November 30, 2018

Email to: Mike.Gravely@energy.ca.gov
Subject: Energy Storage Research Needs for California

Re: Comments of the California Energy Storage Alliance (CESA) on the Notice of Staff Workshop on Energy Storage Research Needs for California

The California Energy Storage Alliance (CESA) thanks the California Energy Commission (CEC) for the opportunity to participate in the November 6, 2018 Workshop on Energy Storage Research Needs for California[1] and appreciates the opportunity to provide written comments on research areas CESA believes will provide greatest benefit to the future electric grid of California. Generally, CESA supports the development of energy storage research initiatives that advance overall market growth and result in a more efficient, reliable, affordable, and secure electric power system for all Californians. Our comments below are structured to respond in more detail to some of the questions posed during the workshop. The focus of our comments is on research areas that support the advancement of the energy storage market overall and the longevity of a healthy electric system as California approaches its greenhouse gas (GHG) emissions reduction goals.

About CESA:

CESA is a member-based association focused on enabling a more affordable, cleaner, efficient and reliable grid through the use of energy storage solutions. CESA works through education and advocacy to ensure that energy storage is a key component of California's mainstream tool kit of energy solutions for customers, policy makers, and utilities.

CESA's operations includes a focus on emerging technology and technology diversity. CESA's Emerging Technology and Diversity Working Group meets actively throughout the year to discuss and identify barriers and resolution of these barriers for emerging technologies. The goal is to ensure that emerging technologies and the energy storage 'tool-kit' is sufficiently developed to competitively meet the state's long-term grid needs.

CESA Responses to CEC Questions:

1.a. For emerging storage technologies, what research support would most bring your technology to commercial viability and which end-use applications are you targeting?

CESA supports energy storage related research initiatives that are technology-neutral and fall within the CEC scope of preparing the future grid. As California moves closer to reaching its SB100 goals, energy storage will play an important role in firming renewable energy assets, addressing a steep demand ramp, and providing overall grid stability.

[1] Notice of Workshop on Energy Storage Research Needs for California, https://www.energy.ca.gov/research/notices/2018-11-06_workshop/2018-11-06_Notice_Staff_Wrkshp_Energy_Storage_Research_Needs_in_CA.pdf

Specifically, CESA encourages the CEC to emphasize high-value research on use-cases that are still emerging in California, but that are necessary to successfully meet State goals. It is particularly important for the CEC to support long-duration storage applications capable of balancing renewable energy on a daily basis and over multiple days. The CEC has concluded that achieving a 100% zero-carbon electric generation mix will be cost-prohibitive without new forms of low-cost, long-duration energy storage, and that to achieve a 100% zero-carbon electricity system, long-duration dispatchable resources would be necessary to maintain resource sufficiency and reliability during sequential days of low renewable energy availability.[2] CEC support for research and demonstration projects that target these use cases is a necessary foundational step to ensure that California has sufficient tools to reach SB100 goals:

- Renewable time-shifting integration, e.g. daily absorption and shifting of renewable output
- Longer-duration applications[3]
- Initial response and the provision of synthetic inertia
- Local area contingency solutions, such as n-2 contingency support
- Disadvantaged Community clean-air reductions through storage enabled gas plants or through stand-alone storage
- Community Storage solutions
- Infrastructure deferral (by lowering PV peak output power via DC-coupled system architecture -- see CPUC decision for more details on how we're accomplishing
- Fire-related resiliency, micro-gridding, and islanding through storage and related Distributed Energy Resources (DER)

In addition, CESA encourages the CEC to characterize and standardize a process of evaluating the costs and benefits of technologies, independent of their stage of development, through the identification of appropriate and consistent performance testing standards. CESA has identified that defined standard testing conditions can provide value and comparability across energy storage solutions (and other solutions as well), and can benefit policy-makers, regulators, end-users, and the market, by offering a comparison tool across technologies to understand the costs and benefits of energy storage.

In addition, CESA supports the establishment of a state-supported performance testing facility. See comments under 5.a.

1.b. What new research grant opportunities would be the most beneficial in supporting these commercial advancements?

Building upon the use-cases mentioned in response to Question 1a, CESA recommends research support that would advance the commercial viability of emerging technologies, including on long-duration energy storage, by prioritizing the following objectives:

- Validate the long-duration storage market by evaluating the expected demand for long-duration storage, which would benefit load serving entities, regulators and investors.

[2] California Energy Commission, "Deep Decarbonization in a High Renewables Future," p. 39-40, available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=223785.

[3] Definitions of "long-duration storage" vary, and different use-cases may require different duration storage solutions. Our members are targeting long-duration applications of many lengths, including 6-hours+, 8-hours+, and more.

- Demonstrate and evaluate applications of 'very long-duration' storage solutions capable of meeting load over 12+ hours or even multiple days.
- Deploy demonstration-related projects that address utility 'experience requirements' by establishing operational experience and track records for newer technologies.
- Identify incentives that need to be developed to support emerging technologies and diversify the State's portfolio of technologies.
- Identify and quantify storage market segments and opportunities so storage developers can focus on areas of expected need with an eye towards market size.
- Identify underserved market segments – both in terms of underrepresented storage technologies in utilities' portfolios and in terms of end-use applications – and evaluate mechanisms to encourage load serving entities to support these segments, such as a long-duration storage procurement mandate.
- Evaluate impacts of energy storage market diversification on grid risk management
- Evaluate benefits and costs of deploying long-duration storage to improve grid resiliency, integrate renewables, avoid transmission investments, and reduce dependence on fossil-fueled resources for resource adequacy.

2.a. For pre-commercial or near-commercial energy storage technologies, what types of demonstration projects would be most useful to inform the finance industry and end users to consider energy storage procurements in the future?

Grants to support utility-scale demonstration projects should be a high priority use of EPIC funds. However, feedback is needed from the finance industry on how demonstration projects impact investment decision-making. CESA encourages the CEC to interview the finance industry (including investors, independent engineers, and insurance companies) about the considerations and evaluation process for deciding to invest in storage technologies or projects.

The size or number of deployments can also support the viability of newer technologies through meeting 'experience requirements' in utility solicitations, through more operational experience and thus less warranty uncertainty, and through more safety records and 'balance of plant' cost insights.

2.b. Which end-use applications are considered the most beneficial for your energy storage technology?

CESA represents many different energy storage developers, technologies, solutions providers, integrators, etc. CESA supports a technology neutral approach where all resources are, when ready, eligible to compete. CESA sees and hears from many industry members that some use-cases and segments of the market are less developed in California, including long-duration technologies.

Input from some CESA members indicate there is strong interest in further development of end-use applications and demonstrations focused on long-duration, seasonal renewables integration, non-wires transmission initiatives, voltage support (T&D), islanding, congestion support (very high LMP pockets), energy-dense inertia, and fast-response services. Relatedly, demonstration project ideas can include:

1. Long-duration storage demonstrations and studies of long-duration storage and its benefits for supporting highly constrained markets (high LMP pockets), peak shifting, stacked services, seasonal renewable integration, and reliability needs over multiple days.

2. Circuit-based storage demonstrations and studies to evaluate the benefits of storage to support non-wire initiatives (voltage support, load support).
3. Remote storage to support community islanding during emergencies, such as long-duration shut-offs to prevent fire during red-flag periods).

2.c. What scale of demonstration project is considered the most valuable to end customers, utilities and project financiers in terms of size and overall cost/value?

CESA recommends focusing the goal of demonstration projects on collecting real data on the project benefits (ex. grid support, co-located value, minimizing load serving entities' portfolio and ratepayer costs, etc.). If projects are too small, they may not necessarily reflect the actual costs and related value proposition, ultimately rendering the research findings as less complete.

For front-of-meter, generally, a basic size threshold would be according to an applicable experience requirement.[4] This size can, generally, satisfy the utility "experience" requirement. CESA also observes that some technologies have a sweet spot that can be large. The CEC should explore if and how demonstration project funds can address parts of a project's costs, but be managed in a way that a larger project could be constructed without concerns over shared ownership of intellectual property of the project.

For behind-the-meter demonstration projects, the impacts on grid benefits should be assessed to ensure the optimal demonstration project size, especially where multiple benefits are being realized.

3.a. For all technologies, what other research activities for emerging energy storage technologies would provide the most benefit to the state in meeting the defined future clean energy goals?

CESA recommends research into the follow areas, which would benefit all technologies:

- Performance testing facility
- Standard test conditions for new and existing storage technologies
- Implications of integrating increasing amounts of behind-the-meter energy storage
- Storage supporting synthetic inertia
- Energy-dense technologies within space constraints
- Impact of multiple use-cases on battery degradation and performance
- Grid needs and market-sizing (e.g. inertia vs. long-duration solar absorption)
- The merits of storage economics (such as levelized cost of energy or lower capital costs)
- Improve battery systems safety for Authorities Having Jurisdiction (AHJs), including fire agencies, local authorities and stakeholders
- Battery disposal and recycling
- Publicly-available tools that allow comparability of storage technologies
- Standard storage definitions for key storage performance parameters such as response time, duty cycle, etc

[4] In some cases, the typical experience requirement is 10MW.

4.a. Are there existing planning tools or models that could be expanded or new tools or models that would assist the state in deploying energy storage throughout the state most efficiently and effectively?

Planning tools or models that help assess market size, market prices and project viability, and that show realistic grid needs are all beneficial. Specifically, many capacity-expansion models or planning models evaluate grid 'needs' in hourly blocks and also lack details regarding local or sub-local transmission restrictions and contingency needs. Without these insights, planners may advance solutions that ultimately do not satisfy grid needs. This potential problem is more important in light of the expansion of Load-Serving Entities in the state. Publicly available price forecast tools can greatly inform developers in identifying sites and penciling out projects. These types of tools can inform R, D&D and, ultimately, position the California grid for the necessarily reliable, low-GHG, and affordable operations.

Additionally, new software tools designed to support or inform the monitoring battery state of health and remaining capacity could support warranties, insurance, bankability, and other indirect but necessary components of project development. One idea for research and development on this topic is to expand existing models, such as the model developed by National Renewable Energy Laboratory (NREL) and documented in the Technical Report NREL/TP-5D00-71545[5], for example.

It would also be beneficial to support the development of new software tools to compare project economics that properly incorporate the duty cycle and the specific performance parameters of any storage technology.

4.b. Are there existing models that can be used to help define the optimum location, size and time duration for energy storage that will help the state meet future SB100 renewable integration and resulting grid management goals?

CESA refrains from mentioning any specific models that may be built upon, but instead recommends global elements of models that can be essential for useful and accurate planning. Specifically, models should:

- Support the comparison of technologies. A technology neutral approach to modelling allows the inclusion of existing and emerging energy storage resources with certain key parameters, such as round-trip efficiency, degradation, and other possible operational restrictions. This will allow the leveled comparison between different storage technologies and the treatment of emerging technologies
- Develop standard testing protocols/conditions and tools to develop tests
- Provide or 'solve for' granular time increments (5 to 15-minute periods) and transmission topology, e.g. power-flow and contingency ready models rather than broad 'bubble' models). This is very important within Capacity Planning models
- Include the full 'tool-kit' of storage to allow for accurate findings and evaluation, including the ability to hybridize generation with energy storage, e.g. a gas plant with storage or a solar plant with storage. Hybridizing some plants as a tool for delaying economic retirements should also be configured into any capacity expansion model

[5] National Renewable Energy Laboratory, "Value Streams from Distribution Grid Support Using Utility-Scale Vanadium Redox Flow Battery," available at https://www.nrel.gov/docs/fy18osti/71545.pdf.

- Include realistic and not overly conservative cost-estimates for energy storage solutions, as well as other solutions too.
- Incorporate differing solution and replacement time-horizons, ranging perhaps up to 40 years so that infrastructure-type storage solutions can be properly compared
- Include reasonably aggressive forecasts of environmental conditions and retirements of existing plants, allowing the integration of renewable generation beyond a 50% penetration, or planning for years of very-low hydro-electric output.

5.a. Is there a need for a state-supported independent energy storage testing facility that would accelerate the commercial acceptance of new and emerging energy storage technologies?

CESA strongly supports a state-supported independent energy storage testing facility for the purposes of more easily comparing commercial and near-commercial technologies. Where possible, the testing facility should be available for all applications and all use-cases and the CEC should first focus on testing existing technologies and those in later stages of development.

CESA has identified the need for such a clearing house for new technology testing with publicly available data and state participation. To start, such a facility could address the need to reasonably compare across existing technologies. CESA emphasizes that a facility for testing existing technologies would have a greater impact on the overall market by helping to build trust and understanding with the regulatory, insurance, and risk management community.

A state-supported performance testing facility will also help accelerate the commercial viability of emerging energy storage technologies. However, a perhaps more important R&D concept is the adoption of standard testing conditions for each application, which will directly enhance the bankability of emerging energy storage projects. Where the standardization of testing protocols and creation of a testing facility can go hand-in-hand, the CEC could have great impact on the market at-large.

5.b. If so, what level of testing would be needed in terms of system size, rating and duration?

Some advanced evaluation of the testing criteria will be appropriate for scoping the testing facility. CESA believes, as a starting place, the following information should be evaluated in such a testing facility.

1. Power capacity
2. Energy capacity
3. Round-trip efficiency at various operating points
4. Power capacity degradation
5. Energy capacity degradation
6. Round-trip efficiency degradation

Further research could further determine the eligibility criteria to qualify for entrance to the performance test facility. The CEC should consider at which state of technology development it is appropriate to test performance. The CESA Emerging Technology Working Group has identified the need for standard testing comparisons for existing commercial energy storage technologies, which are those evaluated according to a Nationally Recognized Testing Laboratory (ie. UL-listed products). After this benchmark facility is established, the CEC could evaluate the need to a performance testing facility specifically designed for earlier stage technologies that is designed to accommodate the safety and operational needs of a new technology.

Finally, CESA recommends research into existing energy technology performance test facilities and testing protocols. Lessons can be learned from the performance testing models used in the solar industry to accelerate solar adoption and monitor photovoltaic (PV) module degradation (such as PV USA Testing Conditions).[6] Similar testing standards could be developed for energy storage to standardize definitions, create credible data, and compare technology performance.

Lessons can also be learned from existing energy storage performance testing facilities, and the CEC could use these facilities as a model for its own facilities. In Australia, an energy storage testing facility funded by the Australian Renewable Energy Agency (ARENA) was established in 2016 to provide comparable unbiased real-time battery performance data.[7] All batteries were required to be commercially available and cover a spectrum of prices and chemistry variants. Batteries tested included lithium-ion, conventional lead acid, advanced lead, zinc-bromine flow, and aqueous hybrid ion. The project has gone through two phases, and ARENA's total contribution to both phases amounts to $870,000.

Conclusion

CESA appreciate the opportunity to provide these comments on Workshop on Energy Storage Research Needs for California.

Sincerely,

Alex Morris
Vice President, Policy and Operations
California Energy Storage Alliance (CESA)
amorris@storagealliance.org

Sarah Busch
Manager, Emerging Technology Program
California Energy Storage Alliance (CESA)
sbusch@storagealliance.org
(510) 665-7811

[6] National Renewable Energy Laboratory, "Photovoltaic Lifetime Project," available at https://www.nrel.gov/pv/lifetime.html.
[7] Lithium Ion Batter Test Centre, http://batterytestcentre.com.au/.