Energy Storage and Distributed Energy Resources Phase 3

Issue Paper

September 29, 2017

Market & Infrastructure Policy

Table of Contents

1 Introduction

The focus of the California Independent System Operator's (CAISO) energy storage and distributed energy resources (ESDER) initiative is to lower barriers and enhance the abilities of energy storage and distribution-connected resources[1] to participate in the CAISO markets. The number and diversity of these resources are growing and represent an increasingly important part of the future grid.

The ESDER initiative is an omnibus initiative with annual phases covering several related but distinct topics. The second phase of ESDER developed enhancements to demand response (DR), non-generator resources (NGR), multiple-use applications (MUA), and station power for storage resources. The CAISO Board of Governors approved ESDER 2 in July of 2017.[2]

The purpose of this issue paper is to introduce the third phase of the ESDER initiative. ESDER 3 will continue to identify barriers that impede both storage and distributed energy resources from efficiently participating in the CAISO markets. Similar to ESDER 2, the CAISO will organize the issue paper as well as address policy development in three topics: DR, NGR, and MUA. This issue paper captures topics submitted by stakeholders and carries forward other unresolved issues previously identified in ESDER 2.

2 Stakeholder Process

The CAISO is at the "Issue Paper" stage in the ESDER 3 stakeholder process. Figure 1 below shows the status of the issue paper within the overall ESDER 3 stakeholder process.

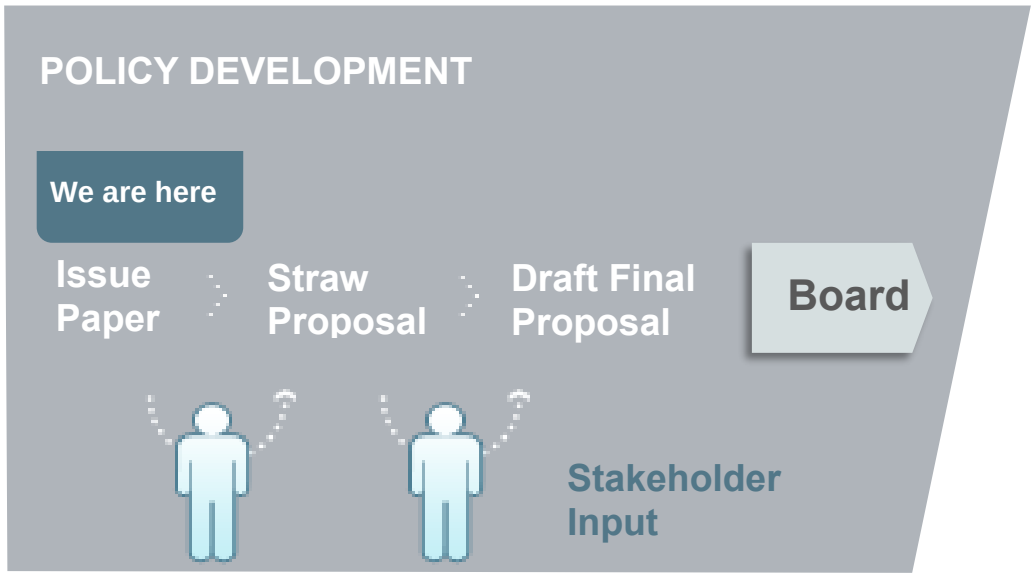
The purpose of the issue paper is to capture stakeholder input to identify and prioritize issues related to the integration, modeling, and participation of energy storage and DERs in the CAISO market. In ESDER 2, the CAISO asked stakeholders to submit desired topics for the CAISO to consider in scope of ESDER 3. The CAISO has reviewed those suggestions and categorized them below. After publication of the issue paper and an initial stakeholder call, the CAISO may hold workshops as necessary to reach a

[1] DERs are those resources on the distribution system on either the utility side or the customer side of the end-use customer meter, including rooftop solar, energy storage, plug-in electric vehicles, and demand response.

[2] The CAISO expects to post draft tariff language this fall. Because ESDER 2 requires significant software enhancements, the CAISO does not expect ESDER 2 enhancements to come online until spring 2018.

consensus on the priority issues the ESDER 3 initiative will address. As appropriate, the CAISO may organize focused working groups to address issues of a complex nature or those that have cross-jurisdictional concerns as we move through the initiative process. The CAISO's intent is to follow up the issue paper with a straw proposal that will restate and clarify the prioritized issues based on stakeholder feedback and input, and offer potential solutions.

Figure 1: Stakeholder Process for ESDER 3 Stakeholder Initiative



3 Demand Response Resources

The CAISO provides an overview of the DR related issues received from stakeholders and as expressed by DR Providers (DRPs) participating in the CAISO market. Increased utility and third party DR resource participation in the CAISO markets has provided real world experiences that inform desired market enhancements and refinements. Below is a list of issues identified:

(1) DR program characteristics are not easily transferable to constraints available for use with the Proxy Demand Resource (PDR) and Reliability DR Resource (RDRR) participation models. Issues in this category include:

a. When and how to set start-up and minimum load costs, and the impacts of a 0 MW Pmin on its real time dispatch;

b. Application and use of minimum and maximum run-time constraints;

c. Recognition of a notification time, if applicable; and

d. Inability for some DR resources to respond to a marginal dispatch.

(2) Variability of weather-sensitive DR (e.g. A/C cycling programs) is not recognized or provided consideration similar to variable energy resources (VERs) Resource Adequacy (RA) qualifying capacity values.

   a. How to set the qualifying capacity for weather-sensitive DR resources.

   b. The ability to update qualifying capacity values more frequently than on a monthly basis to reflect changes in weather sensitive DR resources and minimize risk of failing to meet a must offer obligation (MOO).

(3) Inability of RDRRs to buy back day-ahead awards economically if prices in real-time are forecasted lower than the day-ahead prices.

(4) Aggregation rules requiring a DR resource to contain locations within a sub-LAP served by the same load serving entity (LSE) can limit the ability of some DR to fully integrate into the market and meet the minimum PDR size threshold. Likewise, third party aggregators and DRPs developing PDR resources have expressed difficulty meeting or maintaining the 100kW minimum PDR size requirement as customers within their resource aggregations move to a new LSE.

(5) Inability to recognize contribution of load curtailment from behind-the-meter electric vehicle station equipment (EVSE) separately from the facility load served from the same retail service account, allowing curtailment of EVSE load to be measured separately and uniquely;

   a. Issue includes recognition of sub-meters for EVSE load and identification of a baseline to measure EVSE curtailment performance directly.

(6) PDR's inability to be dispatched to increase load and provide regulation service;

   a. The CAISO will consider a load shift product from behind-the-meter storage devices in ESDER 3.

3.1 Demand Response Issues Summary

3.1.1 *Demand response modeling limitations*

Commitment costs and the impact of a 0 MW Pmin

DR resource operators identify the inability to set use limitations and appropriately define commitment costs as barriers to the effective use and participation of their DR resources. As an example, DR resources often have a Pmin of zero, and a minimum load and start-up cost of $0/MW, which results in the resource having a zero commitment

cost. This characteristic makes a DR resource the "least cost" option in the CAISO's residual unit commitment (RUC) process compared to traditional generation, which have a Pmin > 0 and non-zero startup and minimum load costs. As a result, DR resources often are committed in RUC to be available for dispatch in real time. Once committed at a 0 MW Pmin, the resource is susceptible to real time 5-minute dispatches since the resource is "running" and is able to be dispatched up and down every 5-minutes whenever the DR resource's energy is economic. This can result in an infeasible dispatch for the DR resource. The CAISO will potentially frame this issue by considering the applicability of commitment-based constraints for resources with a 0 MW Pmin.

Minimum and Maximum Run-Time Constraints

As described above, DR resources are being committed in RUC to a Pmin of 0 MW, which meets its minimum run-time constraint because it is considered to be "running".[3] Additionally, DR resources that qualify for RA must be available for dispatch twenty-four hours per month, for at least three consecutive days, and be able to respond for at least four hours per dispatch.[4] Although PDRs must meet these requirements, stakeholders have pointed out that the market does not recognize the maximum run time once the DR resource has reached its daily use limit. The CAISO has suggested that as an alternative, DR resources can use the maximum daily energy limit parameter, but stakeholders have pointed to its limitations in reflecting the maximum run time constraint.

3.1.2 *Weather-sensitive demand response*

Stakeholders have also presented to the CAISO that, similar to wind and solar resources, the PMax of certain DR resources can vary due to their weather-sensitive nature. If a weather-sensitive RA-qualifying DR resource bids into the day-ahead market, depending on the weather, it may be unable to deliver its full RA amount, resulting in penalties associated with the CAISO's Resource Adequacy Availability Incentive Mechanism (RAAIM) since the resource could not bid its full RA qualifying capacity amount. This issue will need vetting at the CPUC and with other LRAs since the matter is

[3] Definition of minimum run time
http://www.caiso.com/Documents/Section34_RealTimeMarket_asof_May2_2017.pdf

[4] CAISO Tariff section 40.8.1.13
http://www.caiso.com/Documents/Section40_ResourceAdequacyDemonstrationForAllSCsInTheCAISOBAA_asof_Mar10_2017.pdf

fundamentally about how resource adequacy qualifying capacity is determined and set for these weather-sensitive DR resource types.

3.1.3 *Resource design constraints*

The CAISO currently requires that DR resource aggregations must consist of locations under a single LSE, represented by one DRP, and within a single sub-LAP. This design feature can segment a DR program into different aggregations by load-serving entity and sub-LAP. The result of this segmentation is the potential to strand some willing customer participants if these requirements, along with the PDR minimum size requirement, are not satisfied. DRPs that have established new resource aggregations, or are in the process of developing new ones, have also expressed difficulty in meeting, or maintaining, the 100 kW minimum participation requirement as customers within their resource aggregations are defaulted or move to new LSEs, such as to a community choice aggregation (CCA).

3.1.4 *Demand response aggregations rules*

The default load adjustment (DLA)[5] settlement mechanism requires resource aggregations to be under a single LSE, making it more challenging for DRPs to aggregate customers by LSE to meet the minimum PDR size requirement of 100 kW. To remedy this challenge and allow multiple LSEs per PDR, the CAISO is, and has been willing to eliminate the DLA rule if stakeholders agree to do so. Stakeholders can consider prioritizing this rule change in ESDER 3.

The CAISO believes that the rule of one DRP per PDR, and the logic for imposing aggregations by sub-LAP to minimize ill affects at congested interfaces are design features that are warranted and must remain.

3.1.5 *RDRR economic buy-back of day-ahead awards*

Certain stakeholders have expressed interest in buying back their day-ahead RDRR positions in real time. The RDRR product was designed on the premise that all available reliability-triggered MWs that qualify for resource adequacy would bid and be made available to the ISO in real-time. The CAISO believes that a RDRR buy-back provision goes against the spirit of the RDRR product and the special treatment afforded this resource. The PDR product is the mechanism that allows full economic participation of

[5] The DLA represents the amount of load curtailed (not meeting the net benefits test) within a Default LAP for a specific LSE.

DR resources. The CAISO encourages DRPs to pursue the PDR option if economic bidding flexibility is desired. Thus, the CAISO is not proposing to discuss a RDRR buy-back provision in ESDER 3.

3.1.6 *Recognition of behind the meter EVSE load curtailment*

FERC approval of the CAISO ESDER 1 initiative tariff filing resulted in the implementation of the metered generator output (MGO) performance measurement, which uniquely recognized a sub-metered storage device's contribution to a facility's overall load curtailment during a CAISO dispatch event. As part of the ESDER 2 initiative process, comments received from certain stakeholders requested that the MGO concept extend to sub-metered EVSE loads so that load curtailment, achieved by managing the rate of EV charging based on an ISO dispatch instruction, could be recognized and measured distinct from the building load. Enabling EVSEs sub-metering and applying a MGO-like performance method would provide an option for EVSE market participation independent of, or in combination with, its host customer. Sub-metering resolves the lack of fifteen-minute interval metering at the host facility for measurement of curtailment in five-minute intervals, enables direct measurement of the actual EV load curtailment achieved, and creates a more viable market participation model for EVSEs.

3.1.7 *Load consumption and regulation*

Certain stakeholders expressed concern about the pace of Load Consumption Working Group (LCWG) and getting load consumption and regulation from demand resources in the final draft proposal for ESDER 2. While there was general consensus in the LCWG about a load consumption capability during periods of oversupply, there was not a fully developed proposal within the ESDER 2 timeframe. The CAISO recognizes the desire to continue working on load consumption capabilities; however, certain stakeholders expressed concerns about retail demand charges, ensuring directed load consumption actions do not create operational problems on the distribution system, and the fundamental issue of incentivizing non-beneficial or wasteful consumption. The CAISO concurred that more work and vetting was warranted if a load consumption product was to be developed by the CAISO. Since then, the CAISO has turned its attention from a load consumption product to a "loads shift" product as described below.

3.2 Priority item in scope for ESDER 3

In approving the ESDER 2 proposal, the CAISO Board of Governors requested staff to continue working with stakeholders on proposals set out by the load consumption working group for enhancing the PDR model to allow for broad participation by DR

resources, particularly in light of opportunities to provide additional services in support of the grid during oversupply conditions. Subsequent meetings held with stakeholders focused development on a "load shift" product that is designated as a priority item under the ESDER 3 initiative.

3.2.1 *Load Shift Product*

The CAISO will consider as "in-scope" the continued development of a load shift product for the participation of a BTM storage device under a DR participation model. The focus on a "load shift" product is a preferred approach since it captures excess supply and stores that energy for later consumption. The initial product will facilitate the provision of both load curtailment and "shift" services while maintaining that any injection into the grid will not be considered as part of its wholesale market compensation for a DR resource.

Within ESDER 3, the CAISO will work with a broad set of stakeholders to develop the detailed feature set desired for a behind-the-meter storage, load shift product. This work will include the identification of gaps in tariff provisions and current DR modeling capabilities. To resolve open issues identified through the gap analysis, the CAISO will establish working groups as appropriate and needed.

4 Multiple-Use Applications

Multiple-use applications (MUA) are when distributed energy resources provide services to and receive compensation from more than one entity (e.g., the CAISO and a UDC). DERs and DER aggregations (DERAs) seek to engage in MUAs in order to "stack" services and revenue streams and thereby optimize the value of their resources. Depending on the points of interconnection of the DERs and the use-case involved in an MUA, the resource may provide services to a combination of end-use customers, the distribution system, and the wholesale market and transmission system.

Since early 2016, the CAISO has supported MUAs by collaborating with CPUC staff in its Energy Storage Proceeding Track 2 (R.15-03-011). This year, CAISO and CPUC staff collaborated to produce a report, "Joint Workshop Report and Framework – Multiple-Use Applications for Energy Storage," which the CPUC issued on May 18, 2017 as part of an ALJ ruling seeking comments. The report was discussed at a CPUC workshop on June 2, 2017, followed by two rounds of stakeholder comments submitted in July 2017.

Throughout the collaborative effort on MUA within the CPUC proceeding, the CAISO has indicated that it would take up at the CAISO any issues that emerge and warrant a separate CAISO initiative because they would involve changes to CAISO markets and to the CAISO tariff. Based on the stakeholder activities this past June and July, the CAISO identified the following MUA topics and proposes to include them in the potential scope of ESDER 3.

4.1 Multiple-Use Applications Issues Summary

4.1.1 *The 24x7 ISO participation requirement for DERs*

Several parties[6] recommend that the CAISO amend the non-generator resource ("NGR") model to allow NGRs the discretion to choose the market intervals in which they want to participate in the CAISO market. Currently, NGRs are 24x7 wholesale market resources comparable to all other supply resources except DR. This means that an NGR is subject to financial settlement through the CAISO market settlement system for its consumption or production in each settlement interval, irrespective of whether the resource submitted a market bid or received a dispatch instruction. This treatment is the same irrespective of whether the NGR provides RA capacity and has a must-offer obligation. The CAISO understands stakeholders' desire to allow NGRs to be able to opt out of CAISO metering and settlement at some intervals in order to provide services to other entities, like a DR resource. The ISO proposes to consider this change in ESDER 3.

4.1.2 *Wholesale market participation model for a micro-grid*

The CAISO received inquiries from micro-grid developers about how a micro-grid could participate in the CAISO markets for energy and ancillary services, including regulation and reserves. Clear requirements and procedures for a micro-grid to participate in the CAISO markets are an essential element of micro-grid participation in MUA. The CAISO is willing to consider this topic for inclusion in the ESDER 3 scope, but requests input from stakeholders to help determine whether there is broad stakeholder interest in this topic and to identify specific sub-issues that would need to be addressed.

The CAISO expects there will be several sub-issues involved in this topic. By design, a micro-grid will contain a mix of complementary resources and facilities whose operation is coordinated primarily to meet the energy supply needs of the micro-grid and the customers it serves. Some of the issues the CAISO expects to consider in this topic are:

- Can the micro-grid operator combine a subset of its internal facilities to form an NGR for CAISO market participation? If so, what metering arrangements would be acceptable?

[6] Stem, CESA, NRG, and SolarCity

- Alternatively, could the entire micro-grid participate as an NGR based on metering at its point of interconnection with the distribution or transmission system? In what ways is a micro-grid, if modeled as an NGR at its point of interconnection, comparable to a stand-alone storage facility, and how is it different?
- If NGR is not a workable participation model for micro-grids, what features would a workable model for micro-grids need to have? Are there examples of micro-grid participation in wholesale markets today that would be useful for this initiative, or must something new be created?
- For a stand-alone storage facility, its energy consumption that supports supply of energy to the grid is considered wholesale consumption, whereas its station power is considered retail. Similarly, a micro-grid participating as an NGR serves internal loads in addition to participating in the CAISO market. When the micro-grid consumes energy from the system, how could we distinguish between wholesale consumption to support supply of energy or reserves to the grid, versus retail consumption to serve its internal load?

The CAISO requests that stakeholders identify other issues relevant to this topic if the CAISO and stakeholder decide to include this issue in the ESDER 3 scope.

5 Non-Generator Resources

Under this topic, the CAISO will provide an overview of issues that NGRs face while participating in the CAISO wholesale market. The CAISO received valuable comments and feedback in ESDER 2 that shaped the discussion on expressing storage limitations through resource modeling, market optimization, and the ability to identify and represent explicit costs and use limitations. The CAISO would like to emphasize the need for explicit examples and data from stakeholders who have expressed the issues summarized below and will be expecting further discussion during the policy development process.

5.1 Non-Generator Resource Issues Summary

5.1.1 *Reflecting costs and NGR use limitations*

Concerning managing physical and contractual use limitations, stakeholders expressed the need to have new tools to manage throughput limitations and State of Charge (SOC). The CAISO has stated that current modeling and bidding practices allow the resource to be represented in a way that meets the resource's physical limitations, including the use of the CAISO Outage Management System to reflect true physical

resource limitations. The issue areas of contractual limitations, costs, and CAISO Use Limited designation are outlined below.

Reflecting costs and non-physical limitations of NGRs

Where the costs of operating a storage resource increase due to increased depth and frequency of cycling, the discussion should not be based on contractual warranty but could be better reflected as an explicit cost in the market optimization as a cost per cycle or cost per MWh included in the bid price. As stated in ESDER 2, the CAISO does not support establishing MWh throughput limitations based on economic factors such as warranty or performance guarantees. The Department of Market Monitoring also supports this view, as stated in its ESDER 2 Stakeholder Comments:

> "The limitations imposed by contractual obligation, while expressed for a defined period of time, appear to have little physical relationship with the period of time beyond ensuring a particular level of battery life and cell health for an agreed upon period of time, or delaying maintenance activities for a specified period of time. These limitations are not exogenous to the resource operator, and indeed may be made more restrictive in exchange for more favorable terms in capacity acquisition. For this reason particularly, it is not appropriate to exempt NGR storage resources from RAAIM penalties when contractual use limits are exhausted. Under this construct, entities contracting with energy storage resource owners may have greater financial incentive to minimize capacity procurement costs at the expense of market availability. This maximizes profits on resource adequacy capacity sold from energy storage resources while simultaneously working to undermine the intent of resource adequacy capacity by limiting its availability."

The CAISO believes that costs and limitations can be reflected in energy bids today to limit use when increased or excessive use may increase degradation or void contractual requirements.

Additionally, the CAISO is open to defining explicit energy storage costs, including additional or different approaches to reflect energy storage costs in the CAISO markets. Examples of alternatives suggested by stakeholders include something similar to Material Maintenance Adders (MMA) or Variable O & M charges (VOM).

CAISO Use Limited Designation Status of NGRs

Stakeholders continue to support allowing NGR resources to be qualified for CAISO defined "Use Limited Status." The CAISO is open to considering a use-limited status for NGR resources, provided the basis of the use-limitation is consistent with those of other

generation resources and complies with the use-limited definition in the CCE3 stakeholder initiative. Similar to generators, use-limited status could exempt resources with RA capacity from RAAIM penalties when the use limitations are exhausted. When considering this topic, a clear definition of a use limitation not connected with a warranty or performance reason will need to be established.

5.1.2 *Market Mechanisms for managing SOC and throughput limitations to facilitate Multi-Use Applications*

Stakeholders have also noted that CAISO market tools are needed for greater end-state management capability of an energy storage resource's SOC in relation to the MUA topic. If an NGR modeled storage resource is given the ability to provide services outside of the CAISO market, stakeholders believe a resource owner lacks visibility and the ability to control the resource's SOC at the end of a CAISO dispatch. The stakeholder inputs for improved SOC management are listed below.

Real time optimization and dispatch based on SOC

The CAISO market optimization utilizes four second telemetered SOC values from storage resources within the real-time market optimization. Stakeholders have stated that the requirement to submit real-time bids seventy-five minutes before the operating hour does not give resource owners sufficient knowledge to alter or correct their bidding strategy to manage a resource's SOC. The primary reason stated by stakeholders is the inability for the resource owner to have a high degree certainty on how the CAISO will use the resource between bid submission and market dispatch (or AGC control). Stakeholders have suggested the option to submit multiple bid stacks where the most recently available resource SOC would be the determining factor on which bid stack was used at real-time execution.

Multi-Segment Ancillary Service Bids

CAISO allows resources to bid in multi-segment energy bids but restricts ancillary service bids at a single segment at a single price. Stakeholders are requesting the ability to offer multi-segment reserve and regulation bids to help with real-time SOC management. The stakeholders state that with multi-segment AS bids, the resource owner can use a multi-segment bid to clear a specific amount of AS at various price levels and then utilize energy bids for the remaining capacity to manage the real-time SOC.

Regulation bidding for SOC management

Stakeholders have identified that storage resources providing regulation services are controlled in ways that that causes excessive cycling that leads to a resource having to

drop out of the CAISO market due to warranty agreements. Although these storage resources can register with a slower ramp rate, stakeholders believe that the CAISO market would not be fully utilizing the full capability of the resource. One potential solution is to establish a cycling limit calculation similar to the mileage calculation used in the Pay for Performance Regulation.

6 Next Steps

In this issue paper, the CAISO has tried to capture and describe the open issues stakeholders want resolved and the enhancements stakeholders would like to see made to the CAISO market and models. The CAISO will hold a stakeholder call on October 12, 2017 to review the issue paper and seek clarity on the issues or enhancements that stakeholders believe were not fully addressed or captured. In addition to the web conference, the CAISO is planning to hold working group meetings to help further define the scope and priority of issues before publishing a straw proposal. The CAISO encourages all stakeholders to submit comments on the issue paper and any additional items that should be considered as part of ESDER 3. Lastly, the CAISO requests stakeholders present data, if available, to help inform any of the identified issues detailed above or any new issues submitted through comments.