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CESA's Comments on the Multi-Year Reliability Assessment Scope, Inputs, and Assumptions

Additional submitted attachment is included below.

CESA
CALIFORNIA ENERGY STORAGE ALLIANCE

July 23, 2021

Email to: docket@energy.ca.gov
Docket Number: 21-IEPR-04
Subject: CESA's Comments on Multi-Year Reliability: Scope, Inputs, and Assumptions

Re: Comments of the California Energy Storage Alliance Regarding the July 8th Workshop on Multi-Year Reliability Scope, Inputs, and Assumptions

Dear Sir or Madam:

The California Energy Storage Alliance ("CESA") appreciates the opportunity to comment on the scope, inputs and assumptions considered by the California Energy Commission ("CEC") in the development of its multi-year reliability analysis ("Analysis"), as shared during the Integrated Energy Policy Report ("IEPR") Workshop held on July 8th, 2021. CESA recognizes the leadership of the CEC in assembling a vast group of stakeholders to provide feedback on this timely analysis.

CESA is a 501(c)(6) organization representing over 100 member companies across the energy storage industry. CESA is involved in a number of planning 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 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 this workshop and moving forward the conversation of better understanding the role fossil resources will play as our state advances towards a fully decarbonized electric sector. CESA is committed to make energy storage a mainstream resource to advance a more affordable, efficient, reliable, safe, and sustainable electric power system for all Californians. In this context, understanding the potential for storage and other preferred resources to meet reliability standards in a post-fossil system is an essential component of our future. As such, CESA finds this effort by the CEC to be extremely valuable as it will inform planning and procurement processes across the state and may provide guidance regarding the eventual sunset and substitution of California's fossil-fueled capacity. Our comments are focused on the following areas:

- **The CEC should link intermittent renewable generation years to each other and demand:** CESA recommends that, to the extend possible, weather years utilized to estimate the contributions of intermittent renewable resources (wind and solar) are matched to one another and to load weather years. CESA recommends this approach as there is a high correlation between expected weather conditions, load, and renewable generation output. As such, the loss-of-load expectation ("LOLE") study proposed for this Analysis should seek to represent this interconnectedness in order to properly identify the hours with the highest reliability risks.

- **The CEC should consider the findings of the California Independent System Operator's ("CAISO") Resource Adequacy ("RA") Enhancements Initiative when establishing forced outage rates for storage resources:** CESA recommends that, if the CEC decides to apply forced outage rates on a technology-class basis, it should utilize the findings of the CAISO's unforced capacity ("UCAP") evaluation, conducted within the RA Enhancements Initiative. Based on CAISO's analysis, CESA recommends assuming a 5% forced outage rate for lithium-ion battery storage assets.

- **The CEC should use a resource mix consistent with the California Public Utilities Commission's ("CPUC") 38 million metric ton ("MMT") Integrated Resource Planning ("IRP") Reference System Portfolio ("RSP"):** CESA recommends the CEC to use future portfolio assumptions consistent with the CPUC's 38 MMT IRP RSP as it most closely matches the results of the 2021 Senate Bill ("SB") 100 Joint Agencies Report ("2021 SB 100 JAR"). Moreover, the RSP was cited as the potential framework for the future Preferred System Portfolio ("PSP") and was considered in the development of the most recent CPUC procurement directive for the 2023-2026 period.

- **The CEC should consider revising its hybrid resource assumptions considering data related to CAISO's queue cluster ("QC") 14:** CESA recommends the CEC consider preliminary QC 14 data to construct its hybrid resource assumptions. According to the CAISO, about 91% of solar capacity in QC 14 will be paired with energy storage; not 100%. This figure is closer to 58% for wind assets. Moreover, the ratio of storage to generation in hybrid projects varies by generating technology in QC 14: while solar-plus-storage hybrids have a median ratio of 1, wind-plus-storage projects have a median of about 0.75.

- **The CEC should assume round-trip efficiencies ("RTEs") consistent with currently deployed storage technologies:** CESA notes that there is a vast diversity of commercially available storage technologies and provides data into their expected values; nevertheless, we recommend the CEC assumes an 86-90% efficiency for the majority of incremental storage resources given the values noted for lithium-ion batteries, the most widely deployed technology in recent years.

- **The CEC should explicitly consider the role of gas-plus-storage hybrids to retain reliability while advancing clean energy targets:** CESA recommends that, in this Analysis' determination of if incremental gas capacity is required to retain reliability, the CEC consider the impacts of hybridizing fossil assets with energy storage. CESA has long advocated for State regulators to consider this approach to retain necessary fossil resources while curbing their environmental impacts.

II. COMMENTS.

1. The CEC should link intermittent renewable generation years to each other and demand.

During the workshop, CEC staff noted that this Analysis will consider 6 different wind profiles, 6 solar profiles, and 20 demand shapes, among other inputs, in order to perform a thorough LOLE study. Consideration of a wide array of load and supply conditions is essential for obtaining robust results from a LOLE study since these variables largely affect the coincidence of supply and demand. In this context, CEC staff asked parties for feedback on whether solar and wind weather years should be linked to each other or demand.

For the purposes of this Analysis, a LOLE study would enable the CEC to identify the reliability contributions of energy- and use-limited resources in comparison to conventional, thermal assets. As such, this study would estimate the degree of overlap between expected output from said intermittent resources and the hours with the highest likelihood of insufficient supply. Considering the increasing reliance of the state on weather-dependent generation, CESA fully supports the CEC studying the interconnected effects of weather, load, and supply.

CESA's experience with capacity expansion modeling verifies the relevance of considering the variance of weather-dependent generation. For *Long Duration Energy Storage for California's Clean, Reliable Grid* (2020), CESA partnered with Strategen Consulting to explore how multiple days of low solar irradiance[1] and corresponding reductions in solar generation will affect grid operations and storage deployments in 2030 and 2045.[2] [3] This sensitivity analysis showed that planning on the expectation of periods of low solar irradiance has a significant impact on the long duration energy storage ("LDES") requirement, increasing it from 46 GW in the Base Case to about 49 GW.[4] This analysis

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[1] An emerging risk is around the impact of wildfire smoke to solar generation. The US Energy Information Administration ("EIA") reported declined up to 30% from historical averages during some of the 2020 wildfires. With the risk of wildfires persisting on a seemingly annual basis since 2015-2016, impacts to the supply of solar generation could also come in this form and supports the case for this type of extreme weather-related modeling. *See* https://www.eia.gov/todayinenergy/detail.php?id=45336

[2] Strategen Consulting, *Long Duration Energy Storage for California's Clean, Reliable Grid,* 2020, at 36. *See* https://www.storagealliance.org/longduration

[3] To test this sensitivity, Strategen extracted renewable generation profiles from 2010 from the historical SERVM dataset. Across all the historical SERVM weather years, the winter of 2011 saw the lowest contiguous solar generation across the year due to a particularly active storm season in California, and the associated cloud cover sharply reducing solar PV production.

[4] *Ibid,* at 47.

focuses on the correlation between weather years and renewable output; however, recent events demonstrate that weather years have a substantial effect on load as well. Increased temperatures in the summer of 2020 lead to the first rolling blackouts in California in almost 20 years, and similar events are occurring in this Summer across the West. As such, it is clear that weather variations (*i.e.* weather years for the purposes of modeling exercises) are significantly correlated to both supply and demand conditions, particularly I increasingly decarbonized grids. Thus, CESA recommends that CEC staff link the wind and solar year shapes studied to each other and to load, to the degree possible.

2. The CEC should consider the findings of the CAISO's RA Enhancements Initiative when establishing forced outage rates for storage resources.

To better understand the reliability contributions of different resource portfolios, CEC staff plans to include the forced outage rates in its analysis. During the Workshop, CEC staff noted they have been considering 6 technology types: non-cogeneration thermal, thermal cogeneration, nuclear, geothermal, biomass, and specified imports. CEC noted that outage rates are already incorporated into the profile shapes of wind and solar resources. In this context, CEC staff asked stakeholders of forced outages should be applied to other technology types, to which degree of specificity this should be done, and which forced outage rate should considered. In this section, CESA focuses on the application of forced outage rates to storage resources.

Energy storage is a diverse resource class that encompasses mechanical, thermal, chemical, electrochemical, and other solutions that enable the usage of generated electricity at a later time. Given its variety, ascribing a forced outage rate broadly for all storage resources is a challenging task. Today, the majority of the storage assets being deployed are electrochemical solutions, usually based on a lithium-ion battery with durations around four hours. Given its rapid deployment since 2010, this particular kind of energy storage has been considered in the CAISO's RA Enhancements process, a policy initiative in which CAISO is developing a capacity count that internalizes forced outage rates, the unforced capacity ("UCAP") approach. To estimate the UCAP of lithium-ion battery storage, the CAISO studied the seasonal availability factor of resources during the hours with the tightest supply conditions.[5] As of January 5, 2021, the CAISO estimated that the UCAP for storage would be between 94.6% and 96.4%, depending on the season.[6] As such, CESA recommends that, if the Analysis requires an estimate of the forced outage rates of lithium-ion battery storage assets, CEC staff use, as first approximation, a value of 5%. Lastly, CESA highlights that as new data become available, the CEC should update these values and refine them accordingly.

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[5] *See* CAISO, *RA Enhancements Draft Final Proposal – Phase 1 and Sixth Revised Straw Proposal*, 2020. Available at: http://www.caiso.com/InitiativeDocuments/DraftFinalProposal-SixthRevisedStrawProposal-ResourceAdequacyEnhancements.pdf

[6] CAISO, Day 1: RA Enhancements Draft Final Proposal and Sixth Revised Straw Proposal Materials, 2021, at 87. Available at: http://www.caiso.com/InitiativeDocuments/Day1Presentation-ResourceAdequacyEnhancements-DraftFinalPropsoal-SixthRevisedStrawProposal.pdf

3. The CEC should use a resource mix consistent with the CPUC's 38 MMT IRP RSP.

During the Workshop, CEC staff presented a straw proposal for the assumed resource build that will be considered as an input for the Analysis. CEC staff noted that creating a planned resource baseline has been complex given the significant number and magnitude of outstanding procurement orders. As a result of these difficulties, CEC staff requested stakeholders to provide feedback regarding what resource mix should be used and how to accurately represent hybrid resources within said mix. In this section, CESA focuses on the topic of the planned resource mix. CESA provides feedback on the characterization of hybrid resources in the following section.

As noted by CEC staff, the State's electric sector has been actively working to rapidly integrate significant amounts of incremental capacity. Capacity additions will be essential to retain reliability; nevertheless, they must also be aligned with the vision of a decarbonized electric sector. In this context, the CPUC noted in its recent IRP procurement decision that the 11.5 GW of incremental procurement are intended to align the resultant mix with the 38 MMT RSP.[7] In addition, the CPUC also highlighted its intention to adopt a PSP based on the 38 MMT target in upcoming IRP decisions, further denoting the relevance of that mix. CESA supported this determination in comments, underscoring that the 38 MMT RSP is more likely to support the buildout rates required to fulfill with SB 100.[8] As such, CESA considers that the CPUC's 38 MMT RSP represents a viable starting point for CEC staff undertaking this Analysis.

CESA is aware that the IRP RSP does not capture the totality of the State's electric sector as it focuses exclusively on the load-serving entities ("LSEs") that are under the CPUC's jurisdiction. If CEC Staff determine that scaling the 38 MMT RSP is not adequate or feasible, CESA recommends using the resource mix resultant from the SB 100 Core scenario studied within the 2021 SB 100 JAR. Since the 2021 SB 100 JAR focused on the attainment of a *statewide* goal, the SB 100 Core scenario results are not limited to the CPUC's jurisdiction. This approach is reasonable as the CEC and CPUC have noted the alignment between these two mixes.[9] Moreover, both of these mixes are the result of exhaustive stakeholder engagement and will continue to serve as planning tools in their respective venues.

4. The CEC should consider revising its hybrid resource assumptions considering data related to CAISO's QC 14.

As mentioned in the previous section, CEC staff requested stakeholders to provide feedback regarding how to accurately represent hybrid resources within the planned resource mix. CESA offers two recommendations based on the CAISO's preliminary QC 14 data.

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[7] CPUC, *Decision ("D.") 21-06-035 Requiring Procurement to Address Mid-Term Reliability (2023-2026)*, issued June 30th, 2021, at 90. Available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M389/K603/389603637.PDF

[8] *Ibid.*

[9] *See* CPUC, *CPUC Integrated Resource Planning (IRP) Presentation for the SB 100 June 2nd, 2021 Workshop*, 2021, at 32. Available at: https://efiling.energy.ca.gov/GetDocument.aspx?tn=238078

First, the assumption that all new wind and solar will be paired with energy storage should be revised. Second, the ratio of energy storage to generating capacity should be defined differently for solar and wind resources.

In their presentation, CEC staff noted that their straw proposal for planned resource build will assume that all new wind and solar generation will be paired with energy storage. CESA does not consider this assumption is supported by the most recent interconnection data. According to the CAISO's preliminary QC 14 data, about 91% of solar capacity in QC 14 will be paired with energy storage; not 100%.[10] For wind resources, this figure is closer to 58%.[11] CESA believes these data points offer a viable starting point to revise the CEC assumptions. Considering the CAISO footprint covers approximately 81% of California load, the trends captured in its interconnection queue represent a good approximation to current commercial interest. Moreover, given the historic magnitude of QC 14, this particular cluster represents a significant share of the resources that will come online in the coming years. Thus, CESA recommends the CEC revise these assumptions based on the data regarding QC 14.

During the Workshop, CEC staff also requested stakeholders to provide feedback regarding the assumed ratio of energy storage to generating capacity for hybrid resources within the Analysis. Once more, the preliminary QC 14 dataset represents an adequate proxy to current market trends. CESA calculated the median of the storage to generation ratio for solar- and wind-plus-storage projects within said dataset.[12] According to the CAISO's data, solar-plus-storage hybrids have a median ratio of 1, which aligns with the CEC's proposed assumption. Nevertheless, this figure is significantly lower for wind-plus-storage resources, which have a median of 0.75. As such, CESA recommends the CEC assume that hybrid solar-plus-storage projects will have a storage to generation ratio of 1 while wind-plus-storage resources should have an assumed ratio of 0.75.

5. The CEC should assume RTEs consistent with currently deployed storage technologies.

In order to better understand the impacts of utilizing use- and energy-limited resources to cover load, CEC staff may consider the RTE of storage technologies. The RTE of an asset indicates the amount of energy needed to charge the asset relative to the amount of energy it will later discharge. Let us consider a hypothetical storage asset with a nameplate capacity of 100 MW, a duration of 4 hours, and an RTE of 92%. Under this example, if we were to fully charge the resource at 100 MW it would be able to output 92 MW for four

[10] Calculation performed by CESA. Of the approximately 36 GW of solar generation seeking interconnection, 3,200 MW represent standalone solar projects. *See* CAISO, *Preliminary Cluster 14 Project List as of May 20, 2021,* 2021. Available at: http://www.caiso.com/Documents/PreliminaryCluster14ProjectListasofMay20-2021.xlsx
[11] Calculation performed by CESA. Of the approximately 10.5 GW of wind generation seeking interconnection, 5.6 GW represent standalone wind projects. *Ibid.*
[12] The storage to generation ratio is mathematically defined as storage nameplate capacity in MW over generation nameplate capacity in MW. CESA chose to use the median as a measure of central tendency since averages are more susceptible to vary given outlier datapoints.

hours before being depleted. To ensure that this resource can discharge at 100 MW, its developer would need to ensure the asset can charge at a rated power around 108 MW. This practice is common and can be identified in the aforementioned QC 14 dataset, for example.

Currently, there is a wide variety commercially available storage technologies that have different charge and discharge efficiencies. These metrics are significantly correlated to the asset's technology and its indented duration. Multiple academic works have compiled the different technical characteristics of utility scale storage, with RTEs ranging from 30% to 98% efficiency.[13] A summary of different operational characteristics for emerging storage technologies is shown below.

Table 1. Technology characteristics for different storage technologies. Adapted from Sepulveda (2021) [14]

Storage method	Technology	Charge efficiency (%)	Discharge efficiency (%)	Round-trip efficiency (%)
Mechanical	Pumped hydro storage	–	–	70–85
	Compressed air energy storage	–	–	42–67
Chemical	Power-H2-power (Brayton cycle)	51–77	35–40	18–31
	Power-H2-power (combined cycle)	51–77	50–55	26–42
	Power-H2-power (fuel cell)	51–77	40–60	20–46
	Power-syngas-power (Brayton cycle)	49–65	35–40	17–26
	Power-syngas-power (combined cycle)	49–65	50–55	25–36
	Power-syngas-power (fuel cell)	49–65	40–60	20–39
Electrochemical	Aqueous sulfur flow batteries	–	–	60–75
	Vanadium redox flow batteries	–	–	65–80
Thermal	Multijunction photovoltaic thermal storage	–	–	40–55
	Reciprocating heat pump energy storage	–	–	52–72
	Firebrick resistance-heated (Brayton cycle)	98	35–40	34–39
	Firebrick resistance-heated (combined cycle)	98	50–55	49–54

The wide variety of efficiencies complicates selecting a single efficiency value for the whole energy storage class. In this context, CESA considers that market dynamics and recent commercial interest should serve as a guide to approximate RTE. Given the planned resource mixes considered by the CEC assume most of the incremental energy storage resources will be lithium-ion batteries, CESA considers that the RTE of this technology represents a viable starting point for the CEC's Analysis.

[13] *See* Table V from Hameer et al. "A Review of Large-Scale Electrical Energy Storage." doi:10.1002/er.3294
[14] Sepulveda, Nestor A., et al. "The Design Space for Long-Duration Energy Storage in Decarbonized Power Systems." Nature Energy, vol. 6, no. 5, May 2021, pp. 506–16. www.nature.com, doi:10.1038/s41560-021-00796-8.

According to an academic literature review performed by the Pacific Northwest National Laboratory ("PNNL") for the Department of Energy ("DOE"), most of the literature places the RTE of this technology between 77% and 98%.[15] As PNNL notes, while li-ion technology is considered the most mature of battery storage technologies, improvements will continue to be made that will increase the performance of these assets.[16] With these considerations, PNNL assumed an RTE of 86.5% for the purposes of their 2019 analysis. As such, CESA recommends assuming an RTE of 86-90% for li-ion assets. This range is reasonable as it has been utilized in academic and industry analyses and captures the potential for future improvements to the li-ion technology.

6. **The CEC should explicitly consider the role of gas-plus-storage hybrids to retain reliability while advancing clean energy targets.**

During the Workshop, CEC staff noted that the main purpose of the Analysis is to determine the reliability benefits of gas generation under three scenarios: (1) only incremental gas capacity, (2) combinations of renewables and storage, and (3) combinations of renewables, storage, and incremental gas capacity. CESA is committed to advancing the role of energy storage as a mainstream resource that can enable decarbonization and support reliability. In this context, we urge the CEC to clarify if and how it will consider the role of gas-plus-storage hybrids within the Analysis.

CESA has long advocated for the consideration of these solutions in planning venues across the State. In January 2019, within Rulemaking ("R.") 16-02-007, CESA strongly urged the Commission to update its proposed IRP methodology to include hybridization of existing gas-fired resources as a candidate resource.[17] Since then, CESA has highlighted that hybrid gas-plus-storage resources are not a hypothetical future technology: it has been installed and is currently operating at multiple locations on California's grid. Moreover, CESA has provided analysis which demonstrates the potential of these solutions. On December 20, 2018, CESA shared its own independent analysis with the CPUC, which modeled the effects of hybrid gas-plus-storage resource deployment on California's system. The model optimized long-term capacity expansion decisions in a manner very similar to RESOLVE. At a high level, the modeling inputs were nearly identical to the 2017-2018 IRP inputs, the ones applicable at the time, except that 1,100 MW of existing gas resources were made eligible for hybridization with battery storage. The results showed that every single one of the candidate resources made eligible for hybridization was ultimately selected under

[15] PNNL, *Energy Storage Technology and Cost Characterization Report,* July 2019, at 4.15. Available at: https://www.energy.gov/sites/default/files/2019/07/f65/Storage%20Cost%20and%20Performance%20Characterization%20Report_Final.pdf
[16] *Ibid.*
[17] CESA, *Comments of the California Energy Storage Alliance to the Administrative Law Judge's Ruling Seeking Comments on Inputs and Assumptions for the Development of the 2019-2020 Reference System Plan*, filed under R.16-02-007 on January 4, 2019, at 16.

the economically optimal scenario.[18] To address ensure the Analysis considers all potential solutions and combinations of renewables, storage, and incremental gas capacity, CESA urges the CEC include consideration of gas-plus-storage hybrids and estimate its economic and environmental effects.

III. <u>CONCLUSION</u>.

CESA appreciates the opportunity to provide these comments and feedback on the Multi-Year Reliability scope, inputs, and assumptions. We look forward to collaborating with the CEC and other stakeholders in this docket.

Respectfully submitted,

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[18] *See* Attachment 1 of CESA, *Comments of the California Energy Storage Alliance to the Ruling of Assigned Commissioner and Administrative Law Judge Seeking Comment on Policy Issues and Options Related to Reliability*, filed under R.16-02-007 on December 20, 2018.