December 9, 2022

Email to: mariko@lumenenergystrategy.com
Proceeding Number: R.15-03-011
Subject: CESA's Draft Lumen California's Energy Storage Procurement Study

Re: Comments of the California Energy Storage Alliance (CESA) on the Draft of "California's Energy Storage Procurement Study"

Dear Sir or Madam:

The California Energy Storage Alliance ("CESA") appreciates the opportunity to comment on the third public stakeholder workshop held on November 4, 2022 ("Workshop"), where Lumen Energy Strategy, LLC ("Lumen") presented the draft of the *California's Energy Storage Procurement Study* ("Draft Study") prepared for the California Public Utilities Commission ("Commission"). CESA recognizes the effort of Lumen in analyzing the performance of energy storage resources procured and operational pursuant to Assembly Bill ("AB") 2514. This diligence is evident in how the Draft Study thoroughly details how the energy storage fleet creates substantial benefits to electrical grid and helps California accelerate decarbonization and further renewable integration.

CESA is a 501(c)(6) organization representing over 100 member companies across the energy storage industry. CESA is involved in a number of proceedings and initiatives in which energy storage is positioned to support a more reliable, cleaner, and more efficient electric grid. Moreover, CESA is actively engaged in first-in-class modeling studies to better understand the need, opportunity, and value proposition for energy storage given Senate Bill ("SB") 100 targets. CESA is also actively engaged in regulatory venues committed to bolster the resiliency of the grid through proper compensation and recognition of the benefits of distributed energy resources ("DERs"), such as behind-the-meter ("BTM") energy storage assets. As such, our background and experience providing technical and policy insights are of particular relevance to this study.

I. INTRODUCTION AND SUMMARY.

CESA appreciates the efforts of Lumen in hosting the Workshop to provide updates to stakeholders on the Draft Study. The results of Lumen's Draft Study demonstrate the value proposition of energy storage technologies to the electrical grid and to achieve timely and affordable decarbonization. These modular and versatile technologies can scale from BTM installations to grid-scale in-front-of-the-meter ("IFOM") applications at a competitive cost. In the same context, CESA supports Lumen's effort to analyze the historical performance of energy storage installations directed via different procurement venues to quantify if they fulfill the goals stated under AB 2514.

While CESA supports Lumen's overall methodological approach, there are important takeaways and recommendations that merit revision and clarification. For example, given the fact that the effective load carrying capability ("ELCC") methodology and the results of the cost-effectiveness analysis could likely inform current and future proceedings relative to energy storage, CESA recommends clearly noting the factors that influence said results. Additionally, CESA urges Lumen to clearly state in the Draft Study that the cost-effectiveness results for BTM installations from the Self-Generation Incentive Program ("SGIP") are the result of the current regulatory policy framework rather than the inherent characteristics of these assets. CESA believes that those specific results underscore the urgency of policy reform rather than the fact that BTM systems do not benefit ratepayers. Therefore, the results shown in Figure 1 from the Draft Study should be properly framed so as to transmit the correct signal to the regulatory agencies – *i.e.*, reforms are needed so that BTM assets can contribute to urgent reliability needs and unlock the capabilities of these resources. The Draft Study should also properly note that the results included therein do not capture the effects of recent modifications to SGIP-funded programs that created a better linkage between energy time-shift and greenhouse gas ("GHG") emissions reduction, which CESA expects would improve their benefit-cost ratio.

While CESA offers this and other feedback in these comments, we recognize the immense effort Lumen undertook to collect real-world data and clean/process them coherently. CESA believes that this study and the operational data collected therein will be crucial for modeling efforts to quantify the value of energy storage technologies correctly. This being said, CESA's feedback and recommendations can be summarized as follows:

- Lumen should highlight that results are limited by the timeframe of the study and recent storage installations show lower costs and additional benefits to the grid.

- Lumen should include a recommendation to develop ELCC values based on the solar-storage surface for energy storage assets with longer durations, such as 10-, 12-, and 24-hour resources.

- Lumen should also note that, in addition to considering longer durations, the ELCC values derived from the Commission's solar and storage surface should also consider a broader range of round-trip efficiencies ("RTEs").

- CESA proposes including a recommendation that supports a procurement program designed to drive attribute-focused procurement but allows for some level of resource-specific procurement should be sought to promote some resource diversity and encourage the development of technologies that will minimize overall costs in the long-run.

- The Draft Study should note that additional barriers also exist to unlocking more optimal uses of BTM storage, including a lack of Resource Adequacy ("RA") capacity valuation that is inclusive of exports, which limits CAISO wholesale market participation for these resources.

- Lumen should not only recommend that the Commission provide stronger grid signals to customers to support grid services from BTM energy storage resources, but also that the CPUC remove explicit barriers to the provision of these services.

- Lumen should clearly acknowledge that the Draft Study does measure the impact of the GHG signal adopted for SGIP in 2020 and remove recommendations to modify the GHG signal requirements, instead noting that the Commission should look to the 2021 SGIP Impact Evaluation Report to consider the effectiveness of the GHG requirements and whether further adjustments are needed.

- Lumen should expand the recommendations on distribution-connected installations to propose incorporating local needs (*i.e.*, Local RA) into long-term planning venues.

- Lumen should include a recommendation to ensure that income requirements for should be confirmed via self-attestation for SGIP's low-income and/or equity budget categories.

- Lumen should add a recommendation to note that the non-residential Equity Resiliency Budget ("ERB") eligibility within SGIP should be expanded to a wider gamut of facilities facing outages beyond Public Safety Power Shutoffs ("PSPS") events.

- Regarding safety, Lumen should highlight the importance of the California Fire Code ("CFC") and the consistent interpretation of the code across jurisdictions.

- Lumen should incorporate CESA's Safety Series as a real example of existing efforts in safety best practices led by the industry in California.

- The Draft Study should underscore the timely creation of and routine maintenance and updates to an energy storage permitting guidebook for residential systems as an example of and recommendation for enhanced safety.

- Lumen should explain and describe the required information from energy storage projects to perform the analysis undertaken in this Draft Study.

- Lumen should highlight in the document that the cost trends observed in this Draft Study (Figure 29 on page A-30) reflect only the beginning of the learning curve of energy storage.

- Lumen's assumption that systems with up to 10 hours of duration will meet most grid needs is unwarranted and Lumen should have included longer storage durations in the analysis, as it is likely that this type of technology will become operational during the study period.

- CESA encourages Lumen to extend the input assumptions range for the cost-effectiveness study with a more realistic range of future energy storage technologies.

- CESA recommends increasing the RTE assumption in Attachment B to at least 90%, which is in line with what has been reported in academic literature.

Overall, our comments and recommendations above are being submitted in the spirit of wanting to have the Draft Study's findings and recommendations to be actionable across the many Commission and other state venues to advance energy storage procurement and deployment and take correct actions where necessary and as informed by the correct data and context. CESA therefore reiterates our support for the efforts taken to complete the Draft Study, which will be seminal in ongoing and future policy and regulatory discussions and decisions.

II. EVOLVE SIGNALS FOR RESOURCE ADEQUACY CAPACITY INVESTMENTS.

In this section, Lumen documents the importance of creating clear signals for the RA capacity market to procure needed resources while providing certainty among stakeholders regarding the value of energy storage as an RA capacity resource. Lumen also states that additional work is required to highlight the need for longer-duration storage investment and that Commission should incorporate "'real" options to increase the energy capacity.

First, CESA largely agrees with the notion that improving ELCC methodologies will better communicate market signals to buyers and sellers. To this effect, CESA commends updates that the Commission has made to the RESOLVE model's assumptions to reflect the interdependent effects increasing penetrations of VERs have on the reliability contributions of energy storage resources. The Commission's adoption of a solar-storage ELCC surface properly recognizes that storage peaking capacity contributions are a function of the penetration of storage and the availability of other renewables. While the changes adopted by the Commission are timely and valuable, the limited set of values developed should be expanded upon. Today, ELCC values are only estimated for energy storage based on the solar-storage ELCC surface for 4- and 8-hour lithium-ion resources. While CESA understands that these assets may be the ones experiencing the most commercial interest and activity at the moment, other technologies (both mature and emerging) would benefit from being considered in the context of a solar-storage ELCC surface. As such, CESA urges Lumen to include a recommendation to develop ELCC values based on the aforementioned surface for energy storage assets with longer durations, such as 10-, 12-, and 24-hour resources. Consideration of longer durations is timely given that, in prior IRP cycles, RESOLVE, despite its methodological shortcomings, already identified the need for long-duration energy storage ("LDES") resources. Moreover, Lumen should also note that, in addition to considering longer durations, the ELCC values derived from the Commission's solar and storage surface should also consider a broader range of RTEs. CESA recommends modeling RTEs across a range between 35% and 85%, as this better represents the diversity and heterogeneity of existing and emerging technologies and helps to understand the tradeoff of different energy storage attributes. Over time, the Commission should strive to develop these curves as a function of charging and discharge rates as well.

Finally, regarding the need to incorporate real options for LDES installations into investor-owned utility ("IOU") solicitations and Commission contract approvals, CESA proposes including a recommendation in support of the programmatic procurement program that the Commission's Energy Division staff is currently developing as part of the Integrated Resource Planning ("IRP") proceeding (R.20-05-003). Specifically, CESA proposes including a recommendation that supports a program designed to drive attribute-focused procurement but allows for some level of resource specific procurement should be sought to promote some resource diversity and encourage the development of technologies that will minimize overall costs in the long-run. Importantly, the Commission should also consider allowing joint procurement in the framework, to enable the deployment of high capital cost assets. This allows the Commission to direct development of resources that would benefit ratepayers in the long run, and incentivize LSEs to, individually or jointly, pursue innovative, large scale and long lead time projects. There may be other needs or attributes that are overlooked, such as value-stacking opportunities (*e.g.*, resiliency, local + system capacity), expected useful life of the resource, supply chain resiliency, among others.

Such a recommendation is warranted because, for example, the 2021 Senate Bill ("SB") 100 Joint Agency Report ("JAR") found that, when zero-carbon firm resources (*e.g.*, geothermal, biomass, seasonal LDES, and hydrogen fuel cells) are adopted at significant levels, total resource costs are reduced by $4 billion. These results are confirmed by CESA's landmark study, *Long Duration Energy Storage for California's Clean, Reliable Grid*, where CESA found that there are savings of up to $1.5 billion per year in system costs by 2045 relative to a grid without LDES. With some flexibility around resource-specific procurement, the Commission would have the ability to address gaps or shortcomings in current IRP modeling and procurement processes.

III. BRING STRONGER GRID SIGNALS TO CUSTOMERS.

In the Draft Study, Lumen states that the installed BTM systems included in this study were not cost-effective for ratepayers, as they provided less benefits than costs to ratepayers. In particular, Lumen states that these non-residential BTM systems could have provided between $3/kW-month and $4/kW-month in energy value, but that the best performers were only providing up to $0.60/kW-month in energy value. Lumen appropriately highlights that there are conflicts in customer rates that leads to sub-optimal storage discharge patterns from a grid perspective. The non-coincident demand charges faced by many non-residential customers pose a barrier to discharging during the peak period, as highlighted by the Draft Study and also discussed by Energy Division in the *Advanced Strategies for Demand Flexibility Management and Customer DER Compensation* White Paper.[1]

The Draft Study should also note that additional barriers also exist to unlocking more optimal uses of BTM storage, including a lack of RA capacity valuation that is inclusive of exports, which limits California Independent System Operator ("CAISO") wholesale market participation for these resources. Currently, the majority of BTM storage systems participating in the CAISO market participate as a Proxy Demand Resource ("PDR"), a market pathway that allows settled

[1] *See* https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/demand-response/demand-response-workshops/advanced-der---demand-flexibility-management/ed-white-paper---advanced-strategies-for-demand-flexibility-management.pdf.

compensation for only load reduction across customer site(s). This does not recognize the incremental export capacity that could be provided by these resources, and limits market contributions from facilities with low loads during times of grid constraint, like schools and commercial facilities that do not operate in the evening or on weekends. Currently, the Distributed Energy Resource Provider ("DERP") model allows for energy compensation for exports, but this pathway has not been used by developers given that DERP resources are ineligible for RA credit, a critical revenue stream since energy value alone is insufficient to entice DERP participation. If this policy barrier is removed, BTM energy storage resources could provide both additional energy and capacity value. The fact that this can be addressed by regulators and is not an inherent limitation of the assets should be highlighted in the Draft Study. Given the two barriers above, among other barriers that are discussed in the Draft Study, CESA recommends that Lumen not only recommend that the Commission provide stronger grid signals to customers to support grid-facing services but also that the Commission remove explicit barriers to the provision of these services.

Additionally, Lumen comments on the GHG emissions of BTM systems, particularly the SGIP systems that make up the majority of the BTM systems in this study. In doing so and due to the timing of this study, Lumen did not evaluate changes that have been made to SGIP to remedy some of the shortfalls in the Draft Study. As such, when Lumen recommends that the Commission "[s]trengthen and leverage requirements to follow the GHG signal,"[2] the Draft Study fails to consider the GHG signal that was only put in place in 2020 and launched in April of that year. This is further complicated by the fact that, as highlighted by the *2020 SGIP Evaluation Report*, "[w]hile new nonresidential projects are required to reduce emissions by at least 5 kg/kWh, Verdant could not develop annual impacts for these systems. […] Some projects received incentives in October or November of 2020 and were not operational throughout the summer period when emission benefits can be best realized."[3] The *2020 SGIP Evaluation* is the most recent evaluation to be released, and concrete conclusions on the effectiveness of the GHG requirements cannot be drawn until a full year of data on effectiveness is available in the 2021 evaluation. Therefore, Lumen should remove recommendations to modify the GHG signal requirements, instead noting that the Commission should look to the *2021 SGIP Impact Evaluation Report* to consider the effectiveness of the GHG requirements and whether further adjustments are needed.

IV. REMOVE BARRIERS TO DISTRIBUTION-CONNECTED INSTALLATIONS.

In the Draft Study, Lumen sheds light on the different barriers that limit the widespread deployment of distribution-connected installations. Lumen argues that Local RA needs coupled with the potential for peaker replacement and the associated decrease in emissions warrant consideration of additional revenue streams and multiple-use applications in order to get storage to a position where it can cost-effectively replace existing polluting assets. To support this argument, Lumen presents a cost comparison of different standalone storage and paired (solar-plus-storage) solutions, and an estimate of how much peaker capacity could be replaced at that price point. The chart, Figure

[2] Draft Study at 9.
[3] Verdant, *2020 SGIP Impact Evaluation Report*. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/self-generation-incentive-program/sgip-2020-energy-storage-impact-evaluation.pdf.

54, provides this information using today's cost and a 2032 cost forecast that assumes a reduction of around 40% for storage and 20% for solar from current cost levels. In this section CESA offers feedback on the assumptions behind Figure 54 and the recommendations shared to remove barriers to distribution-connected installations.

First, while CESA appreciates the efforts of Lumen to estimate the cost trajectories of different standalone and paired configurations inclusive of the Inflation Reduction Act ("IRA"), we believe that the set of solutions identified by Lumen is not exhaustive. Lumen has focused on a narrow subset of solutions that do not exceed 10 hours in duration, an unreasonable assumption for their 2032 scenario considering that several technologies that are commercially available can double this duration and some can exceed it by a full order of magnitude. To address this, CESA offers more detailed comments on how to expand the set of solutions and how to estimate the costs for those asserts in our comments regarding "Attachment B: Cost-Effectiveness of Future Procurement".

Second, in the Draft Study, Lumen recommends that the Commission should pursue policies that accelerate market transformation. Lumen urges for this type of action since, as noted in "Attachment C: Cost-Effectiveness of Peaker Replacement" notes, all of the gas-fired peaking units analyzed (around 10 GW total capacity) are in CAISO-designated local capacity areas and are needed for local reliability. In this context, it is clear that some form of alignment between long-term planning, the RA Program, and the value streams compensated is necessary to achieve the degree of market transformation required. To this effect, CESA recommends expanding the recommendations of this section to propose incorporating local needs (*i.e.*, Local RA) into long-term planning venues. This should be achieved by both modeling Local RA needs, particularly for Local Reliability Areas ("LRAs") with a significant reliance on polluting resources, and by including locationally-targeted procurement directives in future Commission-issued procurement orders. The importance of commencing the alignment of these processes starting with long-term planning is that this models and procurement directives will inform transmission and distribution planning assumptions, allowing for a more holistic view of the investments made at different points of the electric system.

Alternatively, whether in place of or in addition to locationally-targeted procurement directives, Lumen and the Commission should be aware of the multiple barriers to Local RA procurement of new resources such as energy storage since the adoption of the Central Procurement Entity ("CPE"), which eliminated Local RA requirements for individual load-serving entities ("LSEs") and instead set those requirements in aggregate with the CPE. Since the inception of the CPE, there are several known barriers that have disincentivized local energy storage procurement by LSEs, particularly the lack of 1:1 crediting of LSE procurement of Local RA resources. Even if new energy storage resources were to bid and offer their resource directly to the CPE, there are questions about the least-cost, best-fit ("LCBF") bid evaluation methodology, which likely favors short-term contracts of existing resources given the three-year forward requirements of Local RA, whereas new-build local energy storage resources would require a long-term contract of 10-20 years. Similarly, the CPE is allowed to defer procurement to meet Local RA needs if bids exceed a certain cost cap – again, creating a bias against new resources that could meet Local RA requirements but would likely exceed such thresholds as new-build resources. Finally, an important issue to consider is whether local resources should be required to pay for system-level upgrades to be "deliverable"

to the system, even though from a power flow perspective, the energy storage discharge would likely serve load locally rather than to the bulk electric system. With the "bundling" of System and Local RA attributes, energy storage resources that could cost-effectively provide local-only services are prevented, and costlier network upgrades may be required.

Altogether, while Lumen correctly highlights the value of local and distribution-connected energy storage resources, there are clear known barriers in the IRP and RA space that minimally should be flagged and directed for further consideration.

V. IMPROVE THE ANALYTICAL FOUNDATION FOR RESILIENCE-RELATED INVESTMENTS.

In the Draft Study, Lumen provides a detailed argument for bolstering efforts to plan for solutions that enhance resilience at the customer and community level. The Draft Study notes that a functional definition of resiliency would be the first step to develop a stronger framework that can fully realize the potential ratepayer and societal benefits of customer-sited installations. CESA generally agrees with this characterization, as much work is needed to fully recognize resiliency value and integrate said benefits into the planning processes across the state. To materially enhance the framework for resilience-related investments, Lumen recommends continued focus on equity and resiliency in SGIP, expanding and periodically updating estimates on customer resilience-related vulnerabilities. Lumen also argues for further investigation into the barriers faced by non-residential customers under SGIP's ERB. In this context, CESA offers some additional recommendations in the context of recent modifications and discussions in the SGIP proceeding and other related venues.

First, CESA would like to expand Lumen's recommendation to continue focus on equity and resilience in SGIP to support customers with high outage risks but inability to pay for a cost-effective storage solution. CESA proposes including language to ensure that income requirements should be confirmed via self-attestation for the low-income and/or equity budget categories. This amendment to the recommendation would address burdensome demonstration requirements that materially limit participation of vulnerable populations. Easing this type of processes can significantly increase the number of participating low-income customers since many of them today may find it too costly or otherwise laborious to participate. We believe this recommendation is aligned with the Draft Study as it would increase the share of 1B customers, as noted in Figure 55.

Second, CESA recommends noting that the non-residential ERB eligibility should be expanded to schools and facilities facing outages beyond PSPS events. Bolstering participation of these type of facilities is mentioned in passing in Lumen's recommendation to further investigate barriers to non-residential enrollment under SGIP ERBs, but Lumen does not explicitly state that this expansion should consider risks beyond PSPS. While considering a wider gamut of benefits is essential to capture the value of these assets, properly assessing all the risks faced by participants is also key to understand and support the drivers of adoption. Non-residential facilities such as education or medical institutions have different risks profiles, potentials for losses, and redundancy needs. Other outage risks are growing in prevalence as well, such as the IOUs' growing use of

Enhanced Powerline Safety Settings ("EPSS"), the looming risk of earthquakes, and plain historical unreliability of electricity in certain communities (*e.g.*, tribes, San Joaquin Valley). Locking the budget behind the notion that PSPS are the only or even the most notable risks faced by customers is not reasonable in this context. Hence, CESA urges Lumen to note that the non-residential equity resiliency budget eligibility should be expanded to a wider gamut of facilities facing outages beyond PSPS.

VI. ENHANCE SAFETY.

In the Draft Study, Lumen states that "local or site-specific factors may require additional consideration beyond codes and standards."[4] While it is important to consider each energy storage project on an individual basis given the wide variety of technologies, installation configurations, and safety measures in place, CESA recommends that Lumen highlight the importance of the CFC and consistent interpretation of the code across jurisdictions. The CFC is an important piece of code that is developed with a robust stakeholder process. The CFC incorporates new elements and best practices from the International Fire Code ("IFC"), National Fire Protection Association ("NFPA"), and UL. "Relitigating" or "retesting" products that have already been certified to specified standards can present unnecessary barriers to adoption and deployment, and in many ways, defeats the purpose of standards. As highlighted by the Draft Study, safety must also be considered in the context of costs to ratepayers, and the proliferation of unique requirements across the 58 counties and 478 cities in California[5] will increase costs of energy storage development across the board. This risk of increasing costs should also be highlighted by the Draft Study.

At the same time, it is important to understand what certification to any given standard means to apply them in the appropriate way. The CFC appropriately balances this by providing robust requirements while allowing for authorities having jurisdiction ("AHJ") to assess the characteristics of the storage system using the UL 9540A test. CESA notes that having the necessary technical knowledge can pose a barrier to interpreting the UL 9540A test report, and the report can be overwhelming for AHJs that have never seen the report before. Therefore, education and resources are needed to allow AHJs to fully assess storage.

CESA therefore supports the creation of a Safety Knowledge Exchange to provide a place for education, resources, and collaboration on storage safety. Having statewide resources that explain the requirements of the CFC, the standards within the CFC, and a venue for questions and stakeholder discussion would be valuable. However, at this time, the industry is also taking active steps to advance energy storage safety and engage in dialogue with AHJs, local leaders, and the general public, and CESA has created a Safety Series to advance these important issues.[6] We encourage Lumen to incorporate this as a real example of existing efforts in safety best practices for energy storage in California.

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[4] Draft Study at F-27.
[5] *See* https://guides.ll.georgetown.edu/c.php?g=275786&p=1838520
[6] *See* https://www.storagealliance.org/safety

One effort that should be highlighted by the Draft Study is the creation of an energy storage permitting guidebook for residential systems. The creation of this guidebook was directed by the CESA-sponsored bill, AB 546 (Chiu, 2017), and the California Energy Commission ("CEC") is sponsoring this effort through its Electric Program Investment Charge ("EPIC") Program, choosing the Center for Sustainable Energy ("CSE") to develop the guidebook and its content.[7] However, despite the EPIC award being given in 2020, the guidebook has not yet been released, which is unfortunate given that local governments could use additional resources to support the development of automated permitting processes to comply with SB 379 (Wiener, 2022) requirements for residential solar + storage. While, CSE has not released the guidebook yet, Lumen should highlight this as an ongoing effort to provide resources to local governments and AHJs and should recommend that this effort be accelerated. Upon completion, it will be important to routinely update this guidebook and to expand the scope of the guidebook to not just small residential systems (as it stands today) but also to non-residential and larger BTM energy storage systems and IFOM energy storage systems.

VII. IMPROVE DATA PRATICES.

CESA recognizes that the electrical power industry could improve its data practices and transparency to help stakeholders conduct data-driven decisions and enhance the evaluations of policies with operational data. However, CESA recognizes that some data might be challenging to acquire and be subject to confidentiality. Routine data collection is a hurdle for both the collector and the entity providing the information, and we do not encourage this as a data practice. Instead, CESA recommends that Lumen explain and describe the required information from energy storage projects to perform the analysis taken in this Draft Study. With this required information, the Commission or CEC could request it from installers and make it available once the projects become operational.

Furthermore, CESA wants to highlight to Lumen of the existence of the energy storage database,[8] a current effort driven by the Department of Energy ("DOE") that captures project information and characteristics for energy storage across the world. CESA suggests that Lumen includes this reference so that the Commission or CEC could use it as an example of the required information that they should request from energy storage projects. This reference aligns perfectly with the second bullet on page 11, and Lumen should include it in the same paragraph.

VIII. ATTACHMENT A: BENEFIT/COST AND PROJECT SCORING OF HISTORICAL OPERATIONS.

CESA recognizes the importance of the results of this attachment as it highlights the status of the energy storage market and how it has evolved and matured over time. CESA generally agrees with the overall methodological approach used through this attachment to estimate the performance, benefits, and cost trajectories of operational energy storage installations. In addition, CESA

[7] *See* https://www.energystorageca.com/guidebook
[8] *See* https://sandia.gov/ess-ssl/gesdb/public/index.html

recognizes Lumen for its herculean effort to compile and interpret the operations of 24,196 energy storage installations. Still, CESA found out that some of this section's results, without additional explanation, could send a different signal to stakeholders about the value of energy storage and BTM installations.

First, Lumen should highlight in the document that the cost trends observed in this Draft Study (Figure 29 on page A-30) reflect only the beginning of the learning curve of energy storage. In future years, energy storage will become cheaper and more accessible with additional procurement and technological improvements. While near-term costs are rising due to supply chain limitations, COVID restrictions, and increased demand for these resources in the world and across different industries (*i.e.*, electric vehicles), costs for energy storage technologies are also expected to decline further, particularly considering the recent enactment of the IRA. Highlighting this is important since the results of the Draft Study focus on a narrow period at the beginning of energy storage's exponential growth in California. Furthermore, we expect that the value of energy storage to the grid will increase since it is a flexible asset that can contribute to both System, Local, and Flexible RA, as well as for resiliency needs.

On page A-33, Lumen highlights that the top three third-party-owned resources that obtained a high benefit/cost ratio got it due to their high-value Local RA capacity and participation in the CAISO marketplace. In contrast, SGIP-funded and pilot projects obtained the lowest benefit/cost ratios due to their lack of RA and high procurement costs. CESA is worried that Figures 1 and 33 suggest that BTM systems do not benefit the ratepayer, especially considering that the inability of these assets to provide RA is not an inherent limitation but a policy barrier that can and must be overcome. The low benefit/cost ratio is not intrinsic to BTM energy storage; instead, it reveals the need for policy reform to utilize this installation to reach the state goals. For the above reason, CESA requests Lumen to explain that the results observed for BTM installations represent inadequate policy and that the recent changes in SGIP-funded programs likely provide additional benefits not captured in this Draft Study. This request aligns with Lumen's statement that BTM storage could reduce grid-scale energy storage over procurement by 1-2 GW if appropriately used. As such, there are some avoided costs not captured in these findings considering SGIP-funded BTM energy storage is reflected with a reduction in peak capacity in the CEC load forecast.

Finally, given that the findings and the methodology used to score energy storage in the Draft Study could provide a basis for future evaluations led by the Commission or CEC, CESA requests Lumen to publish them in an accessible format such that any stakeholder could replicate this analysis with future data. CESA suggests that the CPUC could host the results and methodologies from this effort.

IX. ATTACHMENT B: COST-EFFECTIVENESS OF FUTURE PROCUREMENT.

Overall, CESA supports the study approach proposed by Lumen to quantify the cost-effectiveness of future energy storage procurement. Considering the results in this section could provide market signals to guide procurement and valuation of storage moving forward, CESA wants to highlight the importance of including adequate modeling assumptions. While we recognize that

models have limitations, and some of the suggestions noted in this section may be out of the scope of the work, in the spirit of improving the framing of the results and the sensitivities explored, CESA request Lumen consider the following clarifications.

In Attachment B, Lumen states that they expect most of the grid needs over the next 10 years will be addressable by energy storage systems that can provide up to 10 hours of continuous discharge capability at full output. CESA disagrees with this blanket statement and urges Lumen to re-frame it considering that multiple authors have shown that longer-duration storage (greater than 10 hours) improves the grid's reliability and can provide additional benefits like seasonal energy shifting and reducing renewable curtailment.[9] Similarly, E3 and the University of California Merced have made a parallel effort in their CEC LDES assessment.[10] In this regard, CESA believes that Lumen should have included longer storage durations in the analysis, as it is likely that this type of technology will become operational during the study period. To this effect, CESA urges Lumen to consider inclusion in the Draft Study of the E3/UC Merced approach to model longer-duration storage.

Further in Attachment B, Lumen describes that the operation of energy storage was calculated in a Python-based optimization. CESA recognizes the importance of the inputs and results of the abovementioned optimization model as it dictates the operational characteristics and state of charge of the energy storage asset, and it plays an essential role in calculating the cost-effectiveness of the technology. Thus, CESA urges Lumen to provide additional information related to this model like the objective function, constraint(s), and other assumptions of relevance to the calculation. This will allow readers and stakeholders to understand the model and provide appropriate feedback on both the model and approach used.

CESA agrees with Lumen that the modularity of energy storage makes it a versatile technology. CESA believes that we will not observe a single technology dominating the energy storage market but a variety of storage technologies – both in capacity and duration – that will help to maintain grid reliability and reduce renewable energy curtailment. Hence, CESA suggests not limiting the analysis to using lithium-ion as a proxy but exploring different energy storage configurations. In the same section, Lumen states that there needs to be more information regarding longer-duration energy storage, which is probably the main reason Lumen did not include it. However, CESA wants to point to the recent research paper from Rui et al.,[11] which compiled the average capital cost ($/kW, $/kWh) for some commercially available LDES companies. Lumen could have used the technologies included in this research paper as storage candidates for the model. Furthermore, in the Draft Study, the capital costs for energy storage assumptions range from $150/kWh to $300/kWh. In contrast, as presented by Rui et al., some commercially available LDES technologies range from $40/kWh for thermal energy and $8,000/kWh for pumped hydro energy storage. With this variety of energy storage technologies, CESA encourages Lumen to extend the

[9] J. A. Dowling *et al.*, "Role of Long-Duration Energy Storage in Variable Renewable Electricity Systems," *Joule*, vol. 4, no. 9, pp. 1907–1928, Sep. 2020, doi: 10.1016/j.joule.2020.07.007.
[10] *See* https://efiling.energy.ca.gov/GetDocument.aspx?tn=244120&DocumentContentId=78013
[11] R. Shan, J. Reagan, S. Castellanos, S. Kurtz, and N. Kittner, "Evaluating emerging long-duration energy storage technologies," Renewable and Sustainable Energy Reviews, vol. 159, p. 112240, May 2022, doi: 10/gqd2jk

input assumptions range for the cost-effectiveness study with a more realistic range of future energy storage technologies.

In the same section, Lumen states that the RTE is in line with what is observed on the existing fleet in California. However, as stated above, most of the energy storage technology analyzed in Attachment A was the beginning of the learning curve, and the technology will keep reducing costs and improving. Therefore, CESA believes Lumen was conservative by assuming future energy storage will perform the same in 10 years. Even though this might look like a fine-tuning of the model, CESA believes better models imply less uncertainty in the state of charge during extreme weather events. Therefore, CESA recommends that this value be increased to at least 90%, which is in line with what has been reported (*see* Rui, et al.).

Finally, CESA requests two clarifications. First, Lumen states that, in the model, there would be around 100 scarcity hours during which market prices would be at around $1,000/MWh. This figure is not well supported as it is five times higher than the events of 2020. Moreover, the estimated prices fail to consider that, during September of 2022, prices jumped to approximately $2,000/MWh, which is twice the value estimated by Lumen. Given these inconsistencies, CESA kindly requests Lumen to explain the rationale of this assumption in the text, as well as what would happen if there was a change in the amount of or price during scarcity hours. The final clarification is regarding the results of the capacity credit for energy storage presented on page B-14. The text makes it unclear why the results from NREL/Astrape differ from those of Lumen. Therefore, CESA requests Lumen to include a more explicit explanation of why the capacity credit curve is not comparable to these results and the limitations of the results from NREL and Astrape in contrast with the findings of this work.

X. ATTACHMENT C: COST-EFFECTIVENESS OF PEAKER REPLACEMENT.

Energy storage could replace peaker plants and conventional generations when paired with variable renewable technologies (*see* work by Rayit et al.).[12] Considering that many energy storage projects are going to be paired with renewables, CESA recommends that Lumen should include a sentence in this section about how energy storage is able to replace peaker plants and other conventional combustion-based technologies that operate on a firm basis. For further feedback, please refer to our comments under the section "Remove Barriers to Distribution-Connected Installations" above.

XI. ATTACHMENT D: PROCUREMENT POLICY CASE STUDIES.

CESA has no comments at this time.

[12] N. S. Rayit, J. I. Chowdhury, and N. Balta-Ozkan, "Techno-economic optimisation of battery storage for grid-level energy services using curtailed energy from wind," *Journal of Energy Storage*, vol. 39, p. 102641, Jul. 2021, doi: 10.1016/j.est.2021.102641.

XII. ATTACHMENT E: END USES AND MULTIPLE APPLICATIONS.

CESA has no comments at this time.

XIII. ATTACHMENT F: SAFETY BEST PRACTICES.

CESA has no comments at this time.

XIV. ATTACHMENT G: END OF LIFE OPTIONS.

CESA has no comments at this time.

XV. CONCLUSION.

CESA appreciates the opportunity to provide these comments and feedback on the Workshop and the Draft Study and looks forward to collaborating with the Commission and Lumen to further refine, clarify, or modify the report. Please do not hesitate to reach out to further discuss.

Respectfully submitted,

Jin Noh
Policy Director
California Energy Storage Alliance
jnoh@storagealliance.org

Sergio Dueñas
Policy Manager
California Energy Storage Alliance
sduenas@storagealliance.org

Grace Pratt
Policy Analyst
California Energy Storage Alliance

Pedro Sánchez
Graduate Research Fellow
California Energy Storage Alliance