every year?

Safety has been my primary focus, and the engineering I have seen in modern BESS is quite impressive. Most of us pay little attention to many of the lithium-ion batteries all around us; I carry them in my pockets, in my ears listening to music, or next to my bed as I sleep. That’s because failure rates (while not zero) are extremely low. Safety engineers describe “risk” as the frequency of failure with consequences of an event.

One thing I would like to see from industry is more transparency when failures do occur. Tesla demonstrated this during the Megapack fire in 2022 when a fire occurred in one of the enclosures at the Pacific Gas & Electric site at Moss Landing. The company released a full root-cause analysis highlighting that the fire was caused by a water leak from an incorrectly installed part

Batteries act like a shock absorber for the power grid by responding in milliseconds. They instantly stabilize fluctuations when solar output drops or when there’s an unexpected outage. They store excess renewable energy for use later, helping us integrate more clean power without risking instability.

What am I concerned about if we would stop all BESS installations in Santa Cruz County? I am concerned this could be a perfect case of “be careful what you ask for.”

Without the grid support energy storage provides, we might have a very fragile grid.

BloombergNEF (BNEF) predicts a significant increase in global electricity demand, driven largely by the growth of data centers and artificial intelligence. BNEF anticipates a 75% rise in power demand by 2050, with data centers alone accounting for a substantial portion of this growth. The elimination of tax credits for solar

and wind generation will further affect this energy gap. Without BESS, we'd need more fossil fuel plants — often natural gas-fired turbines — which take years to build and add greenhouse gas emissions.

Small modular nuclear is coming, but likely five to 10 years away from market scale. The absence of storage could result in a higher risk of blackouts during extreme weather, which resulted in over 250 lives lost in Texas in 2021.

I am often asked why we aren't using safer technologies. There are alternatives, but they have limitations, in some cases significant ones. Some of the research being done at PNNL and Sandia includes technologies such as:

- Flow batteries.
- Zinc and sodium-based chemistries (including sodium-ion).
- Gravity-based systems.
- Non-flammable electrolytes.
- Iron-air.

Some, like certain sodium-ion designs and flow batteries, have promising safety and cost advantages. But most are not yet proven at large scale, as efficient or affordable as lithium-ion today.

Blocking BESS might feel like the safer choice, but it carries its own risks — higher energy costs, more fossil fuel use and less reliability. I feel the real solution is to require the highest safety standards possible for any local projects, even exceeding state minimums when the technology is available.

Matthew Paiss. Credit: Matthew Paiss

I often tell people storing energy is never risk-free — but neither is a grid without it. Our challenge is to make informed, measured choices that protect public safety, our climate and our energy future.

Our community can demonstrate that we not only bounce back from tragedy, but that we can step ahead and lead the way.

Matthew Paiss has been a Santa Cruz resident since 1983. He studied solar technology at Cabrillo College with careers in the semiconductor industry, fire service and as a technical advisor for two Department of Energy labs. He serves on multiple technical committees related to battery safety, and has provided training to over 9,000 firefighters internationally. He lives in Soquel (in a fully solar home with an electric vehicle and home batteries) with his wife and has two children, two dogs and a cat. He spends his time paddling outrigger canoes, and loves to cook and spend time outdoors with friends.

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