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CESAâ€™s Comments on the Public Workshop on the Preliminary Results of Assessing the Value of Long Duration Energy Storage

Additional submitted attachment is included below.

April 19, 2022

Email to: docket@energy.ca.gov
Docket Number: 20-MISC-01
Subject: CESA's Comments regarding the Public Workshop on the Preliminary Results of the Analysis Assessing the Value of Long Duration Energy Storage

Re: Comments of the California Energy Storage Alliance Regarding the March 29th Public Workshop on the Preliminary Results of the Analysis Assessing the Value of Long Duration Energy Storage

Dear Sir or Madam:

The California Energy Storage Alliance ("CESA") appreciates the opportunity to comment on the public workshop held on March 29, 2022 ("Workshop"), where consultants to the California Energy Commission ("CEC") presented the preliminary results of the analysis Assessing the Value of Long Duration Energy Storage. CESA recognizes the insight of the CEC in assembling an experienced analytic taskforce to shed light on the value of long duration energy storage ("LDES") while considering the feedback of a vast group of stakeholders. CESA is convinced that the modeling improvements and tools discussed at the Workshop are vital to the achievement of California's energy and environmental goals.

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 has actively engaged in first-in-class modeling studies to better understand the need and opportunity for energy storage, particularly for LDES resources, given Senate Bill ("SB") 100 targets. As such, our background and experience providing technical and policy insights are of particular relevance to this subject.

I. INTRODUCTION & SUMMARY.

CESA appreciates the CEC hosting the Workshop to provide updates to stakeholders on the preliminary findings of the analyses performed by Energy + Environmental Economics ("E3") and the University of California, San Diego ("UCSD"). The results presented during the Workshop underscore the value proposition of LDES resources and present a path towards affordable and timely decarbonization. In this context, the modeling improvements associated with this initiative should be adopted across planning venues. Such coordination, in conjunction with increased geographic granularity of needs, is crucial to ensure the cost-effective deployment of resources and an equitable transition to a decarbonized electric sector.

While CESA is supportive of the methodological approach utilized by CEC's consultants and the takeaways shared during the Workshop, we find that the definition of storage archetypes could be improved and be more accurate. CESA agrees with the utilization of technology-neutral storage "archetypes" as a means to represent resources with different durations and roundtrip efficiencies ("RTEs"); nevertheless, we find that the limited set of storage technologies considered for their unduly limits archetype diversity, which could highlight the specific LDES resource attributes in support of the state's reliability needs and decarbonization goals.

This being said, CESA is supportive of the consideration of deep decarbonization scenarios, as these tend to underscore the value proposition of LDES more concisely. By modeling different energy storage alternatives in a technology-neutral manner and considering full decarbonization scenarios, E3's analysis yields very similar results to those of Strategen Consulting's *Long Duration Energy Storage for California's Clean, Reliable Grid* (2020), which concluded that California will need between 45 and 55 GW of storage by 2045 to achieve its decarbonization goals while retaining reliability.[1] The materials presented during the Workshop demonstrate that timely deployment of LDES can materially accelerate the achievement of our climate goals. Hence, CESA's comments are focused on means to enhance the analyses presented during the Workshop and ensure the timely enhancement of the planning tools utilized by the CEC and the California Public Utilities Commission ("CPUC"). CESA's comments can be summarized as follows:

- The LDES breakeven analysis should include a 16-hour, 80% RTE storage archetype.
- Refinement of geographic constraint assumptions for emerging storage technologies should not be advanced at the expense of technological neutrality.
- The preliminary results underscore the urgent need to explicitly consider local reliability area needs.
- E3 should provide further clarity in the forecasted storage technology cost for the LDES archetypes identified.
- Additional clarification is needed to understand how the different selection of representative periods changes the LDES utilization.

II. <u>COMMENTS</u>.

A. The LDES breakeven analysis should include a 16-hour, 80% RTE storage archetype.

During the workshop, E3 presented their technology-neutral approach to model different characteristics of energy storage resources. To do so, E3 proposes utilizing energy storage archetypes that differ in terms of duration and RTE. The development of these archetypes is crucial for the estimation of a breakeven cost – *i.e.*, the cost at which an emerging resource would be able to compete and become commercially-viable. E3 proposes

[1] *See* Strategen Consulting, *Long Duration Energy Storage for California's Clean, Reliable Grid,* 2020. Available at: https://static1.squarespace.com/static/5b96538250a54f9cd7751faa/t/5fcf9815caa95a391e73d053/1607440419530/LDES_CA_12.08.2020.pdf

six archetypes: 4-hour at 90% RTE; 8-hour at 90% RTE; 12-hour at 80% RTE; 24-hour at 60% RTE; 100-hour at 45% RTE; and 1,000-hour at 30% RTE. E3 argues that these archetypes are sufficient since 8- to 12-hour storage does not operate significantly differently from 4-hour li-ion and these assets are well-captured in today's models.[2]

CESA does not believe that the six aforementioned archetypes are sufficient to accurately represent the diversity of energy storage solutions available today. E3 has taken an overly prescriptive approach for the technologies considered in the development of these archetypes. This is demonstrated by the chart included in page 11 of the Workshop materials, where E3 illustrates the expected operational range of the technologies considered to develop the technology-neutral archetypes. For example, the chart characterizes thermal energy storage in a limited fashion, generally ignoring significant advancements regarding this technology. The chart in slide 11 represents thermal energy storage as a technology with an expected operating range of approximately 10 to 24 hours at RTE between 40 and 55%. While these values may be adequate to represent older thermal energy storage resources based on heat concentration, they are not representative of newer configurations, including those that can be deployed behind-the-meter ("BTM"). As noted by the Environmental and Energy Study Institute ("EESI"), the efficiency of thermal energy storage ("TES") can range from 50% to 90% depending on the type of thermal energy used, with some cool-based configurations reaching round-trip efficiencies of 80% or higher.[3]

In order to address the aforementioned omission, CESA recommends adding a seventh archetype that would capture 16-hour storage with an RTE of 80%. The addition of this archetype is warranted for two reasons. First, cycling behavior data presented by E3 indicates that there are significant dispatch differences between 12-, 16-, and 24- hour storage. Second, currently only one archetype approximates the operational characteristics of numerous technologies that can operate in the 12- to 24-hour timeframe, such as gravitational storage or TES, among other technologies.

In slide 9 of the materials presented at the Workshop, E3 includes a heatmap of storage cycling plotted by efficiency and duration. This illustration shows that resources with durations at or below 12 hours routinely surpass 250 cycles per year if their RTE is at or above 80%. This is applicable to the first three of the six archetypes proposed by E3. The same heatmap also shows that 24-hour resources with an RTE of approximately 60% would be expected to cycle approximately 100 times per year. This is applicable for the fourth archetype proposed by E3. The heatmap also indicates that a 16-hour resource with an RTE around 80% would cycle between 150 and 200 times per year. Currently, this combination of characteristics is not represented by the archetypes proposed despite them resulting in a significantly distinct dispatch schedule.

Moreover, the inclusion of this proposed archetype could also serve as a means to better represent the numerous technologies that could meet said performance characteristics. As illustrated by the chart in page 11 of the Workshop materials, at least four technologies could perform at 80% RTE for approximately 16 hours: pumped hydro storage, adiabatic

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[2] Workshops materials, at 9.
[3] EESI, 2019, *Fact Sheet | Energy Storage,* available at https://www.eesi.org/papers/view/energy-storage-2019

compressed air energy storage, flow batteries, and zinc-hybrid storage. While some of these technologies could be represented via the proposed 12-hour archetype, the addition of a seventh archetype can minimize the potential to overlook the operational space of these technologies. Thus, CESA recommends adding a seventh archetype that would capture 16-hour storage with an RTE of 80%.

B. Refinement of geographic constraint assumptions for emerging storage technologies should not be advanced at the expense of technological neutrality.

During the workshop, E3 noted that it will continue to refine geographic constraint assumptions for emerging storage technologies.[4] While CESA supports the development of availability limits for emerging technologies, such assumptions should only be incorporated if there is a deliberate effort to model a specific technology, as opposed to a storage archetype. This is reasonable as applying availability constraints to energy storage archetypes would be against the spirit of tech-neutrality that spurred E3 to develop the archetypes in the first place.

This tension is evident when considering the 12-hour, 80% RTE archetype, which seeks to capture the operating characteristics of pumped hydro storage, adiabatic compressed air energy storage, flow batteries, and zinc-hybrid storage. Of these four technologies, the former two are considerably more prone to be geographically constrained. In this context, it would be counterproductive to apply a blanket geographic availability constraint to the storage archetype as it would sacrifice the tech-neutrality of this formulation and could significantly skew resource selection. Thus, CESA recommends that E3 continue refining geographic constraint assumptions for emerging storage technologies ahead of their potential inclusion as individual technologies in the new toolkit but refrain from incorporating it directly for the models in which the storage archetypes are to be used in order to ensure technology neutrality.

C. The preliminary results underscore the urgent need to explicitly consider local reliability area needs.

During the workshop, E3 and Form Energy highlighted the economic case for LDES. In particular, when reviewing the preliminary bulk system portfolio analysis, the analytic team noted that the selection of LDES was strongly correlated with the need to replace firm capacity (gas-fired generation) and to meet deep decarbonization targets (the *"plus"* scenarios).[5] Form Energy also noted that, in Reference scenarios, availability of LDES options has no or net positive cost impacts.[6] Critically, when LDES is an available resource

[4] Workshops materials, at 25.
[5] Workshop materials, at 17.
[6] Workshop materials, at 18.

total resource costs decline about 20%,[7] a third less of capacity is required,[8] and the necessary deployment rate of energy storage goes from 8.2 GW per year to 3.6 GW per year.[9] These results underscore that it should be a priority of the state to ensure the procurement of energy storage resources in a cost-effective manner and with a sensible deployment strategy that aligns with the intent of fully decarbonizing the electric sector., To this end, CESA continues to underscore the importance of incorporating local reliability area ("LRA") representation and requirements within the RESOLVE model, as this is the only way to ensure that the selection and location of available resources is in line with system and local needs. Thus, this effort should seek to revise the formulation of capacity expansion models to co-optimize resource selection to meet system and local needs. Inclusion of BTM candidate resources could also further this goal by underscoring the value of demand-side management and distributed generation, valuable characteristics to preserve reliability in generation- and/or transmission-limited areas.

In the CPUC's IRP proceeding, the CPUC has expressed its intention to develop a more sophisticated modeling toolkit beginning in 2022, one that would be capable of local analysis to help the CPUC better understand how to advance the policy objectives of reducing reliance on Aliso Canyon, reducing dispatch of natural gas generation, and contributing to an "orderly" retirement of the fossil-fueled generation fleet as it ages. CESA is fully supportive of the development of such tools and requests that E3 clarify how this coordination with the updates expected in the IRP proceeding will take place. Moreover, CESA, with the support of a subset of our membership, is currently partnering with Strategen Consulting and the Pacific Northwest National Laboratory ("PNNL") to develop a modeling approach that can identify a diverse and optimal portfolio of zero-carbon generation and energy storage in the Los Angeles Basin to support local reliability while advancing decarbonization. This project will utilize first-in-class capacity expansion modeling with enhanced geographical and temporal granularity. CESA looks forward to share on an ongoing basis the findings of our Los Angeles Local Area Storage Study ("LASS") in the future to inform further RESOLVE updates. As such, considering the economic findings of the preliminary analysis, CESA recommends E3 to prioritize the incorporation of LRAs and their needs in the new modeling toolkit, in alignment with the CPUC's IRP tools.

D. E3 should provide further clarity in the forecasted storage technology cost for the LDES archetypes identified.

During the workshop, E3 and Form Energy presented the preliminary version of the LDES cost projections for different energy storage technologies. This information was presented using a line plot highlighting the range of plausible overnight capital costs per storage duration. While this format shows the tradeoffs among technology types in a visual manner, it does not provide clarity of which costs will be used for the study and how these relate to the assumptions previously used in the CPUC's IRP proceeding. In particular, E3

[7] Workshop materials, at 19.
[8] Workshop materials, at 20.
[9] Workshop materials, at 20.

did not disaggregate the costs of these resources in terms of capacity ($/MW) and energy stored ($/MWh). To improve the transparency of this study, CESA requests that E3 further expand and detail the cost breakdown for both capacity ($/kW-year) and energy ($/kWh-year) that will be considered for the different LDES archetypes proposed.

In our engagement with Strategen for *Long Duration Energy Storage for California's Clean, Reliable Grid,* both capacity and energy cost were found to be binding factors of the selected additional capacity required to meet the state's goals as well as the value proposition of LDES. CESA suggests that one way of presenting this information is to include a table that shows the annual energy storage cost data as presented in the RESOLVE model by specifying the capacity cost ($/kW-year), energy capacity cost ($/kWh-year), and any O&M considered for the LDES archetypes. CESA believes that a table comparing the cost of these different storage archetypes, as well as the references for the cost, and previously used assumptions, will improve the transparency and impact of this study. An example of this table is provided below. CESA requests that this information is provided as soon as possible to parties in order to further vet this modeling exercise.

Table 1. Example of Cost Assumption Summary Table for 2035.

			Energy capacity cost ($/kW-yr)[10]			Energy Storage cost ($/kWh-yr)		
Energy storage technology	Minimum duration (hours)	Efficiency (%)	2019 IRP[11]	2020 CESA[12]	2021 PSP[13]	2019 IRP	2020 CESA	2021 PSP
Lithium-ion	1	85%	10.0	10.8	21.1	20.8	22.2	12.2
Flow battery	1	70%	87.4	86.6	96.4	13.2	13.8	13.2
Pumped Storage	12	81%	111.5	109.0	118.4	9.0	8.7	9.0
LDES Archetype 1	5	72%	-	43.0	-	-	7.3	-
LDES Archetype 2	10	72%	-	64.7	-	-	5.6	-
LDES Archetype 3	100	64%	-	80.9	-	-	2.8	-
LDES Archetype 4		49%	-	21.5	-	-	1.1	-

Finally, CESA wants to highlight that the storage cost forecast has been evolving over time. This is clear from Table 1 where the 2019 IRP and the latest 2021 Preferred System Plan ("PSP") include significantly distinct costs for lithium-ion storage. While capturing all probable sources of cost variance is neither practical nor in scope, CESA recommends E3 consider studying different cost sensitivities to incorporate this uncertainty and better understand storage needs across a wide range of possible costs structures.

[10] All-inclusive cost considering both fixed and O&M yearly cost.
[11] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2019-20-irp-events-and-materials/resolve-model-inputs-and-results-used-for-2019-irp-reference-system-plan-decision
[12] https://www.storagealliance.org/longduration
[13] https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2019-20-irp-events-and-materials

E. Additional clarification is needed to understand how the different selection of representative periods changes the LDES utilization.

CESA is fully supportive of the development of tools and methods that improve the accuracy of the RESOLVE model. CESA has long advocated for reforming capacity expansion modeling to fully capture the value of seasonal arbitrage patterns. In this context, CESA is supportive of E3's intent to modify their model to capture this data and make optimal investment decisions. A model that fails to capture the opportunity for and value of seasonal arbitrage will be unduly biased in favor of shorter-duration storage due to the limitation of the balancing horizon and overlook potential solutions to address multi-day or multi-week reliability events. With the proposed modifications, the model will now be capable to identify the storage requirements of both short and LDES in a technology-neutral way as shown in the workshop materials

In the spirit of improving the modeling and clarifying the results, E3 should provide more information regarding the discrepancies in the number of cycles and the state of charge of the different storage selections across all the scenarios using representative periods for balancing. CESA believes this request is reasonable as there are substantial differences in the number of dispatches for LDES assets in the model using 8,760 hours and those using a subset of representative periods. The same is true regarding the state-of-charge ("SOC") of these assets as well. The storage utilization changes drastically from the 12 representative periods to the 36 periods where 24-hour and 100-hour LDES assets are below 25% SOC throughout the summer period. These results might highlight a dependence on the utilization of storage and the order and number of the representative. While the results suggest that the macro-trends are not affected, the substantial difference in some seasons of the years cannot be ignored. Therefore, CESA requests E3 conduct an exhaustive investigation of why the selection of different representative periods yields different storage utilization for the same temporal resolution.

III. <u>CONCLUSION</u>.

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

Respectfully submitted,

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