CALIFORNIA ENERGY STORAGE ALLIANCE

Stakeholder Comments on the September 25-26, 2019 Meeting
2019-2020 Transmission Planning Process (TPP)

Submitted by	Company	Date Submitted
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Introduction

CESA appreciates the opportunity to comment on the 2019-2020 Transmission Planning Process (TPP) and commends the California Independent System Operator (CAISO) for its efforts to provide opportune and detailed analysis and modeling to identify transmission needs and potential transmission solutions, including alternatives such as energy storage. CESA focuses its comments on two topics that were discussed in the September 25, 2019 meeting at the CAISO: (1) incorporation of operational costs of batteries, both within the Production Cost Model (PCM); and (2) modeling of renewable curtailment.

In summary, CESA further explains below why the operational cycling costs of batteries should be set at $15.50/MWh, instead of the $33.75/MWh as proposed by the CAISO based on its formula and data sources. Furthermore, we offer our thoughts on future consideration of modeling renewable curtailment prices, especially as the state transitions to a larger fleet of hybrid resources, where different approach may need to be considered.

Inclusion of operational costs of batteries in the PCM

CESA is supportive of the CAISO's commitment to estimate the impacts of depth of discharge (DOD) on the operational costs of lithium-ion battery storage, which have different variable operations and maintenance (O&M) costs based on throughput and cycling of the battery. CESA thus understands the inclusion of DOD as a factor in O&M costs to ensure the resources selected for future deployment behave in the way projected in the California Public

Utilities Commission's Integrated Resource Planning (IRP) proceeding (IRP) that has key linkages to the TPP modeling.

At the same time, the CAISO should also be aware of how O&M costs can vary based on use case (*e.g.*, deep cycling versus ancillary services) as well as on different types of storage technologies, such as flow batteries and many others, which have different O&M costs related to cycling and other operational parameters. For these reasons, CESA has advocated for a customizable pathway for assessing default energy bids (DEBs) in the Energy Storage and Distributed Energy Resources (ESDER) Phase 4 Initiative, where similar questions about representing storage's marginal operational costs have been discussed.

In the September 25, 2019 workshop, CAISO proposed two modifications to the way batteries are modeled within the PCM: (1) modeling the dispatchable energy as 80% of the actual energy capacity to reflect an 80% DOD; and (2) using a single flat average cost per MWh to approximate the cost adder related to replacement costs, which was calculated at $33.75/MWh using estimates derived by the Department of Energy (DOE). CESA believes that the CAISO's proposal be modified after having assessed the assumptions of the DOE report and instead proposes that different data sources be used to ensure that the modeled O&M costs are better in line with what CESA members have seen as more realistic assumptions.

First, the 80% DOD assumption in the DOE report is an assumption based on academic literature, not a metric derived from empirical data.[1] A potentially better publicly-available source for actual operation parameters could be the assumptions assembled by Lazard in their *Levelized Cost of Storage Analysis Version 4.0* study. Based on industry survey data, Lazard estimates that a wholesale energy storage system has a lifetime of 7,000 cycles with a 100% DOD,[2] which is likely on the high end of total cycle life. CESA thus recommends employing a mid-point assumption that is still in line with all literature reviewed in the DOE report and Lazard's estimates: a DOD of 80% and a lifetime of 5,000 cycles.[3] Using this assumption within the formula results in a flat average cost of $23.60/MWh.

Another component of the CAISO's formula that could use refinement is the assumed replacement cost of batteries. The CAISO has stated that using 2025 estimates available in the DOE's *Energy Storage Technology and Cost Characterization Report* is an interim measure that could be modified when 2030 estimates are available. CESA recommends that the CAISO consider cost estimates included in the *Cost Projections for Utility-Scale Battery Storage* report, published by the National Renewable Energy Laboratory (NREL) in June 2019. This report estimates high-,

[1] Mongird et al, Energy Storage Technology and Cost Characterization Report, DOE, July 2019, pp. 3.6 and 4.15.
[2] Lazard, *Lazard Levelized Cost of Storage Analysis Version 4.0*, November 2018, p. 10.
[3] Consider DiOrio et al, *Economic Analysis Case Studies of Battery Energy Storage with SAM*, NREL, 2015; and, European Association for Energy Storage (EASE), *Energy Storage Technologies*, 2016.

mid-, and low-cost trends by 2030 based on the available academic literature. Given the results of most of the literature reviewed by the NREL report, as well as the 5% yearly decline in costs used in the DOE report cited by CAISO, CESA recommends considering the low-cost trend estimation of $124,000/MWh.[4] Using this data point and keeping all other assumptions of the CAISO intact would result in an adder of $22.12/MWh. If combined with CESA's proposed lifetime cycle assumption, the adder would equal $15.50/MWh.

Second, while the assumptions for a flat average cost estimate can be refined, this would not overcome the issue that such an approach may oversimplify the cost structure of battery storage and generalize their operation. To overcome these risks, CESA supports the future development of an incremental cost function that can incorporate the rate of change of operational costs relative to the DOD. In order to develop such a function, CESA is supportive of further coordination among CAISO's initiatives and their stakeholders.

Overall, CESA supports the CAISO's efforts to better model energy storage O&M costs since it is not reasonable to model storage as having zero marginal costs, but as discussed above, there could be modifications to reflect what CESA sees as more reasonable data sources and estimates. This difference relative to CAISO's proposed estimate could considerably impact the PCM's results on WECC total production cost, renewable curtailment, and battery market revenue. Since the CAISO is an important stakeholder in signaling reliability needs and in optimizing resources in the market, CESA believes it is important to better approximate storage marginal costs, especially in a potential future where storage can play a large part in achieving the state's 2030 and 2045 decarbonization goals.

Consideration of renewable curtailment within the PCM

CESA is supportive of the CAISO's effort to better approximate the behavior of renewable generators in order to inform its TPP. As pointed out in the September 25, 2019 workshop, it is particularly challenging to simulate the performance of variable energy resources (VERs) within models that have been optimized with conventional thermal generation in mind. To resolve the various PCM issues, the CAISO proposes modeling each renewable resource as a collection of smaller resources or "blocks" that will represent a fraction of the overall Pmax while maintaining identical generation shapes. The main difference between the blocks is the inclusion of slightly different curtailment prices, so as to imitate partial curtailment of a resource. CESA believes this methodology is appropriate for the 2019-2020 TPP.

[4] Cole and Frazier, *Cost Projections for Utility-Scale Battery Storage*, NREL, June 2019, p. 5.

In its proposal, the CAISO argues for this method mentioning the implementation impracticality of a more locationally granular and resource specific solution; that is, the development of resource- and area-specific curtailment cost curves. While sympathetic to such an argument, CESA considers that a more granular approach might be better in the long run, especially considering the need to model curtailment of hybrid resources. CESA acknowledges this might not be a pressing issue for the 2019-2020 TPP; however, with over 35 GW of hybrid resources currently in the CAISO interconnection queue, CESA believes it is fundamental to consider how the curtailment of this resources would be estimated under the PCM.

In the topic of curtailment, hybrid resources present their own set of challenges relative to standalone VERs. Since they have a dispatchable component, hybrids are more likely to have a curtailment cost curve that can be easily approximated to that of a conventional resource (*i.e.*, with several price-points and small steps). A more important issue when modeling these resources is the fact that they are able to partially curtail from the grid's perspective without foregoing potential revenues from said energy. This makes the opportunity cost of curtailment considerably different from that of a VER. Thus, it could be inadequate to apply the same curtailment price to all solar and wind generators as proposed by the CAISO.

Conclusion

We appreciate CAISO's consideration of CESA's comments and look forward to ongoing participation in the TPP. Going forward, CESA hopes to work with the CAISO to broaden the conversation to also consider how storage resources can be operated in the market to provide daily load shifting, which the recent IRP modeling has shown solar and storage to do. Significant recent attention has been paid to how storage is operating in the market today to provide ancillary services as opposed to daily load shifting, raising concerns with how storage is modeled in PCM and questions as to whether storage can be relied upon in such a future. However, the conversation should not only focus on modeling O&M costs of storage cycling but also on how the CAISO market can send the market price signals to storage to encourage such cycling, especially when energy price spreads are not sufficient. CESA looks forward to those conversations with the CAISO.