

Submit comment on initiative scope and schedule

Initiative: Market enhancements for summer 2021 readiness

1. Provide a summary of your organization's comments on the proposed initiative scope and schedule:

LS Power appreciates CAISO opening a formal initiative to evaluate market enhancements for summer 2021 readiness and providing this opportunity for comment. LS Power agrees with CAISO's statement in the stakeholder meeting that these changes should be for tight system conditions triggered by specific circumstances and not during all hours of the day. In addition, LS Power suggests that any changes implemented in this initiative be considered temporary for summer 2021 only. If CAISO decides to make permanent changes they should be raised in this or another initiative that allows more time for deliberation and refinement of the policy change.

LS Power suggests the following three issue areas be included in Topic 3 on Requirements for Storage to ensure summer 2021 readiness. In each of these areas, LS Power emphasizes that CAISO should seek to implement in-market solutions and use transparent prices to achieve desired goals wherever possible, as opposed to out of market solutions such as Exceptional Dispatch (ED) and Minimum State of Charge Requirements (MSOC) that drive up costs and create unnecessary risk for resource owners. This is good practice, is squarely in line with CAISO's stated principles, and will minimize risk for any changes that need FERC approval. LS Power was in a unique position as one of the few market participants operating a large-scale battery storage project in the CAISO wholesale energy markets this past summer. Based on this operating experience we recommend a few urgent changes needed to enable storage to maximize its contribution to grid reliability. We summarize the issues here and expand on them in response to question 4 below.

- <u>Issue Area 1: Real Time Dispatch and Multi-Interval Optimization problems</u>. The Real Time market currently creates unnecessary economic and reliability risk due to legacy design decisions that are appropriate for traditional generators but have unintended consequences with storage. Storage-specific changes to the way the multi-interval optimization (MIO) algorithm works in the Real Time market are urgently needed.
 - MIO Recommendation: MIO is unnecessary for battery energy storage resources due to their extremely fast ramp rates. Real Time Dispatch (RTD) instructions for storage should strictly be made based on the Binding interval and not any advisory intervals. This will accomplish a better reliability outcome. Alternatively, MIO should be constrained to a much smaller number of advisory intervals for Non-Generator Resources (NGRs) (maybe 2-3 intervals, i.e. 10-15 minutes, instead of the current 13 intervals, i.e. 65 minutes). The risk with dispatching NGRs based on advisory intervals is that RTD can deplete the storage resource before the evening peak thereby causing unintended reliability risk and exposing the resource to huge imbalance charges if resource is not able to discharge to its Day Ahead evening peak award. The dispatch based on advisory interval pricing (which may or may not materialize) is often not in line with resource's bid curve and thereby could make it

impossible for resource owner to maintain desired SOC to meet its DA discharge awards, which could lead to another unintended consequence – ED issued by CAISO Operations.

- <u>Issue Area 2: Exceptional Dispatch and Infeasible Dispatch</u>. This past summer CAISO leaned heavily on Exceptional Dispatch (ED) with large energy storage projects, frequently taking resources out of market either via phone calls from CAISO Grid Ops to Resource SC or out of market instructions through Automated Dispatch System (ADS). Unfortunately, several ED requests made by CAISO Grid Ops were either impossible to follow (i.e. instruction to charge when the unit is already full), or that would make it impossible for a resource to meet its Day Ahead market schedules LS Power team has been working closely with CAISO Grid Ops team and while we have been able to resolve a few of the infeasible dispatch issues, more work is needed in this area as described below.
 - **ED Recommendation 1:** To be ready for summer 2021, CAISO operations desk personnel need to have more information about a storage resource's schedules and their physical characteristics than they had this past summer, and need to be trained on how storage is different from traditional generators. LS Power is always available to collaborate on improving telemetry, documentation, and training for this purpose.
 - **ED Recommendation 2:** If EDs are being used to remove the storage resource from the Real Time market, as was often done in 2020, then the ED should by default request that the unit exactly follow its Day Ahead schedule. This would eliminate the scenario where EDs are requested by a grid operator and unintended consequences are created hours later if the plant's operator or scheduling coordinator is not quick to figure out and explain the risks.
 - Infeasible Dispatch Recommendation: LS Power has previously suggested fixes to CAISO to eliminate infeasible dispatch situations. We will continue to work with CAISO team in addressing these issues and will be happy to participate in a stakeholder dialogue on this topic, as needed. We urge CAISO team to implement recommendations provided at the earliest so EDs related to Infeasible Dispatch can be eliminated.
- <u>Issue Area 3: Bid Cost Recovery as currently implemented does not work for energy storage</u>. CAISO must review the current bid cost recovery (BCR) calculation for the real time market as it is applied to non-generator resources. Due to the specifics of that calculation, NGRs are never made whole for losses incurred by resources following CAISO dispatch (i.e. the settlement charge code is always zero at the end of the day), and these losses can and do occur due to the undesirable outcomes mentioned above from both Real Time/MIO dispatch issues and ED.
 - BCR Recommendation: BCR rules should be completely rewritten for NGRs in a way that takes into account the specific economics of energy storage. One plausible option would be for CAISO settlements to compute BCR using a backtest of what a resource would have earned if it was a price taker and its bid curve had been honored exactly in each hour given the resource's physical characteristics and actual prevailing LMPs in each of the Day Ahead, Fifteen Minute, and Five Minute Market runs for the day (after any adjustment to the bids is made for market power mitigation of course). The BCR payment would make up the difference between actual market revenue and what the resource would have earned had it been dispatched according to its bids and prices only (i.e. it would undo any damage from MIO or ED dispatch that took it out of the market).

2. Provide your organization's feedback on export and load scheduling priorities:

LS Power has no feedback at this time.

3. Provide your organization's feedback on reliability demand response resource dispatch and real-time price impacts:

LS Power has no feedback at this time.

4. Provide your organization's feedback on the requirements for storage resources during tight system conditions:

Background: All of the following discussion pertains to large scale storage resources, and is especially focused on stand-alone storage resources. The vast majority of storage projects participate in CAISO markets through the Non-Generator Resource (NGR) model, specifically as Non-REM type NGRs. In general, the Day Ahead Market does a good job of determining energy storage dispatch schedules that support economic outcomes and reliability. However, the Real Time Market is in need of storage specific updates. With appropriate Real Time Market changes in place, CAISO operators should be able to rely on the markets to dispatch storage and reduce on the need for Exceptional Dispatch (ED) and other proposed out-of-market actions for energy storage.

Storage resource owners/operators such as LS Power are completely aligned with CAISO with respect to maintaining reliability of the grid. Storage resource owners have the same operational goal as CAISO during tight system conditions: to have the battery full and ready to discharge when needed (such as during evening peak hours). It is also important that CAISO wholesale market prices both accurately reflect reliability need and guide dispatch the vast majority of the time, so that energy storage resources can effectively contract with load serving entities to mitigate their risks as the natural buyers in the sometimes volatile wholesale energy markets. This concept, plus a functioning resource adequacy market, are what enables the storage investment taking place today that California is relying on to meet both its environmental and reliability goals. As stated above, LS Power emphasizes that CAISO should seek to implement in-market solutions and use transparent prices to achieve desired goals wherever possible. This is good market practice, is squarely in line with CAISO's stated principles, and will minimize risk for any changes that need FERC approval

Issue Area 1: Real Time Dispatch and Multi-Interval Optimization problems

The Real Time market currently creates unnecessary economic and reliability risk due to legacy design decisions that were appropriate for traditional generators, but have unintended consequences with storage. Specifically, storage-specific changes to the way the Multi Interval Optimization (MIO) algorithm works in the Real Time market are urgently needed.

How MIO works today: Briefly, MIO is a design aspect of the Real Time market that estimates market conditions several intervals in the future, known as the advisory intervals, in order to optimize the dispatch signals given to resources in the immediately following interval, known as the binding interval. This way CAISO could start ramping up slow moving but low-cost traditional generators if CAISO anticipated a need occurring later in the hour, keeping costs low. However, most battery storage resources differ from conventional resources in various key aspects, and the MIO algorithm has unintended consequences as a result. Specifically, the MIO algorithm is extremely sensitive to changes in CAISO's estimate of future system conditions, and frequently those estimates do not materialize in practice (this is a major reason why just extending the time horizon for MIO would not solve these problems, that "solution" in effect requires perfect knowledge of the future).

Having no inertia, storage resource dispatch signals (DOTs) are thus moved up and down in the binding interval in a way that is beyond the control of resource owners, any time CAISO estimates a very low or high price materializing in the advisory intervals. The algorithm also does not consider Day Ahead schedules in any way when determining Real Time market dispatches. Because MIO in real-time does not consider awards in prior market runs, it is not uncommon for the MIO algorithm to lock in financial losses in storage operation during various intervals of the day.

The result of this takes two forms:

- A. When CAISO expects a future high price, it starts charging the resource at prices that may be outside of the resource's bid curve. The expected future high price may or may not actually occur, leading to potential financial losses and unnecessary battery cycling.
- B. When a future low price is anticipated, CAISO starts discharging the resource at prices that may be well below the prices that the resource has stated a desire to charge at in its bid curve. This discharge could occur regardless of potential Day Ahead award schedules and could make it difficult for the resource to stay charged ahead of its DA discharge hours.

Both outcomes make it very difficult for a resource owner to control their resource's state of charge through the only mechanism available to them: the bid curve. Outcome B also creates reliability risks: it discharges a resource, potentially for low prices, leaving it empty relative to where it should be. To be clear: there are currently no market guardrails against this undesirable outcome happening prior to the evening peak, even if it is a tight supply day where the resource has a Day Ahead schedule and needs to be full an hour later. This at least should be fixed before Summer 2021.

MIO Recommendation: MIO is unnecessary for battery energy storage resources due to their extremely fast ramp rates. Real Time Dispatch (RTD) instructions for storage should strictly be made based on the Binding interval and not any advisory intervals. This works because resource owners have a very clear incentive in the market to have their resources be full to meet their schedules in the Day Ahead market, because failure to do so means risking massive imbalance penalties. Storage resource owners can, should, and do offer to charge at higher prices through their bid curves submitted to CAISO in the hours leading up to a Day Ahead schedule. (This suggestion would not hold for non-battery storage resources with slower ramp rates closer to those of a traditional generator, those will likely benefit from MIO).

Alternatively, MIO could be constrained to a much smaller number of advisory intervals for NGRs (maybe 2-3 intervals, i.e. 10-15 minutes, instead of the current 13 intervals, i.e. 65 minutes).., and an adjustment could be made to specifically avoid "B" above, where the unit's state of charge is lowered in anticipation of future low prices. The reliability risk to the grid and financial risk to storage operators from that scenario is so great that LS Power and others would surely prefer to forgo any theoretical opportunity to "earn a spread" in those intervals when a low price does subsequently appear after we've been discharged for prices less than we have bid into the market.

Issue Area 2: Exceptional Dispatch and Infeasible Dispatch.

In 2020, CAISO relied on the Exceptional Dispatch (ED) tool to control storage resources in tight conditions and LS Power recommends *against* relying on this tool for 2021. Specifically, this takes the form of the CAISO operations desk making phone calls to the resource's scheduling coordinator and operators, telling them that the resource is being removed from the market and needs to set its output at a specific level for a certain time period. In some cases, CAISO operators have made ED requests that were impossible to follow (i.e. "charge at X MW for the next 3 hours", requested at a

time when the resource is already full). In other cases, the ED requests would have made it impossible for the resource to subsequently meet its Day Ahead schedule (i.e. "discharge at X MW for the next 4 hours", where X was a value that would have left the resource completely empty immediately prior to a discharge scheduled in the Day Ahead market). Reliability issues were avoided at the last minute by storage plant operators explaining the physical limitations of the resource to the CAISO operations desk and getting the EDs adjusted; this scenario should be avoided altogether going forward. LS Power team has been working with CAISO Grid Operations and we stands committed to provide any information needed by CAISO so the Operations can understand the physical characteristics and make dispatch decisions accordingly.

This ED practice took storage out of the Real Time market, with grid operators losing the resource's ability to quickly and flexibly respond to reliability needs, and in some cases creating significant lost opportunity cost for the resources. Excessive use of this tool creates market inefficiencies, which in turn leads to increase in cost to serve load. If CAISO decides to rely on this tool, LS Power also suggests revising the ED settlement rules to make storage resources whole to their bids (which according to our understanding is not happening) and also to potential lost opportunity costs for storage when it is taken out of market. Related to this, there are several "low hanging fruit" type of fixes to the Non-Generator Resource (NGR) model, which can greatly improve the CAISO operations desk's ability to dispatch storage in line with both its physical capabilities and day ahead schedules.

ED Recommendation 1: To be ready for summer 2021, CAISO operations desk personnel need to have more information about a storage resource's schedules and their physical characteristics than they had this past summer, and need to be trained on how storage is different from traditional generators. LS Power is always available to collaborate on improving telemetry, documentation, and training for this purpose.

ED Recommendation 2: If EDs are being used to remove the storage resource from the Real Time market, as was often done in 2020, then the ED should by default request that the unit exactly follow its Day Ahead schedule. This would eliminate the scenario where EDs are requested by a grid operator and unintended consequences are created hours later if the plant's operator or scheduling coordinator is not quick to figure out and explain the risks.

CAISO also regularly sends infeasible dispatches (ID) to NGRs due to limitations of the NGR model, specifically an inability to express the physical limitations that all batteries have with respect to charge rates that change as a function of State of Charge. A straightforward fix for CAISO utilization of existing telemetry points has been proposed privately by LS Power to CAISO, although there are other possible options. This issue should be addressed quickly, infeasible dispatches by definition cannot be followed by the resource receiving them, and the result is increased area control error, financial risk for resource owners, and consternation for CAISO operators and plant operators alike.

ID Recommendation: LS Power has previously suggested fixes to CAISO's EDAS group and would like CAISO to provide inputs or implement these recommendations such that EDs related to infeasible dispatches can be eliminated.

Issue Area 3: Bid Cost Recovery as currently implemented does not work for energy storage.

CAISO must review the current bid cost recovery (BCR) calculation for the Real Time market as it is applied to NGRs. Due to the specifics of that calculation, NGRs are never made whole for losses incurred by resources following CAISO dispatch (i.e. the settlement charge code is always zero at the end of the day). These financial losses can and do occur due to the undesirable outcomes mentioned above from both Real Time/MIO dispatch issues and ED. These losses in specific

periods are not covered by BCR due to an implicit assumption in the BCR math, which works perfectly well for traditional generators that only have positive levels of output and whose operational costs have a different relationship to their bid curve (i.e. operation requires a specific number of dollars for each MWh generated) than energy storage does (which uses a curve formatted the same way to convey a necessary spread between charge and discharge prices, as well as to price in the opportunity cost of being empty at the wrong time).

BCR Recommendation: BCR rules should be completely rewritten for NGRs in a way that takes into account the specific economics of energy storage. One plausible option would be for CAISO settlements to compute BCR using a backtest of what a resource would have earned if it was a price taker and its bid curve had been honored exactly in each hour given the resource's physical characteristics and actual prevailing LMPs in each of the Day Ahead, Fifteen Minute, and Five Minute Market runs for the day (after any adjustment to the bids is made for market power mitigation of course). The BCR payment would make up the difference between actual market revenue and what the resource would have earned had it been dispatched according to its bids and prices only (i.e. it would undo any damage from MIO or ED dispatch that took it out of the market). This type of a script is relatively simple to develop, and indeed many market participants already run something like this in their own offices each day. This is only one plausible solution and we recognize it is a complicated subject and deserves a dedicated workshop and a place in an appropriate stakeholder process at CAISO. We look forward to collaborating on it.

Storage specific requirements should allow for adequate compensation and be considered temporary for summer 2021. Lastly, LS Power recommends if CAISO makes any specific requirements for storage to hold a specific state of charge that takes the resource out of the real-time market, CAISO should also provide adequate compensation for providing that reliability service. As highlighted by stakeholders in the Resource Adequacy Enhancements initiative, CAISO's current proposals for minimum state of charge are discriminatory for storage resources and are a product of short comings in the current CAISO market discussed above. Further, because CAISO is already debating how to ensure storage is available for local and system needs and should not duplicate the process to enact changes in this initiative. Any changes that increase out of market activity resulting from this initiative should only be temporary for summer 2021, and longer-term changes should be evaluated in other initiatives.

5. Provide your organization's feedback on cost recovery provisions for hourly block imports during tight system conditions:

LS Power has no feedback at this time.

6. Provide your organization's feedback on short-term scarcity price enhancements:

LS Power has no feedback at this time.

7. Provide your organization's feedback on EIM coordination during emergency conditions and review of the current resource sufficiency evaluation design:

LS Power has no feedback at this time.

8. Please provide suggestions for additional topics to be considered in this stakeholder process that can be implemented by June 1, 2021:

LS Power has no feedback at this time.

9. Additional comments: