April 8, 2019

Email to: docket@energy.ca.gov
Docket Number: 19-MISC-01
Subject: DER Roadmap Draft Technical Assessment

Re: Comments of the California Energy Storage Alliance (CESA) on the California Energy Commission (CEC) Workshop on the Distributed Energy Resources (DER) Roadmap Draft Technical Assessment

CESA appreciates the opportunity to participate in the development of the *Distributed Energy Resources (DER) Roadmap Draft Technical Assessment* and to provide feedback to the California Energy Commission on potential research and commercialization opportunities that support distributed energy storage technologies. CESA is a 501(c)(6) organization representing over 80 member companies across the energy storage industry and is involved in a number proceedings and initiatives that address the various strategies and barriers related to growing the energy storage market to support a more reliable, cleaner, and more efficient electric grid. With our background and expertise, CESA hopes to help inform the CEC staff on research priorities for future grant funding opportunities through the Electric Program Investment Charge (EPIC) Program that target some of the barriers identified in the Draft Technical Assessment.

Energy Storage: Feedback on Draft Technical Assessment

CESA appreciates the opportunity to provide these comments and feedback on the DER Roadmap. A key threshold question for CESA is around the scope of this report – *i.e.*, whether this effort is intended to capture all distribution connected energy storage – *i.e.*, both in-front-of-the-meter (IFOM) and behind-the-meter (BTM) energy storage – or just customer-sited BTM energy storage.

Storage Technologies

The report largely captures the main classes of energy storage technologies but they should be broken down into sub-classes of technologies in order to more usefully inform the CEC on key barriers and gaps. CESA recommends the categorizations and sub-classes used in the IRENA *Electricity Storage and Renewables: Costs and Markets to 2030* report as a reference, which offers a detailed framework for technology sub-categories and looks at cost structures of various energy storage technologies from a fundamental materials or chemicals basis to understand potential cost reduction drivers. IRENA's framework may be helpful with the CEC's efforts.

Importantly, CESA notes that thermal storage is missing from the list of energy storage technologies covered in this report. Hot or cold thermal storage technologies provide load shifting capabilities that can support the electric grid in integrating renewables and help customers save on their electricity bills. Thermal storage should thus be added to this report. Furthermore, while not a technology *per se*, the Draft Technical Assessment should give consideration to hybrid energy storage configurations – *e.g.*, gas-plus-storage, solar-plus-storage, lithium-ion batteries paired with flow batteries, lithium-ion batteries paired with supercapacitors, etc. The possibilities of hybrid configurations are numerous, so there may need to be some consideration of enabling technologies that support greater pairing of a specific storage technology with other/multiple generation or storage technologies.

For the review of the advantages, disadvantages, and technical specifications, CESA recommends greater granularity by specific energy storage technologies, as opposed to broad categories of "electrochemical storage" for example. In general, there is some inconsistency between assessing broad categories and more specific technologies at different sections of the report, which makes it challenging to follow. Even as there are commonalities for multiple technologies, a more consistent tech-by-tech assessment would be helpful in informing focus areas for the CEC.

To assess the performance attributes of different storage technologies, CESA recommends a literature review of lab studies and demonstration project reports rather than focusing exclusively on industry research reports and survey reports. Especially for technologies that have limited market penetration, there may be little data to assess the state of the technology. While lab and demonstration reports are reported in ideal testing conditions as opposed to real-world field conditions, they present some performance data starting points to assess where further work is needed.

On energy storage costs, CESA recommends the use of Lazard's *Levelized Cost of Storage* report, which is issued annually and forecasts out through 2030. This publicly available report is used in official CPUC proceedings and provides granularity on the cost drivers as well as costs by use case and application. At the same time, the report has some limitations, so CESA supports the use of other reports as well to benchmark this report. Specifically, CESA also notes that the cost declines forecasted for lithium-ion batteries in the Draft Technical Assessment is almost entirely driven by battery pack/module costs.[1] This forecast may underestimate the cost reduction potential in balance of system costs and other 'soft' costs based on other industry reports. As raised at the workshop on March 25, 2019, it would also be beneficial for stakeholder review to have the consultant to the report make its references and citations available, especially as it cites its internal assessments from their research team. If unable to do so, then CESA recommends the use of publicly available data to the degree possible.

[1] Draft Technical Assessment, pp. 15-16.

Storage Metrics

The report lists a number of "metrics" to presumably measure the performance characteristics, benefits, and market penetration of energy storage technologies. CESA is unclear on the purpose or intent of the outlined metrics. If used to help inform how to prioritize possible research opportunities between short-, medium-, and long-term agendas, CESA recommends the following metrics and categorization for each storage technology:

Category	Storage Metric	Purpose
Performance Characteristics	• Cycle life (100% depth of discharge equivalent) • Single-cycle roundtrip efficiency (%) • Charge/discharge rate (MW/s, MW/h) • Standby losses • Degradation rate (annually, per 1,000 cycles) • Above performance metrics differentiated by ambient temperature and application, if possible	Low scores or performance in any metric here can highlight areas of more basic R&D that could support technical barriers to any given technology
Market Penetration	• Installed capacity (MW, MWh) • Capacity participating in CAISO market (MW, MWh) • Cost per installed capacity by use case ($/MW, $/MWh)	Low market penetration and/or high costs may highlight a need for more focus on deployment (short- or medium-term focus area) and scaling but it also may signal other market or regulatory barriers
Prospective Benefits	• Avoided outages (minutes per customer) • GHG emissions and criteria pollutants reduction (MT-CO2/year) • Reduced renewable curtailments (% of total generation) • Reduced production and operating costs ($, $/year) • Planned distribution investments avoided or deferred ($, $/year)	Significant prospective benefits for a technology with less-than-ideal performance characteristics and/or insufficient market penetration may highlight medium- or long-term focus areas and would ensure EPIC investments better align with California grid needs

For each of the metrics above, there may not be clear quantitative numbers – *e.g.*, due to the lack of standardized performance testing. Where specific metrics cannot be quantified, CESA recommends the use of qualitative "grades" to understand how the technology is rating across any given metric.

Importantly, the benefits category of metrics may not be available by each storage technology and should be viewed cautiously as they may point to a market or regulatory issue as opposed to a technology issue, which is the focus of this report and the EPIC Program efforts. In other words, these outputs is likely subject to how the energy storage technology is operated (*e.g.*, in response to economic signals or other rules/requirements) rather than what the energy storage technology is. As a result, CESA recommends that the above the benefits category of metrics should focus on prospective or modeled benefits to highlight where and how the CEC should focus its efforts to support improved performance characteristics and/or increased market penetration. While these benefits are modeled and likely based on perfect foresight or ideal dispatch, CESA believes that it is the responsibility of the CPUC, CAISO, and storage operators and owners to resolve how the energy storage should be operated to realize the modeled or ideal scenarios. The prospective, historical, or actual benefits can be sourced from other state agencies.[2]

CESA also requests some context behind Figure 11, which highlights the breakeven installed cost of storage for various use cases. It would be helpful to understand what factors (*e.g.*, revenues, operations) go into determining the breakeven installed cost.

Regarding the barriers to further adoption, CESA believes that the Draft Technical Assessment captures most of the key barriers. However, as noted before, greater consideration of broadly applicable as well as technology-specific barriers may be helpful. For example, long-duration storage technologies lack sufficient valuation in planning models as well as incremental capacity value from the RA Program to deliver longer-duration capacity. To address these barriers, the Draft Technical Assessment report appropriately identifies standardized configurations and designs for interconnection as a near-term solution, but standardized contracting and market products will also address some deployment challenges.

Regulatory Drivers

There are many regulatory drivers from the California Independent System Operator (CAISO) and California Public Utilities Commission (CPUC) than the few listed under "Federal and/or State Policy Drivers" section of the report. First, CESA offers three minor corrections or enhancements to the report:

- California AB 2868: The report notes this as a Senate Bill ("SB") when in fact this was an Assembly Bill ("AB").[3] Furthermore, this point could be elaborated to show that each of the investor-owned utilities (IOUs) submitted applications to the CPUC on February 28, 2018 (SDG&E) and March 1, 2018 (PG&E, SCE) that proposed behind-the-meter (BTM) energy storage programs mirroring some of the program design of the Self-Generation Incentive Program (SGIP) while targeting low-income and disadvantaged community customers. A CPUC Proposed Decision was recently issued that approved PG&E's BTM Thermal Storage Program for 5 MW. This could be a continued driver of energy storage procurement as each IOU is authorized to propose programs or investments up to 166.66 MW (*i.e.*, for a total of 500 MW

[2] For example, the IRP proceeding is conducting capacity expansion and production cost modeling to highlight how energy storage can impact relative costs, GHG emissions, reliability, etc. Meanwhile, for BTM energy storage systems, Itron conducts an annual evaluation of energy storage impacts on GHG emissions, peak reductions, and customer bill savings for the SGIP Program. Both the IRP and SGIP include modeled or ideal dispatch studies that may inform the CEC's EPIC funding focus areas.

[3] Draft Technical Assessment, p. 24.

across the three IOUs), where each IOU has yet to propose plans up to the authorization cap.

- AB 2514: This policy driver should be elaborated. In particular, as it relates to BTM energy storage resources as a supply-side resource, AB 2514 was a critical driver for innovation of this use case, where SCE and PG&E have procured supply-side BTM energy storage to meet a portion of their recent local capacity requirements (LCR) needs. Without the customer domain targets of AB 2514, it is unclear if the IOUs would have tested out and procured for this use case.

- CPUC E-4791: Resolution E-4791 is not accurately characterized. In the report, the report is characterized as updating the storage procurement requirements for the IOUs pursuant to the AB 2514 targets.[4] However, in actuality, the impact of Resolution E-4791 was to direct expedited energy storage procurement to address an emergency grid reliability situation (*i.e.*, moratorium on the Aliso Canyon gas storage facility that serves 18 key gas generators in the LA Basin area).

In addition to the two corrections above, CESA recommends reference to several additional regulatory drivers as elaborated below. CESA found several key drivers that were missing and should be included:

- Self-Generation Incentive Program (SGIP): This program is notably absent in this section, even though SGIP is responsible for supporting the deployment of hundreds of megawatts of BTM energy storage by providing upfront and performance-based incentives. Recently, with the passage of SB 700, Over $400 million in incentives is available through 2019 for BTM storage systems, including a 20% Equity Budget set-aside, and with the recent passage of SB 700, program funding will be extended with $166 million per year through 2024.

- CPUC E-4909 and E-4949: Related to Resolution E-4791, the report should also include references to Resolution E-4909 that authorized expedited procurement of energy storage to be procured as an economic alternative to gas generators in the Moss Landing and South Bay areas and to Resolution E-4949 that ultimately approved 567.5 MW of energy storage procured. In this case, the reliability and economic option value of energy storage was demonstrated through these expedited procurements, potentially to replace or enhance gas-fired resources.

- Integrated Resources Planning (IRP): IRP modeling and procurement is the new world of resource procurement. With SB 100 setting the stage for 100% of the state's electricity coming from zero-carbon resources and the IRP dealing with the economic gas retirements issue, energy storage will play a role in supporting renewables integration and enabling the retirement of the state's gas fleet. Already, we have some of those efforts through the ongoing but close-to-

[4] *Ibid*, p. 25.

concluding Moorpark and Goleta RFPs in SCE's territory, where resources such as energy storage are being procured to obviate the need for gas resources. With each IOU nearing fulfillment of its AB 2514 obligations, the new IRP world will drive energy storage deployments going forward and may highlight the need for new types of energy storage technologies (*e.g.*, long duration). The CPUC's 2018 Reference System Plan identified more than 2,000 MW of energy storage through 2030 as part of the "optimal portfolio" while alternative modeling by SCE under a high electrification scenario showed the need for more than 9,000 MW of energy storage through 2030.

- Distribution Investment Deferral Framework (DIDF): The DIDF was adopted in February 2018 that established an annual distribution planning process to consider potential deferral opportunities for DERs such as energy storage. Annually, there could be between 10 MW to 30 MW of opportunity for DERs such as energy storage to provide distribution capacity, voltage support, and resiliency services.

- Demand Response Auction Mechanism (DRAM): After four rounds of pilot solicitations, the DRAM will be extended for another few years to have the IOUs procure supply-side DR resources to provide Resource Adequacy (RA) capacity. This DR-only reverse auction procurement mechanism will provide frequent opportunities for BTM energy storage to be procured to meet RA needs.

- Transportation Electrification Programs: There are rebates for electric vehicle supply equipment (EVSE) and some procurement opportunities for energy storage to support DC fast charger buildout in various IOU EV and transportation electrification applications. These include the SB 350 Trasnportation Electrification Applications, SCE's Charge Ready Program, PG&E's Electric Vehicle Charging Network (EVCN) Program, and more.

- 2019 Building Energy Efficiency Standards: The CEC recently adopted Title 24 requirements that will allow zero-net-energy home to use energy storage as a compliance option under the building standards. With all new construction being subject to these standards, new customer load will include some level of energy storage deployment.

- Microgrid Resiliency (SB 1339, Stern): This bill directs the development of a microgrid tariff, allows for third-party owed microgrids, and directs actions to support and streamline deployment of microgrids, where energy storage may play a major role.

- Clean RA Requirements (SB 1136, Hertzberg): This bill links RA requirements with the state's clean energy goals and highlights the role of energy storage and hybrid storage configurations.

- Green Electrolytic Hydrogen (SB 1369, Skinner): This bill directs the IRP process to consider the existing and potential uses for green electrolytic hydrogen in meeting statewide GHG goals. This will affect IRP modeling and scenarios and may lead to policy actions and/or procurement.

Identified RDD&D Needs

CESA understands that our feedback will help inform how to prioritize possible research opportunities between short-, medium-, and long-term agendas. EPIC funding remains an important tool for evolving our grid and energy storage toolkit. CESA is not well positioned to recommend a focus on one technology over another because we are technology neutral in our approach toward energy storage market development. That said, we think RDD&D focused on key grid needs for our future grid will involve much storage RDD&D. We recommend RDD&D on the following:

- **Near term:** Local area energy and capacity, fast flexibility and ramping, end-use customer energy management, cross-sectoral decarbonization, fire-safety, avoidance and grid-resiliency, integration of DERs, and transactive energy

- **Medium term:** Renewable shifting, low utilization storage (*e.g.*, for contingencies, infrequent needs, resiliency), multi-day shifting and capture

Furthermore, EPIC Investments in modeling tools,[5] performance testing standards,[6] calculators,[7] and other tools will support growth of the energy storage market in promoting comparability of energy storage technologies, addressing the challenges in insufficient or inability to model the benefits of different energy storage use cases or technologies, and allowing for standardized ways to configure and pair energy storage resources. CESA believes that the CEC is well-positioned to support such investments, which will have broader impacts beyond any one technology.

Finally, CESA recommends that the CEC also consider how the regulatory barriers identified in the report be used to support potentially overlooked use cases. For instance, there is currently no quantifiable benefit or framework for energy storage resources to be used to

[5] There are a limited range of models currently available that allow for multi-day or seasonal storage optimization and dispatch. This will critically miss opportunities to value long-duration storage technologies.

[6] There are standards development organizations and testing laboratories that are developing standard testing protocols. The CEC should support these efforts and, if possible, develop the tools and calculators to identify the performance characteristics of a technology based on input values and in various standard testing conditions. Such a tool would support end-user adoption and promote greater adoption of emerging energy storage technologies.

[7] Calculators would be especially helpful to support 'rule of thumb' insights into how energy storage will perform or how they will benefit the grid. For example, California is critically in need of a calculator to determine the Effective Load Carrying Capability (ELCC) value – *i.e.*, RA capacity value – of solar-paired-storage systems and other paired-storage systems. The CEC may be well-positioned to support the development of such a tool that would promote greater adoption of hybrid storage systems.

provide distribution resiliency. The inability to quantify this benefit has led to difficulties in cost-effectiveness assessments for energy storage used in such applications. Similar barriers exist for the aforementioned near-term and medium-term use cases above. Similar to what was done for the EPIC-funded PG&E Vaca-Dixon energy storage project, demonstration and evaluation of energy storage being used for some of these overlooked use cases would support greater deployment of energy storage technologies for these purposes.

<u>Vehicle-Grid Integration (VGI): Feedback on Draft Technical Assessment</u>

CESA supports the CEC's consideration of electric vehicles (EVs) and vehicle-grid integration (VGI) as a key technology category in the report. At a high level, CESA agrees with commenters at the March 25, 2019 workshop where greater coordination between these roadmapping efforts and the CEC's VGI Roadmap efforts. In other words, it is unclear what the linkages are between these two roadmaps.

EV Integration Metrics

CESA recommends a similar format for EV integration metrics as what we proposed for energy storage metrics. However, it may be difficult to obtain the metric data as proposed in the draft report, which includes operational data that may not always be available to assess the state of the technology or use case. Whereas energy storage systems have historical operational data made publicly available on an aggregated basis when funded by SGIP to support program evaluation, CESA is unclear on whether such operational data would be made available for smart and/or bidirectional EVs and EVSEs. In particular, the metrics around revenue opportunity maximum MW output and consumed may be difficult to obtain unless such data is required to be reported as part of a ratepayer-funded program.

Regulatory Drivers

CESA recommends that the CEC and the consulting team refer to our comments on the Draft VGI Roadmap. In those comments, CESA provides our input on what the key regulatory and market barriers are present that may limit the potential deployment and utilization of VGI resources.[8] The draft report section captures many of the barriers, including around the lack of compensation or valuation of benefits and the need for aggregation, but there are additional barriers such as those around Rule 21 interconnection that are in the process of being resolved or need to be resolved going forward. As noted at the workshop, the draft report should reassess

[8] See *Comments of the California Energy Storage Alliance (CESA) on the VGI Roadmap Workshops*, submitted in Docket 18-MISC-04 on November 21, 2018.

whether battery warranty impacts are indeed a barrier for vehicle-to-grid (V2G) systems, since some recent studies have shown negligible impacts to the battery.

Conclusion

CESA appreciates the opportunity to provide these comments and feedback on the DER Roadmap. We look forward to collaborating with the CEC and other stakeholders in this proceeding.

Sincerely,

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