Energy Storage and Distributed Energy Resources Phase 2

Third Revised Straw Proposal

April 17, 2017

Market & Infrastructure Policy

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1 Executive Summary

The central focus of the California Independent System Operator's ("CAISO") energy storage and distributed energy resources ("ESDER") initiative is to lower barriers and enhance the ability of transmission grid-connected energy storage and distribution-connected resources, i.e., distributed energy resources ("DER"), [1] to participate in the CAISO market. The number and diversity of these resources are growing and represent an increasingly important part of the resource mix. Integrating these resources will help lower carbon emissions and add operational flexibility.

The ESDER initiative is an omnibus initiative covering several related but distinct topics. For the second phase of ESDER, i.e., "ESDER 2" these topics include demand response ("DR"), non-generator resources ("NGR"), multiple-use applications ("MUA"), and station power for storage resources. ESDER 2 is taking multiple approaches to pursue and address each topic. For example, in the case of the DR topic, a stakeholder-led working group – the Baseline Analysis Working Group ("BAWG") is discussing and recommending stakeholder-desired enhancements to the proxy demand resource ("PDR") performance evaluation methods. The proposal produced by this working group is not the CAISO's proposal, but is the work product of the working group. A working group for the NGR topic is exploring use-limitations for storage resources. A different approach is being used for the remaining two topics of ESDER 2 – MUA and station power for storage resources – wherein the CAISO is continuing its efforts to address these two topics in collaboration with the California Public Utility Commission ("CPUC") through its energy storage proceeding.[2]

In this third revised straw proposal, the CAISO presents the status of its work in addressing the four topics of ESDER 2. The CAISO is preparing to submit three topics – DR enhancements in the form of alternative baselines, distinguishing between charging energy and station power, and a net benefits test for DR resources that participate in the Energy Imbalance market ("EIM") - for approval by the CAISO Board on July 26-27, 2017. The CAISO will continue to work with stakeholders on the remaining ESDER 2 topics. The CAISO will carry forward into a new ESDER Phase 3 ("ESDER 3") stakeholder initiative any topics that are not approved by the CAISO Board in 2017. ESDER 3 will start in September 2017 with the posting of an issue paper.

[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 DR.
[2] CPUC Rulemaking 15-03-011.

2 Stakeholder Process

The CAISO is at the "Third Revised Straw Proposal" stage in the ESDER 2 stakeholder process. Figure 1 below shows the status of the third revised straw proposal within the overall ESDER 2 stakeholder process.

Figure 1
Stakeholder Process for ESDER 2 Stakeholder Initiative

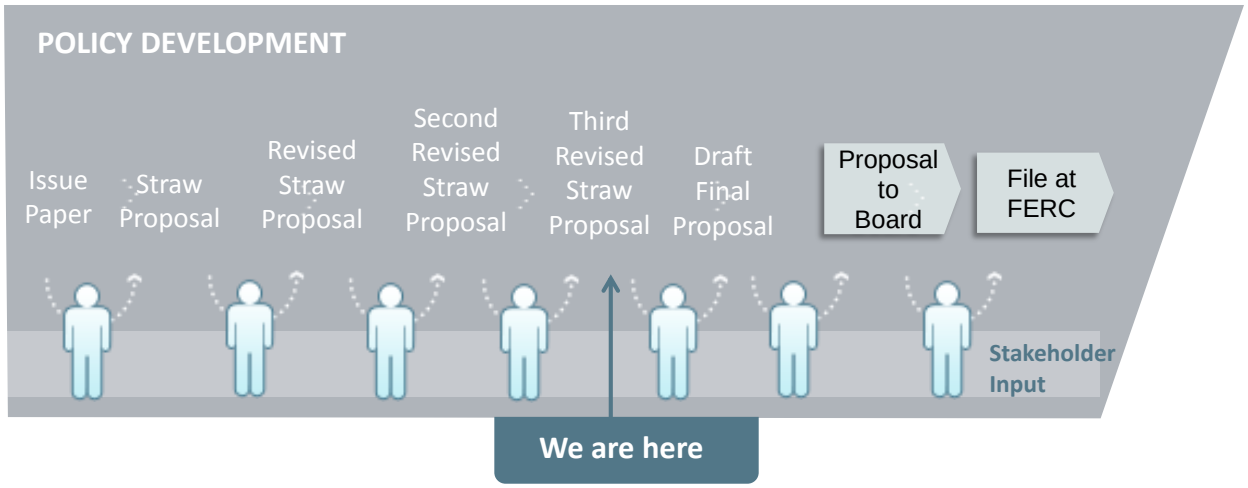


Table 1 below summarizes the major milestones for the ESDER 2 and ESDER 3 stakeholder initiatives. Table 1 does not include implementation steps, including milestones for developing and filing the tariff amendments, changes to CAISO business practice manuals, and changes to implement new market system software and hardware.

The policy issues in ESDER 2 will affect the CAISO's EIM where a participating EIM entity wishes to enable the functionality within its EIM entity area. Therefore, the EIM Governing Body will have an advisory role in approving the policy resulting from this initiative and the CASO will present its ESDER 2 proposal at the July 13, 2017 EIM Governing Body meeting.

The CAISO will present its ESDER 2 proposal to the CAISO Board of Governors for approval on July 26-27, 2017.

Table 1
ESDER 2 and ESDER 3 Stakeholder Process Schedule
(Shaded Milestones are completed)

Milestone	Date	Activity
ESDER 2 Issue Paper	March 22, 2016	Post ESDER 2 issue paper
	April 4	Hold stakeholder web conference
	April 18	Stakeholder written comments due
Straw Proposal	May 24	Post ESDER 2 straw proposal
	May 31	Hold stakeholder web conference
	June 9	Stakeholder written comments due
Revised Straw Proposal	July 21	Post ESDER 2 revised straw proposal
	July 28	Hold stakeholder web conference
	August 11	Stakeholder written comments due
Second Revised Straw Proposal	September 19	Post ESDER second revised straw proposal
	September 27	Hold stakeholder web conference
	October 11, 2016	Stakeholder written comments due
Third Revised Straw Proposal	April 17, 2017	Post ESDER 2 third revised straw proposal
	May 4	Hold stakeholder meeting
	May 18	Stakeholder written comments due
Draft Final Proposal	June 8	Post ESDER 2 draft final proposal
	June 15	Hold stakeholder meeting
	June 23	Stakeholder written comments due
Presentation to EIM Governing Body	July 13	Present ESDER 2 proposal at Energy Imbalance Market Governing Body meeting
Presentation to Board for Approval	July 26-27	Present ESDER proposal for approval at CAISO Board meeting
ESDER 3 Issue Paper	September 29	Post ESDER 3 issue paper

The CAISO received comments from stakeholders on all of the topics discussed in the September 19, 2016 Second Revised Straw Proposal.[3] The CAISO provides written stakeholder comments and CAISO responses in the sections below for each ESDER 2 topic.

3 Introduction

The central focus of the ESDER initiative is to lower barriers and enhance the ability of transmission grid-connected energy storage and DER to participate in the CAISO market. The number and diversity of these resources is growing and represent an increasingly important part of the resource mix. Integrating these resources will help lower carbon emissions and add operational flexibility.

In 2015, the CAISO conducted the first phase of ESDER ("ESDER 1")[4], which made progress in enhancing the ability of storage and DER to participate in CAISO markets. The CAISO worked with stakeholders to develop policy proposals. The CAISO Board approved proposals that needed tariff changes – enhancements to the NGR model and enhancements to DR performance measures – at its February 3-4, 2016 meeting. The CAISO filed tariff changes with FERC on May 18, 2016.[5] On August 16, 2016, FERC accepted the tariff revisions effective October 1, 2016.[6]

In 2016, the CAISO began ESDER 2 to explore additional topics of interest to stakeholders.

- In its March 22, 2016 ESDER 2 issue paper, the CAISO proposed the following topics: further NGR model enhancements, further DR enhancements, further work on MUA, clarify station power for energy storage, and review the allocation of transmission access charge to load served by DER.

[3] (1) Advanced Microgrid Solutions ("AMS"), SolarCity and Stem; (2) California Energy Storage Alliance ("CESA"); (3) California Large Energy Consumers Association ("CLECA"); (4) OhmConnect, Inc.; (5) Pacific Gas & Electric Company ("PG&E"); (6) San Diego Gas & Electric Company ("SDG&E"); and (7) Southern California Edison Company ("SCE") submitted written stakeholder comments on the September 19, 2016 second revised straw proposal.

[4] More information about ESDER 1 may be found at: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResourcesphase1.aspx.

[5] The ESDER 1 tariff filing may be found at: http://www.caiso.com/Documents/May18_2016_TariffAmendment_ImplementEnergyStorageEnhancements_ER16-1735.pdf.

[6] See http://www.caiso.com/Documents/Aug16_2016_LetterOrderAcceptingTariffAmendment_EnergyStorage_DistributionEnergyResourceInitiative_ER16-1735.pdf.

- In its May 24, 2016 straw proposal, the CAISO refined the scope of topics for ESDER 2 and clarified its proposed direction on these topics based on stakeholder feedback, i.e., feedback received from both written comments and the joint workshop held with the CPUC.
- In its July 21, 2016 revised straw proposal, the CAISO further refined topics in scope and made progress in developing proposals to address those issues.
- In its September 19, 2016 second revised straw proposal, the CAISO presented the status of its work with stakeholders in addressing the four topics of ESDER 2.
- In this April 17, 2017 third revised straw proposal, the CAISO presents the latest status of its work with stakeholders in addressing the four topics of ESDER 2, including three topics that the CAISO proposes to take to the CAISO Board for approval on July 26-27, 2017.

4 Changes from Second Revised Straw Proposal

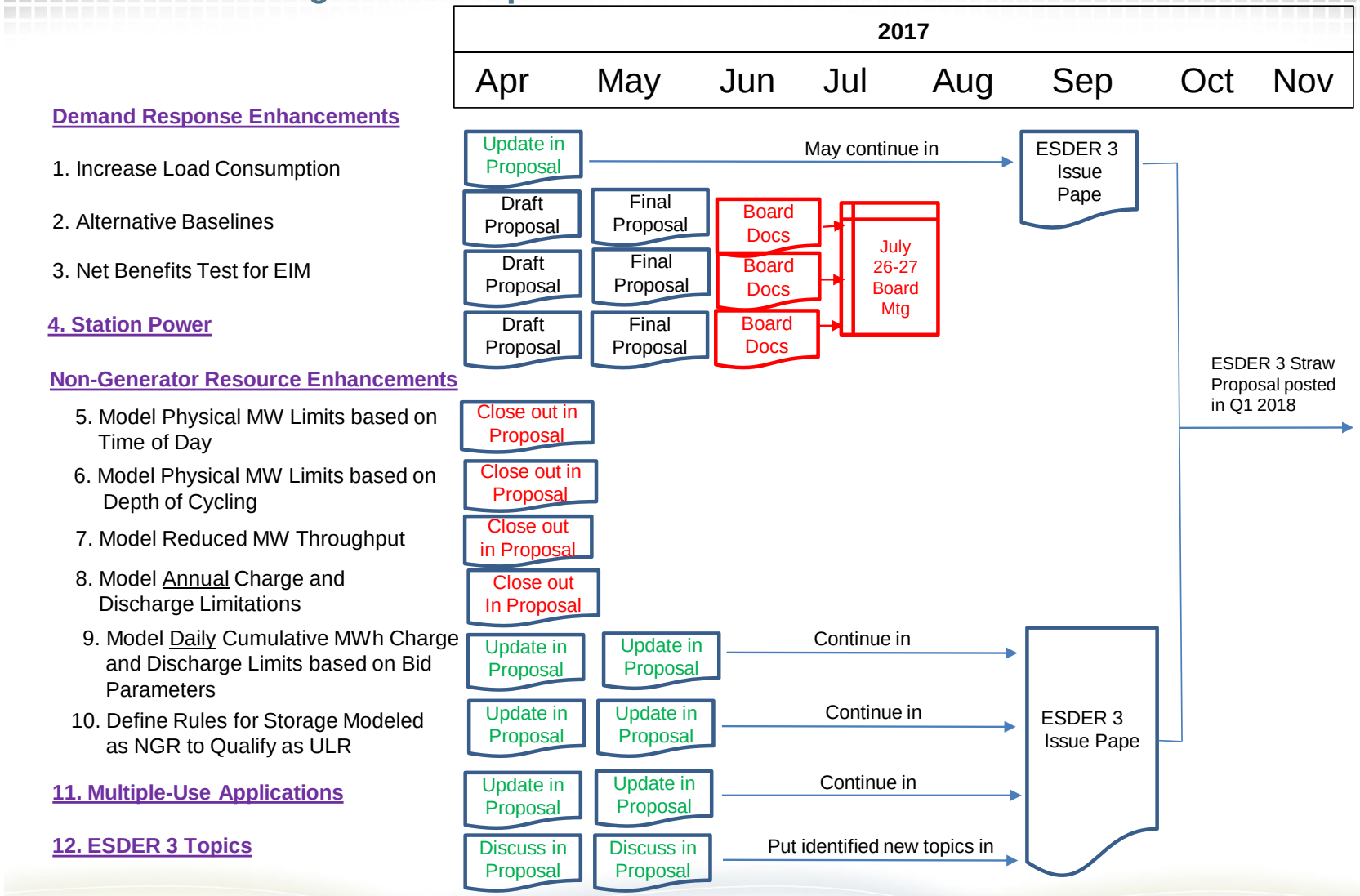
This section discusses the changes that the CAISO has made from the second revised straw proposal to create this third revised straw proposal. The major changes are:

1. Separated the proposal into the topics that the CAISO believes will be ready for approval by the CAISO Board this year (which will be at the July 26-27, CAISO Board meeting), and the topics that the CAISO believes require additional discussion in ESDER 2 and subsequently in ESDER 3.
2. Provided an updated proposal from the BAWG working group on DR enhancements in the form of alternative baselines, which the CAISO plans to present for approval at the July 26-27, 2017 Board meeting.
3. Provided an updated proposal from the CAISO on distinguishing between charging energy and station power, which the CAISO plans to present for approval at the July 26-27, 2017 Board meeting.
4. Provided a new topic in this initiative, and a proposal from the CAISO, on developing a threshold price, determined by the net benefits test, to account for EIM participant bidding, which the CAISO plans to present for approval at the July 26-27, 2017 Board meeting.
5. Provided updated discussion on the following three ESDER 2 topics that the CAISO does not plan to take to the July 26-27, 2017 Board meeting: DR enhancement in the form of increased load consumption, NGR enhancements, and MUA.

6. Provided a discussion of the CAISO's plans for the ESDER 3 initiative and requested stakeholder input now on potential topics to include in ESDER 3.

Figure 2 on the following page shows the breakout of the scope between ESDER 2 and ESDER 3, as well as the general timeline of the ESDER stakeholder process.

Figure 2 - Scope Breakout - ESDER 2 and ESDER 3



5 Proposals for July 26-27, 2017 Board Meeting

The CAISO plans to seek approval of the following three topics at the CAISO Board meeting on July 26-27, 2017: (1) alternative baselines to enhance DR, (2) distinguishing between charging energy and station power; and net benefits test for DR. This section of the paper discusses these three topics.

5.1 Alternative Baselines to Enhance DR

In this section, the CAISO summarizes the discussion on this topic that occurred in the second revised straw proposal, the written comments received from stakeholders on that discussion and the CAISO's response to those written comments, and the CAISO's third revised straw proposal.

5.1.1 Proposal in Second Revised Straw Proposal

The September 19, 2016 second revised straw proposal presented a proposal from the BAWG for additional baselines to assess the performance of PDR when application of the current approved 10-in-10 baseline methodology is sufficiently inaccurate. The BAWG proposed the following settlement options for PDRs and Reliability Demand response Resources ("RDRR"):

- Residential Resources:
  - 4-day weather match by max temperature, and
  - Control group.
- Commercial Resources:
  - 10 of 10 with 20% adjustment cap,
  - Average of previous 5 days; and
  - Control group.

The CAISO asked stakeholders to provide written comments on the BAWG proposal.

5.1.2 Stakeholder Comments

A majority of stakeholders were supportive of the work and proposal developed by the BAWG. Stakeholders who supported the proposal stated that the use of additional baselines for residential and commercial customers would improve the accuracy and reduce bias when compared to the 10-in-10 baseline. CLECA commented that the CAISO's proposal to audit a Demand Response Provider ("DRP") if an alternative baseline is used would increase implementation costs for DRPs. Market participants

would need to assess if increased precision is worth the increased cost of implementation.

The CAISO appreciates the overwhelming support of the alternative baseline proposal. In agreement with other stakeholders, the CAISO would like to recognize the tremendous work by the BAWG. The CAISO will specifically address stakeholders' comments after stakeholders review the revised proposal. The CAISO believes that it has addressed many of the comments through the frequent working group conference calls and multiple releases of the BAWG proposal. In response to CLECA's comment, the CAISO proposes that all baseline calculations be performed by the DRPs under the auspices and responsibility of Scheduling Coordinator ("SC"). The CAISO believes having these calculation performed through the SC provides greater flexibility and allows new alternative baselines to be deployed quickly.

5.1.3 Third Revised Straw Proposal

This section summarizes the alternative baselines proposed by the BAWG. The BAWG focused on three major areas of research and analysis.

- The use of alternative traditional baseline methods to estimate the load impact of current DR resources.
- The option of using control groups rather than traditional baselines to estimate the load impacts of DR resources.
- The impact of frequently dispatched resources to baselines evaluated.

The complete BAWG proposal, including detail on multiple baselines accuracy assessments performed in development of this proposal, is posted on the ESDER 2 Initiative website at http://www.caiso.com/Documents/2017BaselineAccuracyWorkGroupProposal-Nexant.pdf.

The CAISO currently provides multiple performance evaluation methodology options for PDR and RDRR;[7] however, the only day matching performance evaluation method offered uses a 10 of 10 customer load baseline with a 20% same day adjustment. While research has shown this day matching baseline to be accurate for many medium and large commercial and industrial customers, research has also shown that this baseline is not accurate for all customer types. The objective of the BAWG was to identify additional performance evaluation methodology options, which, when offered in

[7] See DRS User Guide for available Performance Evaluation Methodologies beginning on page 149 http://www.caiso.com/Documents/DemandResponseUserGuide.pdf.

addition to the 10 of 10 customer load baseline, will enable a wider variety of CAISO DR resources to be accurately estimated and settled.

The BAWG analyzed and proposed the three types of customer load baseline methodologies summarized below.

- **Control Groups**
  A control group performance evaluation method determines a resource's performance by evaluating the energy consumption of a set of similar, but non-participating customers with the energy consumption of the participating customers. A control group should be made of customers who have nearly identical load patterns and experience the same weather patterns and conditions as the customers dispatched. The control group establishes the baseline of what load patterns would have been absent the curtailment event. There are three ways to establish valid control groups: random assignment of customers, random assignment of clusters, and matching.

- **Day Matching**
  Day-matching baselines estimate what electricity use would have been in the absence of a DR dispatch, relying exclusively on the electricity use data from the dispatched customers. The load patterns during a subset of non-event days are used to estimate the baseline for the event day. A total of 13 day matching baselines were evaluated to determine the most accurate and precise of the 13.

- **Weather Matching**
  Like-day-matching baselines, weather-matching baselines estimate what electricity use would have been in the absence of dispatch by relying exclusively on electricity use data from the dispatched customers. The load patterns with the most similar weather conditions during a subset of non-event days are used to estimate the baseline for the event day. Weather matching baselines do not include information from an external control group. A total of seven weather-matching baselines were evaluated to determine the most accurate and precise of the seven.

The CAISO accepts the following recommended additional performance evaluation methodologies as proposed by the BAWG, summarized in Table 2 below.

Table 2: BAWG's Recommended Baselines for CAISO Performance Evaluation Methodologies

Customer Segment	Weekday	Baselines Recommended	Adjustment Caps
Residential	Weekday	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		Highest 5/10 day matching	+/- 40%
	Weekend	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		Highest 3/5 weighted day matching	+/- 40%
Non-residential	Weekday	Control Group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		10/10 day matching	+/- 20%
	Weekend	Control group	+/- 40%
		4 day weather matching using maximum temperature	+/- 40%
		4 eligible days immediately prior (4/4)	+/-20%

The proposal considered the best performing baselines for residential and non-residential loads. The analysis showed that randomized control groups with sample sizes between 200 and 400 participants were more than twice as precise as day or weather matching baselines. The addition of day or weather matching baselines provides alternative options for DRPs that do not have the proposed minimum size of 150 participants. Section 3.1-3.3 in the BAWG proposal details the process and rules for each baseline and are included as Appendices A-C in this proposal.

The BAWG recognized that the proposed performance calculation results provided to the CAISO as Settlement Quality Meter Data ("SQMD") must be in intervals of five minutes when a PDR or RDRR offers real-time or ancillary services (non-spin and spinning reserve). At this time, the BAWG did not have a fleshed out recommendation about how to achieve a 5-minute derived baseline. Absent a recommendation, the CAISO proposes to employ its current methodology for deriving these results, borrowing from the CAISO's current 10 in 10 customer load baseline methodology.[8] In summary, to achieve a 5-minute DR Energy Measurement[9], an hourly baseline is pro-rated to create a 5-minute baseline from which the 5-minute interval load, measured during the event, is subtracted. The CAISO would maintain its current requirement that baselines, and measured load during the event, be derived using, at maximum, a 15-minute interval load measurement when the PDR or RDRR is participating in real-time or ancillary service markets.

[8] See DRS User Guide for DR Energy Measurement Adjustment for Real Time beginning on page 160 http://www.caiso.com/Documents/DemandResponseUserGuide.pdf.

[9] The resulting Energy quantity calculated by comparing the applicable performance evaluation methodology of a PDR or RDRR against its actual underlying performance for a Demand Response Event.

For greater flexibility and timely baseline implementation, the CAISO is proposing to have all baseline calculations, including the current 10-of-10 customer load baseline, performed by the DRP or its SC and submitted to the CAISO by the SC as SQMD. Shifting this responsibility to the SC accelerates the needed retirement of the CAISO's legacy Demand Response System and gives the SC access to the CAISO's Market Results Interface- Settlements ("MRI-S") system to submit, view, export and upload SQMD in batch files. The CAISO believes this change will provide a more consistent and flexible approach to performance calculation management and SQMD processing.

The CAISO will continue to rely on a pre-established approval process for use of a performance methodology that requires the DRP to submit a request with detail on how they will perform calculation in compliance with tariff requirements for the methodology requested. Additionally, the CAISO would continue to leverage auditing provisions including the annual SC self-audit and on an as-needed basis to ensure accurate development and submission of SQMD to the CAISO.

The CAISO requests that stakeholders provide comments specific to the following areas:

- Do stakeholders support the BAWG's recommended baselines for adoption by the CAISO?
- Does the BAWGs proposal report, April 4, 2017 version, provide the necessary level of detail for DRPs to implement the proposed baseline options?

5.2 Distinguishing between Charging Energy and Station Power

5.2.1 Background

The CAISO is working to resolve the distinction between wholesale charging energy and station power. The CAISO is examining this topic area through its continued collaboration with the CPUC in Track 2 of the CPUC's energy storage proceeding (CPUC Rulemaking 15-03-011) rather than exclusively through ESDER 2. This dual-track effort recognizes that the CAISO's efforts in re-defining station power from a wholesale perspective could be counter-productive if the CPUC makes a different station power determination from a retail perspective.[10] Without careful consideration and final determination from the CPUC, incompatible retail and wholesale station power rules could result in the same energy incurring both wholesale and retail charges, resuscitating the years of litigation that preceded the current station power

[10] See, e.g., *Southern California Edison Co. v. FERC*, 603 F.3d 996, 1002 (D.C. Cir. 2010).

framework.[11] The CAISO believes it is important that its station power regulations be consistent with the CPUC's, and vice versa.

The CAISO tariff currently defines station power as "energy for operating electric equipment, or portions thereof, located on the Generating Unit site owned by the same entity that owns the Generating Unit, which electrical equipment is used exclusively for the production of Energy and any useful thermal energy associated with the production of Energy by the Generating Unit; and for the incidental heating, lighting, air conditioning and office equipment needs of buildings, or portions thereof, that are owned by the same entity that owns the Generating Unit; located on the Generating Unit site; and used exclusively in connection with the production of Energy and any useful thermal energy associated with the production of Energy by the Generating Unit."[12] The CAISO tariff specifically excludes from its station power definition "any Energy used to power synchronous condensers; used for pumping at a pumped storage facility; or provided during a Black Start procedure. Station Power [further] does not include Energy to serve loads outside the CAISO Balancing Authority Area."

The CAISO tariff explicitly states that station power includes, for example, the energy associated with motoring a hydroelectric generating unit to keep the unit synchronized at zero real power output to provide regulation or spinning reserve.[13] Because the CAISO tariff allows for netting of consumption against output within a five-minute interval, station power under the CAISO tariff is only measured as the amount of consumption that exceeds output within a five-minute interval.[14]

As part of the CAISO's new resource implementation process, the CAISO verifies that new resources have a load serving entity in place to meet station power needs prior to commercial operation.

5.2.2 Second Revised Straw Proposal

The September 19, 2016 second revised straw proposal stated that the CAISO will continue its collaboration with the CPUC through Track 2 of the CPUC's energy storage

[11] See, e.g., *id.*; *Calpine Corp. v. FERC*, 702 F.3d 41 (2012); *Duke Energy Moss Landing LLC v. CAISO*, 134 FERC ¶ 61,151 (2011).
[12] Appendix A to CAISO tariff.
[13] Station power does not include any energy used to power synchronous condensers; used for pumping at a pumped storage facility; provided during black start procedure; or to serve loads outside CAISO BAA.
[14] See Sections 10.1.3, 10.2.9.2, and 10.3.2.2 of CAISO tariff.

proceeding (CPUC Rulemaking 15-03-011) rather than exclusively through ESDER 2.[15] The CAISO proposed the following:

- Revise the CAISO tariff definition of station power to exclude explicitly charging energy (and any associated efficiency losses); and
- Revise its tariff later to be consistent with investor owned utility ("IOU") tariffs on state-jurisdictional issues, as needed, in the event that they revise their station power rates. The CAISO speculated that two potential, substantial forms this could take that would require the CAISO to revise its tariff regard netting and metering for storage resources.

On February 24, 2017, the CPUC issued its Proposed Decision on Track 2 storage issues.[16] The proposed decision seeks to implement the following changes regarding station power:

1. All energy that is used for purposes other than for supporting a resale of energy back into the wholesale markets is station power and inherently retail, subject to the CPUC's rules regarding netting of energy consumption.
2. All energy drawn from the grid to charge energy storage resources for later resale, including energy associated with efficiency losses, should be subject to a wholesale tariff.
3. Wholesale includes charging energy, resistive losses, pumps (flow batteries and pumped hydro), power conversion system, transformer, battery management system, thermal regulation, and vacuum (for flywheels)

   Station power: information technology and communications, lighting, ventilation, and safety.
4. Insofar as a storage resource withdraw energy (charges) or injects energy (discharges) subject to a dispatch at a greater absolute value of energy than its station power consumption, that consumption should be able to be netted against the response to the dispatch, within a fifteen-minute settlement period, just as it is for conventional generators.

[15] See CPUC website at http://www.cpuc.ca.gov/General.aspx?id=3462 for information and documents for the 15-03-011 proceeding.
[16] The CPUC Proposed Decision can be found at http://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M176/K948/176948560.PDF.

The Proposed Decision deferred action on providing any specific rule on metering configuration and on the possibility of wholesale treatment for separately sub-metered behind-the-meter resources.

The CPUC will vote on the Proposed Decision on April 27, 2017.

5.2.3 Third Revised Straw Proposal

It remains to be seen if the CPUC's Proposed Decision will be adopted. Nevertheless, it is prudent for the CAISO to seek feedback from stakeholders on what changes should be made to the CAISO tariff in light of potential changes to retail tariffs. The CAISO realizes that this will potentially be a moving target until the issue is settled for retail local regulatory authorities in California and the West.

Tariff Definition

To date, stakeholders have generally supported the CAISO's core proposal in ESDER 2: to modify the CAISO tariff definition of station power to exclude energy used to charge batteries for later resale. To avoid jurisdictional inconsistencies, the CAISO proposes to modify its definition of station power further to exclude agreed-upon wholesale uses, including charging energy, resistive losses, pumps (flow batteries and pumped hydro), power conversion system, transformer, battery management system, thermal regulation for batteries, and vacuums (for flywheels). The CAISO views these loads as sales for resale under the Federal Power Act.

The CAISO believes that it also may be prudent to reduce the amount of verbiage in the CAISO's Station Power definition. Most of this verbiage originally sought to constrain what retail loads could be included for netting purposes in the anachronistic station power protocol. A simpler approach for the CAISO's purposes could be to define station power simply as Energy to serve load located on a Generating Unit site and jurisdictional to the local regulatory authority and settled pursuant to a retail tariff. The CAISO intends to seek stakeholder feedback on this subject. The CAISO notes that whatever definition the CAISO ultimately adopts should focus on the jurisdictional lines between wholesale uses and retail uses. As the CPUC's Proposes Decision indicates, a local regulatory authority may seek to apply a wholesale *rate* to a retail *use*, but the CAISO tariff should not conflate these issues with its definition.

Potential for Commingling of Energy

Based on the current CPUC Proposed Decision, the CAISO's principal concern is that there could be potential for storage resources to "commingle" their charging load and station power load. Put another way, the CAISO is concerned—especially in single-meter configurations—that storage resources could use their wholesale, CAISO-metered

charging energy (negative generation) to serve their station power load. This could have one of two negative consequences: either the retail energy provider will not be able to charge the resource for serving its station power load, or the resource will be charged twice for the same energy (i.e., the CAISO would charge the entire load according to the wholesale locational market price—believing it is all charging energy—and the retail energy provider would charge a retail rate[17] for what it believes is the station power portion). Either of these results obviously is untenable for all parties.

The CAISO intends to solicit stakeholder feedback on what CAISO tariff revisions will be necessary to ensure that this issue does not arise. Solutions must be consistent with FERC jurisdiction, meaning that solutions cannot include the CAISO's settling station power charges, which is inherently retail and outside of CAISO/FERC jurisdiction.

An obvious solution would be to require that all wholesale load and retail load be metered completely separately. This would allow the CAISO and the retail energy provider to meter and settle only those loads that are jurisdictional to them. However, the CAISO is also interested in other potential solutions that would not require separate metering and clear electrical bifurcation of loads, which may not be possible for all resources.

5.3 Net Benefits Test

This is a new issue that the CAISO believes is appropriate for inclusions and resolution in ESDER 2.

5.3.1 Third Revised Straw Proposal

The DR-net benefits test establishes a price threshold above which DR resource bids are deemed cost effective. CAISO staff, along with the Department of Market Monitoring ("DMM"), identified a gap in the DR net benefits test formula as it applies to EIM entities.

Currently, an adjustment is made to the supply curve used in calculating the DR net benefits test to reflect differences in resource availability and fuel prices between the target and reference month. The CAISO tariff explicitly states that significant changes in fuel prices will be determined by using a simple average of the Pacific Gas and Electric

[17] Pursuant to Proposed Decision's new netting rules, the "retail rate" could also be the LMP. It would nevertheless be considered a retail rate for jurisdictional purposes.

Company Citygate price and the Southern California Edison Company Citygate price.[18] If neither of the prices are available, then the formula will default to the Henry Hub price.[19]

The CAISO is proposing to expand the list of gas price indices available for use in the calculation of the DR net benefits test to represent prices relevant to EIM entities outside of California. The fuel indices will be included in the business practice manual for market instruments rather than hardcoded in the CAISO tariff.[20] The proposal aligns the need for the DR net benefits test to recognize a variety of regional gas price indices, which will accommodate EIM entities outside of California that want to participate as DR in the CAISO market.

6 ESDER 2 Topics that require Further Development

This section discusses the following three topics that are being developed as part of the ESDER 2 effort, but will not be ready for CAISO Board approval in July 2017: increase load consumption as DR enhancements, NGR enhancements, and MUA. The CAISO will further develop the topics discussed in this section over the rest of 2017, in both the ESDER 2 and ESDER 3 stakeholder processes.

6.1 Increase Load Consumption as Demand Response Enhancement

In this section, the CAISO summarizes the discussion on this topic that occurred in the second revised straw proposal, the written comments received from stakeholders on that discussion, the CAISO's response to those written comments, and the status of this effort and the need to resolve certain fundamental policy and technical issues before the CAISO can invest significant time and resources developing a bi-directional PDR product.

[18] Refer to CAISO tariff section 30.6.3.1
[19] A natural gas pipeline that serves as the official delivery location for futures contracts on the NYMEX.
[20] Link to business practice manual for Market Instruments: https://bpmcm.caiso.com/Pages/BPMDetails.aspx?BPM=Market%20Instruments

6.1.1 Proposal in Second Revised Straw Proposal

In the September 19, 2016 second revised straw proposal, the Load Consumption Working Group ("LCWG") proposed that PDR have bi-directional functionality, able to curtail and consume load based on CAISO dispatch instructions, including the ability provide regulation service. The LCWG also recommended maintaining clear separation between wholesale and retail energy settlement. In other words, no netting would occur between wholesale and retail settlements; both would settle independently. This bi-directional approach assumes there is value in increased load consumption to the DRP and customer even though any increased consumption would continue to be charged the applicable retail rate.

The CAISO asked stakeholders to provide written comments on the LCWG proposal, including whether the proposed construct is feasible.

6.1.2 Stakeholder Comments on Proposal

AMS, SolarCity and Stem - AMS, SolarCity and Stem all participate in the Baseline Analysis and Load Consumption working groups (LCWG) and are highly supportive of these important initiatives under the ESDER Phase II. We encourage the CAISO to adopt the working group's recommendations reflected in the Staff Proposal. In particular, AMS, Solarcity and Stem are encouraging swift extension of frequency regulation to PDR as proposed by the LCWG. AMS, SolarCity and Stem strongly believe that regulation markets should be accessible to BTM energy storage systems.

PG&E - PG&E remains supportive of expanding PDR functionality to include load consumption and regulation services. What remains open is how this conceptual proposal will be operationalized. Turning a concept into reality will require a forum, which does not seemingly exist. Therefore, PG&E recommends that the CAISO consider this topic for inclusion in a Phase 3 of ESDER or possibly another forum that is available for undertaking what could be a significant effort.

SCE - SCE supports the LCWG proposal to maintain the separation of wholesale and retail energy settlement for increased load consumption. In past comments, SCE has supported this aspect of the proposal because, among other purposes, it helps eliminate jurisdictional issues while also maintaining the same relationship between wholesale market payments and retail billing that exists for current load reduction demand response. The stakeholder comments template asks: "The LCWG proposes to maintain the separation of wholesale and retail energy settlement for increased load consumption. This supposes that the value of increased wholesale consumption, perhaps at a negative price, has value to the DRP or customer since the increased

consumption would also be charged under retail rates. Under this construct, is this a feasible concept?" SCE believes this is appropriate and, given is how demand response works today, does not understand why it could not be feasible. Retail rates account for more than just wholesale market costs (including distribution costs). Increased load consumption, even when directed by the CAISO through a new DR product, still requires use of the distribution system, transmission system, and other factors and those costs need to be accounted for. This construct also appropriately assumes that there is potential value to increased load from customers. Customers have the choice at which price point to bid increased load consumption. Even if the price a customer is bidding does not completely offset their retail bill, the load consumption product is effectively acting as a discount to their retail bill. There are still multiple details that need to be developed for the load consumption product. In the last set of comments, SCE identified issues surrounding baseline applications and uninstructed imbalance energy. In addition to these issues, SCE believes the stakeholder process needs to eliminate revenue insufficiency issues created by the load consumption product. Similar to the revenue insufficiency created by traditional DR, load consumption DR will create a need for uplift since both the DR resource and Load Serving Entity (LSE) load are being compensated for the increased load during periods of negative prices. A DR resource will in effect be paid for consuming energy at a negative LMP while the LSE will see an increase in load in the real time market, likely at a discounted DLAP price, and be compensated as well. That means for every 1 MW of load consumption DR dispatched by the CAISO, the CAISO could need to pay for 2 MW of increased consumption. This discrepancy will result in the need for uplift, a market inefficiency, and should be avoided. The CAISO should commit, as part of this process, to work with stakeholders to resolve this issue before finalizing a proposal.

SDG&E - SDG&E is waiting to review the results of the Demand Response Enhancements working group.

6.1.3 CAISO Response to Stakeholder Comments

The CAISO appreciates the stakeholder comments received on enabling a bi-directional PDR capability. The CAISO understands why certain market participants wish for the prompt development of a bi-directional PDR product and how bi-directional capability could enable access to additional service opportunities and value streams. Generally, stakeholders express support for developing a bi-directional PDR capability; however, certain parties' caution the CAISO about the inherent complexities making directed load consumption a reality. For instance, SCE expresses concern about additional distribution and transmission system costs from increased throughput due to directed load consumption. SCE also raises concern that market inefficiencies result when the

CAISO pays both the demand response provider and the load-serving entity for consuming negatively priced energy, once as an instructed energy settlement to the DRP for the load consumption, and twice as an uninstructed energy settlement for the excess load consumed above the load-serving entity's scheduled demand (assuming negative priced energy). SCE's market inefficiency concern has the same analog on the load curtailment side. Addressing this market inefficiency in the original PDR design generated intense debate, which led to the CAISO implementing the default load adjustment settlement mechanism, and, in part, FERC instituting a net benefits test price threshold. Directed load consumption begs these same questions about creating market inefficiencies and double payments and how these issues should be resolved. Resolving these issues is essential to bringing a wholesale bi-directional PDR product to market.

PG&E questions how the conceptual idea of directed load consumption turns into operational reality. PG&E's excess supply pilot is exploring how customers can shift loads to take advantage of renewable energy available in situations of excess supply given new usage patterns from adoption of new technologies, such as EV, battery storage, PV, and appliances. On March 24, 2017, PG&E presented lessons learned from their excess supply pilot, which were informative to this effort. Two particular challenges PG&E highlighted in their presentation were 1) the impacts of participation on the customer's retail bill (i.e. how demand charges are affected), and 2) how to ensure directed load consumption actions do not create operational and congestion problems on the distribution system. In its ESDER 2 comments, PG&E questioned where the forum is to vet these issues to make load consumption an operational reality. The CAISO believes the forums exist, including at the CPUC, where fundamental rate design concerns and distribution system impacts must be resolved; the existing load consumption working group where issues can be identified and vetted collaboratively; and importantly, PG&E's own excess supply pilot where information and ideas can be tested and shared about how directed load consumption works, what customer, policy, and technical barriers exist, and how to measure and validate load response.

6.1.4 Straw Proposal Update

The LCWG recognizes significant policy issues exist around retail rates and their impact and interaction with wholesale-directed load consumption. The LCWG's discussions have focused primarily on the technical aspects and design of a wholesale bi-directional product. However, the deeper policy discussions needed around retail rate interactions, customer costs and benefits, demand charges, and the technical implementation issues are still unaddressed and unresolved. PG&E's excess supply pilot has delved into these

issues to some degree and has reported that participants are concerned about rate impacts and ratcheting demand charges.

The CAISO appreciates these lessons learned from this pilot and views retail rate impacts and demand charges as fundamental barriers that must be addressed, and on a path to resolution, before the CAISO can investment time and resources creating a wholesale bi-directional PDR product. Issues that need investigation are, for example, could a load-serving entity turn its retail demand charge settlement off and on in sync with when a customer receives a dispatch instruction from the CAISO to consume more energy? Is this feasible, and if so, what information technology would this functionality require and what changes would be needed to legacy billing systems? What is the impact of load consumption on rates, rate designs, and revenue requirements? Is a retail load consumption "program incentive" appropriate, and if so, how is it set and valued since the underlying retail customers participating in a load consuming supply resource are not paid the negative wholesale energy price, but are charged a retail rate.[21] Additionally, how is the value of load consumption determined since load consumption is not a "capacity" or resource adequacy resource in the traditional sense and load consumption is not valued on a traditional avoided generation and transmission and distribution cost basis?

The CAISO believes these are first priority issues that must be addressed before a wholesale load consumption product can be developed. These retail rate and valuation issues emerge whether the load consumption is providing instructed imbalance energy or regulation service.

The CAISO looks forward to collaborating with the CPUC and the LCWG to help resolve these fundamental issues and develop a path forward for designing and implementing a bi-directional PDR product.

6.2 NGR Enhancements

In this section, the CAISO summarizes the discussion on this topic that occurred in the second revised straw proposal, the written comments received from stakeholders on that discussion, the CAISO's response to those written comments, and the CAISO's third revised straw proposal.

[21] This is the converse of traditional "load curtailment" DR where the customer benefits by receiving a DR incentive payment and avoids retail rate charges for energy not consumed.

6.2.1 Discussion in Second Revised Straw Proposal

The September 19, 2016 second revised straw proposal stated that the CAISO was focused on two areas of potential NGR enhancement: (1) representing use limitations in the NGR model and (2) representing MW throughput limitations based on a resource's state of charge ("SOC"). The paper stated that the CAISO has concluded that the second area will be re-evaluated once more resources are participating as storage resources modeled under NGR. The CAISO will no longer pursue MW throughput as a condition of SOC in ESDER 2 as MW throughput may already be managed in an NGR's bid, and will instead focus its efforts in the first area of potential NGR enhancement, which includes understanding the physical use limitations of storage resources and the potential modeling, market optimization, and settlement treatment impact of these limitations. For example, how to address depth and frequency of cycling, how to model charge and discharge limits in a way to respect manufacturing warranties and performance guarantees. In addition, we are exploring the areas of commitment costs, opportunity costs, and if or how storage would fall under the CAISO designation of use-limited status and its subsequent treatment as a use limited resource.

The CAISO requested stakeholders provide comments specific to these areas:

1. What are the exogenous limitations for NGRs that are not able to be optimized within the market?
2. What are the opportunity costs and commitment costs that need to be reflected in energy bids to manage limitations?

6.2.2 Stakeholder Comments on Discussion

AMS, Solar City, and Stem commented that metering and settlement of resources that do not participate in the wholesale market 24 hours a day, seven days a week, and rules that support metering and settlement of storage resources located behind a retail meter are priority areas of interest. Metering and settlement frameworks that support these use cases will be required for Multi Use Application opportunities to provide benefits to multiple customers. They stated that NGR-modeled storage resources should be able to qualify as a CAISO designated use-limited resources and that understanding storage performance limitations and non-linear degradation based on state of charge and depth of cycling is important. The ability to reflect opportunity costs and commitment costs in energy bids to manage limitations need to be explored and should reflect economic considerations of multi-use commitments. These commitments may include shifting retail charging from off-peak to on-peak or missing the opportunity to curb peak demand as a result of wholesale market dispatch, increased battery cycling, and multiple transitions to charge and discharge states per day.

CESA commented that NGR's should be eligible for CAISO Use Limitation status and that NGRs should be able to represent commitment costs and throughput or other limitations. CESA stated that the development of a 'MWh-throughput limitation' tool or constraint to help manage NGR resources in line with use-limitations, contractual restrictions, or physical parameters of the resource would be helpful. CESA stated that the Commitment Costs for NGRs remain poorly understood and the CAISO should address this dearth of information through accommodating rules that clarify how resources may economically or administratively reflect their preferences for dispatch. CESA stated that the CAISO should not regulate or limit use-limited resources or access to this status based on planning capacity views, which they understand are currently out of scope for ESDER.

PG&E, SCE, and SDG&E commented that a MWh constraint would help them manage battery cycling that is in accordance to battery contracts and performance guarantees and would allow the CAISO to best optimize the resources based on overall system needs as opposed to having the SC do this in their bidding strategy. PG&E added that this daily limit should be managed in a way that does not expose resources providing RA to RAAIM penalties once the daily throughput limit is exhausted through regulation or energy dispatch. Participants should have flexibility not to bid the resource in real time if the resource has reached its throughput limit in order to ensure the limit is respected.

SCE commented that that they would like to pursue the ability to represent use limitations for energy storage resources as Non-Generating Resource model enhancements while also open to defining storage as Use Limited Resources. SCE would also like to investigate opportunities to utilize a Major Maintenance Adder, multiple bid stacks, or multi-stage capability for storage resources.

SDG&E commented that they do not support extensive changes to CAISO market mechanisms to accommodate the specific attributes of specific NGRs. The existing CAISO market mechanisms are adequate to allow NGRs to express their economic preferences in the form of start-up costs and price/quantity offers that internalize the opportunity costs of dispatching the NGR during day-ahead and real-time market intervals. SDG&E stated that NGRs, like generating resources, should be allowed to reflect opportunity costs in their price/quantity offers submitted into the day-ahead and real-time markets, allowing the NGR scheduling coordinator to control, on an economic basis, when the NGR will be dispatched to supply or consume energy, or to provide ancillary service capacity. SDG&E provided examples of opportunity costs of foregone profits where a limited energy NGR is dispatched at intervals where clearing prices are lower than later intervals and commitment costs that include increases or decreases in

work force and inventories depending on whether the price/quantity offer submitted by the NGR scheduling coordinator results in an increase or decrease in load.

6.2.3 CAISO Response to Stakeholder Comments

The CAISO believes that NGR resources are still in the early stages in terms of balancing the operational and physical needs of the storage technologies while maximizing the value potential within the CAISO markets and electric grid system needs.

The CAISO agrees with AMS, Solar City, and Stem comments that further work is needed to understand how storage resources can maximize their value by potentially providing services across multiple markets and platforms. For example, providing services to both the CAISO wholesale market and to the distribution utility system. To accomplish this, the ESDER initiative will continue to work jointly with the CPUC to explore how this can be accomplished and use this ESDER 3 stakeholder Initiative to share those results. Please refer to the MUA section of this ESDER 2 third revised straw proposal.

The CAISO agrees with CESA in that the efforts to understand how NGR can qualify for use-limitation status should align to the efforts and developments of the Reliability Services Initiative ("RSI) and Commitment Cost Enhancements Phase 3 ("CCE3") stakeholder initiatives. The intent of the ESDER stakeholder initiative is to create a unified strategy for developing the framework by which NGR's would apply for use-limited status. The CAISO is re-evaluating the best approach to further define NGR use-limited status criteria, whether it continue as a separate working group effort under ESDER, or whether this should fall under the continuing and future commitment costs stakeholder efforts. Similarly, understanding NGR commitment costs and opportunity costs and how to best reflect those areas for NGR modeled resources can move to ESDER 3.

6.2.4 Third Revised Straw Proposal

The CAISO is interested in pursuing NGR modeling enhancements in the area of MW throughput and MWh constraints. Stakeholders continue to request the need to track or limit MWh constraints in a way that reflects specific resource physical requirements. With respect to this topic, the CAISO will continue to work with stakeholders to develop policy on creating the ability to offer a daily cumulative charge limit and a daily cumulative discharge limit in MWh. These two cumulative daily energy constraints would be submitted to the CAISO as day ahead bid parameters and would apply to day-ahead and real-time markets for resource optimization and dispatch. These parameters would be different from existing NGR MWh energy limits provided as high or low MWh energy limits for a given market dispatch and would instead accumulate distinct charge

and discharge MWh totals over the course of the day as a physical MWh constraint. This daily cumulative charge and discharge limit capability will move forward in the ESDER 3 initiative.

The cumulative energy limits will be developed in context with and parallel to efforts on use-limited status and definition of NGR modeled storage commitment and opportunity costs. The CAISO will work with stakeholders to better understand and clarify gaps in energy storage modeling and plans to discuss these enhancements with stakeholders during the remainder of ESDER 2 and in ESDER 3.

NGR Modeling Enhancement

In the area of physical resource modeling enhancements, stakeholders have identified the following topics: (1) modeling MW limits based on time of day, (2) modeling MW limits based on depth of cycling, (3) modeling reduced MW throughput, (4) modeling annual charge and discharge limitations, and (5) modeling daily cumulative MWh charge and discharge limits based on daily market bid parameters.

For modeling MW limits based on time of day or depth of cycling (topics 1 and 2 above), the CAISO contends that the capability is already provided in the form of bidding practice and outage management. Resources that exhibit physical limitations that can be characterized over time can impose physical re-rates to the resource using the CAISO outage management system as long as the outages reflect true physical limitations of the resource, including the need to maintain battery health and adverse cell degradation. The CAISO understands that existing outage reason codes do not necessarily best reflect storage resource outage needs and seeks further input and comment from stakeholders on potentially updating these codes to reflect storage resource needs more accurately. Regarding modeling reduced MW throughput, the previous straw proposal discussed the concept of dynamic ramping based on SOC. After further analysis, the CAISO determined that the true nature of the resource's ability to ramp at different levels of SOC was more a function of MW throughput. The CAISO also determined that storage original equipment manufacturers typically factored this throughput limitation based on SOC into their batteries as a matter of design and sized the battery cell capacity in such a way to provide consistent MW throughput across the entire SOC operating range of the battery. In this third revised straw proposal, the CAISO seeks to close out these three topics, with the intent to monitor and potentially revisit them once more storage resources are participating in the CAISO markets.

Additionally, stakeholders requested the ability to model annual charge and discharge limitations or monthly charge and discharge limitations (topics 4 and 5 above). Because the CAISO market optimization horizons are based on day ahead and real time intervals,

an annual or monthly tracking of charge and discharge would be infeasible and the CAISO intends to close out this topic. However, the CAISO is interested in developing policy that would enhance the NGR model such that SCs and resource owners could define a daily cumulative maximum energy charge limit and a daily cumulative maximum energy discharge limit. This would be different from existing MWh energy limits provided for a given dispatch interval and would instead accumulate charge and discharge intervals over the course of the day and respect a limit to those cumulative values as a physical constraint. This daily cumulative charge and discharge capability will continue to be developed with stakeholders and will move forward in the ESDER 3 issue paper.

NGR Qualifying for Use-Limited Status

Stakeholders have asked the CAISO to consider allowing NGR modeled storage resources to qualify as a use-limited resource. The CAISO tariff defines a use-limited resources as "a resource that, due to design considerations, environmental restrictions on operations, cyclical requirements, such as the need to recharge or refill, or other non-economic reasons, is unable to operate continuously." This use-limited resource status is available for certain generating resources that are able to define commitment costs, such as start-up costs, minimum load costs, and minimum megawatt hour run time for market optimization and bid cost recovery. A resource can be flagged as use-limited in the CAISO market if it meets the current definition, completes the application/registration process, and provides an annual use plan. However, the use-limited concept is in the midst of an evolution regarding the definition, application process, and market treatment of such resources. The CAISO's Board-approved CCE3 initiative modifies the definition of a use-limited resource. While the CCE3 initiative defined rules for storage modeled as a PDR, it did not consider storage modeled as an NGR but deferred to the ESDER 2 initiative.

The CAISO believes that further work is needed on this topic, both within ESDER 2 and ESDER 3, on whether storage resources modeled under NGR can qualify for use-limited status and understanding if storage resources can quality for commitment costs. The CAISO held two working group sessions in 2016 on NGR use limitation and made progress in determining value of additional physical modeling such as the cumulative charge and discharge energy limits. In the area of commitment costs and use-limited status, more work is needed. Given the current efforts going on in existing stakeholder processes, namely RSI and CCE3, the CAISO is evaluating the best approach to continue this topic area. The CAISO will make a determination on whether it makes sense to combine the NGR use-limited status efforts under ESDER or under the work of a commitment costs initiative.

6.3 Multiple-Use Applications

In this section, the CAISO summarizes the discussion on this topic that occurred in the second revised straw proposal, the written comments received from stakeholders on that discussion, the CAISO's response to those written comments, and the CAISO's third revised straw proposal.

6.3.1 Discussion in Second Revised Straw Proposal

The September 19, 2016 second revised straw proposal stated that the CAISO has not yet identified specific MUA issues or topics that require treatment in ESDER 2 and the CAISO proposes to continue its collaboration with the CPUC in this topic area through Track 2 of the CPUC's energy storage proceeding (CPUC Rulemaking 15-03-011). If an issue is identified that should be addressed within ESDER 2, the CAISO can amend the scope and develop a response.

The CAISO requested that stakeholders provide comments on this topic, as well as this proposed approach.

6.3.2 Stakeholder Comments on Discussion

AMS, SolarCity and Stem - As we continue to work with the CAISO, the CPUC and utilities in resolving MUA-related issues, it is important to set the market participation rules and incentives, as well as the performance requirements for specific grid services needed to allow energy storage providers to optimize their technologies and operational characteristics. Stacking the values associated with multiple uses increases the resource value and economic viability of energy storage systems, while improving wholesale market efficiency and reducing costs to the electric grid. With this in mind, AMS, SolarCity and Stem support the CAISO's continued collaboration with the California Public Utilities Commission in Rulemaking 15-03-011 to develop appropriate standards and guidance for MUAs. MUAs reflect DER owners offering a combination of the thirteen value streams identified by the Rock Mountain Institute to the three identified stakeholders: the CAISO, UDC and end-use customers.

CLECA – CLECA supports the current CAISO approach.

PG&E - PG&E supports the approach the CAISO outlines in the straw proposal. There are no new MUA-related issues that need to be addressed at this juncture, although issues will likely arise as the Energy Storage OIR (R.15-03-011), Track 2 unfolds. Furthermore, PG&E commends the CAISO, stakeholders and working groups for recognizing and addressing potential issues that arise with MUA, including the mutual exclusivity of energy and capacity, and the issue of selling the same energy twice. PG&E echoes its

previous comments and adds that energy stored for later retail usage should always have a retail rate for charging, compensation should not occur if an action would have otherwise been taken, and that a resource should not be paid twice inadvertently for the same service. The CAISO has been following these principles thus far in the PDR enhancements; a great example of these principles applied to PDR is the clarification that retail rates apply to an end customer for load consumed even when this load is bid into a PDR Load1 Consumption product. PG&E looks forward to working with the CAISO and the CPUC to further develop guiding principles and eventually develop rules for MUA storage.

SCE - SCE agrees that the CPUC's energy storage proceeding is the correct place to address multiple-use applications at this time. SCE is particularly interested in the CPUC and the CAISO developing rules for resources that provide both distribution reliability and resource adequacy.

SDG&E - SDG&E believes the CAISO needs to address the MUA in the context of Energy Storage Phase 2.

6.3.3 Third Revised Straw Proposal

At this time, the CAISO proposes to continue its collaborative efforts with the CPUC in the context of the energy storage Track 2 proceeding, and not to pursue a CAISO initiative on MUAs unless and until the collaborative efforts identify an issue that would most appropriately be addressed in a CAISO initiative.

CAISO staff and CPUC staff are currently finalizing a joint report, to be released in April 2017 summarizing the efforts on MUA thus far and providing a framework for addressing the issues identified. The report will review the comments received previously from stakeholders, offer preliminary findings and recommendations, and pose additional issues and questions for further discussion. Following the release of the report, the CPUC and CAISO will jointly host a workshop to discuss the report and will invite a round of written comments on the report and the workshop. The CAISO expects to continue working with CPUC staff following the workshop to resolve the remaining issues as far as possible. If these activities identify any issues that need to be addressed in a CAISO initiative, the CAISO will include them in the scope of ESDER 3 when that effort begins in September 2017.

7 ESDER Phase 3

The CAISO is planning to continue the ESDER initiative in ESDER 3, which will continue to refine and address enhancements to DR, NGR and MUA. Specifically, the CAISO will continue to address:

- Defined rules for storage modeled as NGR to qualify as a use-limited resource,
- Model daily cumulative MWh charge and discharge limits based on bid parameters for NGR, and
- Any issues identified in the Track 2 of the CPUC's energy storage proceeding (CPUC Rulemaking 15-03-011) on MUA.

The CAISO requests stakeholder input on additional topics that could be included in the scope for ESDER 3. Stakeholders can present their suggestions in the written comments that are due on May 18, 2017. The CAISO is planning to release an issue paper in September 2017 that will address the scope items mentioned above along with stakeholder suggested topics.

Appendix A Control Group Baseline Process and Rules

The following table summarizes the control group process and rules. The process and baseline rules are identical for residential and non-residential customers and for weekdays and weekends.

Component	Explanation
Baseline process	1. Determine the method for developing the control group 2. Identify the control group customers 3. Narrow data to hours and days required for validation checks (see validation options) 4. Calculate average customer loads for each hour of each day 5. Drop CAISO event days and utility program event days for programs the resource or control customers participate in. 6. Validate on the schedule described in 'Validation Options' below. Conduct validation checks and ensure all of the following requirements are met for: a. Sufficient sample size – 150 customer or more b. Lack of bias - see Section 6 c. Precision – see Section 6 7. Submit information about which sites designated as a control group and which sites will be dispatched to CAISO in advance. 8. Submit the validation checks to CAISO. 9. For event days: a. Calculate the control group average customer load for each hour of event day b. Calculate the dispatch group average customer load for each hour of the event day c. Subtract the control group load (a) from the treatment group load (b) for each hour of the event day. The difference is the change in energy use for the average customer attributable to the event response, known as the load impact. d. Multiply the load impact for each hour by the number of customers controlled or dispatched. 10. Submit summary results to CAISO and store code, analysis datasets, and results datasets. 11. Update control group validation for changes in the resource customer mix of more than +/-10% or to remain compliant with seasonal or rolling window validation requirements.
Event period	Per CAISO, the event period includes any phase-in or phase-out ramp defined by the schedule coordinator, in addition to hours where the resource is dispatched.
Method for control group development	List the method used to develop the control group – random assignment of site, random assigned of clusters, matched control group, or other. For random assignment, please retain the randomization code and set a random number generator seed value.
Replication and Audit	Control group equivalence and event days calculation are subject to audit. The results must be reproducible. The underlying customer level data, randomization files, and validation code, and event day analysis code must be retained for 3 years and be made available the CAISO within 10 business days of a request. In the case where the California ISO deems it necessary, DRPs will be required to securely provide the control and treatment group's interval data to recreate the bias regression coefficient and CVRMSE to ensure they meet the criteria
Validation options	Validation is performed by the DRP and subject to audit by CAISO. The validation method uses 75-day lookback period with a 30-day buffer. Validation is required as described in note e, below. The 75 days selected for

Component	Explanation
	validation should be chosen such that the validation is complete prior to finalizing the control group to act as the designated baseline method for that resource. a. 30 days used to collect and validate the groups b. Prior 45 days used for the validation (t-31 to t-75) c. Candidate validation days used to establish control group similarity are either non-event weekdays (if the resource is dispatched only on weekdays) or all non-event days (if the resource can be dispatched on any day) d. A minimum of 20 candidate days are required to be in the validation period. If there are not 20 non-event validation days, extend the validation period backwards (t-76 and further) until there are 20 candidate days in the validation period. e. Requires validation check updates every other month if the number of accounts in the resource does not change more than ± 10%. If the number of accounts changes by more than ± 10%, the control group must be validated monthly. f. If the validation fails, the control group method is unavailable for that resource unless the control group is updated and revalidated. Control groups may be updated monthly. g. 90% of the population must be in both the validation period and the active period
Aggregation of Control Groups across Sub Load Aggregation Points (subLAPs)	Aggregation of control groups is permissible across different subLAPs; however the same performance on intra-subLAP equivalence checks must be demonstrated. While sourcing a control group from a region with similar weather and customer mix conditions is not explicitly mandated, considerations for these attributes that affect load may help in developing an appropriate control group.
Rotation of control groups	The assignment to treatment and control groups can be updated on a monthly basis; however this assignment must be completed prior to any events. Validation of new control groups must also be completed prior to any events in concurrence with any new control group development. The assignment cannot be changed once set for the month and cannot be changed after the fact

Appendix B Weather Matching Baseline Process and Rules

The following tables summarize the weather matching rules separated between residential/non-residential and weekday/weekend.

B.1 Residential

	Weekday Baseline 4 Day Matching Using Daily Maximum Temperature	Weekend Baseline 4 Day Matching Using Daily Maximum Temperature
Baseline calculation process	1. Identifying eligible baseline days that occurred prior to an event 2. Calculate the aggregate hourly participant load on the event day and on each eligible baseline day during the event period hour. 3. Calculate the resource's participant weighted temperatures for each hour of each event day and eligible baseline day 4. Select the baseline days out of the pool of eligible days 5. Average hourly customer loads across the baseline days to generate the unadjusted baseline. 6. Calculate the same-day adjustment ratio based on the adjustment period hours. 7. If the same day adjustment ratio exceeds adjustment limit, limit the adjustment ratio to the cap. 8. Apply the same day adjustment ratio to the overall unadjusted baseline to produce the adjusted baseline. Application of the baseline adjustment is not optional. It must be employed to calibrate the unadjusted baseline. 9. Calculate the demand reduction as the difference between the adjusted baseline and actual electricity use for each event hour	
Eligible baseline days	Weekdays, excluding event days and federal holidays, in the 90 days immediately prior to the event.	Weekends and federal holidays, excluding event days, in the 90 days immediately prior to the event
Baseline day selection criteria	Rank eligible days based on how similar daily maximum temperature is to the event day	Rank eligible days based on how similar daily maximum temperature is to the event day
Number of days selected to develop baseline	4 days with the closest daily maximum temperature	4 days with the closest daily maximum temperature
Calculation of temperatures	1. Map the resource sites to pre-approved National Oceanic Atmospheric Association weather station based on zip code and the mapping included as **Error! Reference source not found.** 2. Calculate the participant-weighted weather for each hour of each event and eligible baseline day. That is the weather for each relevant weather station is weighted based on the share of participant associated with the specific weather station. 3. Calculate the average temperature or daily maximum temperatures across all 24 hours in both the event day and eligible baseline days.	
Event	Per CAISO, the event period includes any phase-in or phase-out ramp defined by the schedule coordinator, in addition to hours where the resource is dispatched.	
Unadjusted baseline	The hourly average of the resource's electric load during baseline days. The unadjusted baseline includes all 24 hours in day.	
Adjustment hours	Two hours immediately prior to the event period with a two hour buffer before the event and two hours after the event with a two hour buffer. For example, if an event went from 1pm to 4pm, the adjustment hours would be 9am-11am and 6-8pm.	
Same day adjustment ratio	Calculate the ratio between the resources load and the unadjusted baseline during the adjustment hours. $\text{Adjustment ratio} = \frac{\text{Total kWh during adjusment hours}}{\text{Unadjusted baseline kWh over adjustment hours}}$	

Adjustment Limit	Cap the ratio between +/- 1.4x. If the ratio is larger than 1.4, limit it to 1.4. If the ratio is less than 1/1.4 = 0.71, limit it to 0.71
Adjusted baseline	Apply the capped same day adjustment ratio to the unadjusted baseline to calculate the final adjusted baseline. The ratio is applied to all 24 hours of the unadjusted baseline

B.2 Non-Residential

	Weekday Baseline 4 Day Matching Using Daily Maximum Temperature	Weekend Baseline 4 Day Matching Using Daily Maximum Temperature
Baseline calculation process	10. Identifying eligible baseline days that occurred prior to an event 11. Calculate the aggregate hourly participant load on the event day and on each eligible baseline day during the event period hour. 12. Calculate the resource's participant weighted temperatures for each hour of each event day and eligible baseline day 13. Select the baseline days out of the pool of eligible days 14. Average hourly customer loads across the baseline days to generate the unadjusted baseline. 15. Calculate the same-day adjustment ratio based on the adjustment period hours. 16. If the same day adjustment ratio exceeds adjustment limit, limit the adjustment ratio to the cap. 17. Apply the same day adjustment ratio to the overall unadjusted baseline to produce the adjusted baseline. Application of the baseline adjustment is not optional. It must be employed to calibrate the unadjusted baseline. 18. Calculate the demand reduction as the difference between the adjusted baseline and actual electricity use for each event hour	
Eligible baseline days	Weekdays, excluding event days and federal holidays, in the 90 days immediately prior to the event.	Weekends and federal holidays, excluding event days, in the 90 days immediately prior to the event
Baseline day selection criteria	Rank eligible days based on how similar daily maximum temperature is to the event day	Rank eligible days based on how similar daily maximum temperature is to the event day
Number of days selected to develop baseline	4 days with the closest daily maximum temperature	4 days with the closest daily maximum temperature
Calculation of temperatures	4. Map the resource sites to pre-approved National Oceanic Atmospheric Association weather station based on zip code and the mapping included as **Error! Reference source not found.** 5. Calculate the participant-weighted weather for each hour of each event and eligible baseline day. That is the weather for each relevant weather station is weighted based on the share of participant associated with the specific weather station. 6. Calculate the average temperature or daily maximum temperatures across all 24 hours in both the event day and eligible baseline days.	
Event	Per CAISO, the event period includes any phase-in or phase-out ramp defined by the schedule coordinator, in addition to hours where the resource is dispatched.	
Unadjusted baseline	The hourly average of the resource's electric load during baseline days. The unadjusted baseline includes all 24 hours in day.	
Adjustment hours	Two hours immediately prior to the event period with a two hour buffer before the event and two hours after the event with a two hour buffer. For example, if an event went from 1pm to 4pm, the adjustment hours would be 9am-11am and 6-8pm.	

Same day adjustment ratio	Calculate the ratio between the resources load and the unadjusted baseline during the adjustment hours. $\text{Adjustment ratio} = \frac{\text{Total kWh during adjusment hours}}{\text{Unadjusted baseline kWh over adjustment hours}}$
Adjustment Limit	Cap the ratio between +/- 1.4x. If the ratio is larger than 1.4, limit it to 1.4. If the ratio is less than 1/1.4 = 0.71, limit it to 0.71
Adjusted baseline	Apply the capped same day adjustment ratio to the unadjusted baseline to calculate the final adjusted baseline. The ratio is applied to all 24 hours of the unadjusted baseline

Appendix C Day Matching Baseline Process and Rules

The following tables summarize the Day matching process and rules separated between residential/non-residential and weekday/weekend.

C.1 Residential

	Weekday Baseline Highest 5 of 10	Weekend Baseline Highest 3 of 5 weighted
Baseline calculation process	1. Identifying eligible baseline days that occurred prior to an event 2. Calculate the aggregate hourly participant load for the event day and for each eligible baseline day 3. Calculate total MWh during the event period for each eligible baseline day 4. Rank the baseline days from largest to smallest based on MWh consumed over the event period 5. Select the baseline days out of the pool of eligible days 6. Average hourly customer loads across the baseline days to generate the unadjusted baseline. Apply weighted average, if appropriate. 7. Calculate the same-day adjustment ratio based on the adjustment period hours. 8. If the same day adjustment ratio exceeds adjustment limit, limit the adjustment ratio to the cap. 9. Apply the same day adjustment ratio to the overall unadjusted baseline to produce the adjusted baseline. Application of the baseline adjustment is not optional. It must be employed to calibrate the unadjusted baseline. 10. Calculate the demand reduction as the difference between the adjusted baseline and actual electricity use for each event hour.	
Eligible baseline days	10 weekdays immediately prior to event, excluding event days and federal holidays	5 weekend days, including federal holidays, immediately prior to the event
Baseline day selection criteria	Rank days for largest to smallest based on MWh over the event period, pick the top 5 days	Rank days for largest to smallest based on MWh over the event period, pick the top 3 days
Application of weights (if needed)	Not applicable	1. 50% - Highest load day 2. 30% - 2nd Highest load day 3. 20% - 3rd Highest load day
Event	Per CAISO, the event period includes any phase-in or phase-out ramp defined by the schedule coordinator, in addition to hours where the resource is dispatched.	
Unadjusted baseline	The weighted hourly average of the resource's electric load during baseline days. The unadjusted baseline includes all 24 hours in day.	
Adjustment hours	Two hours immediately prior to the event period with a two hour buffer before the event and two hours after the event with a two hour buffer. For example, if an event went from 1pm to 4pm, the adjustment hours would be 9am-11am and 6-8pm.	
Same day adjustment ratio	Calculate the ratio between the resources load and the unadjusted baseline during the adjustment hours. $\text{Adjustment ratio} = \frac{\text{Total kWh during adjusment hours}}{\text{Unadjusted baseline kWh over adjustment hours}}$	
Adjustment Limit	Cap the ratio between +/- 1.4x. If the ratio is larger than 1.4, limit it to 1.4. If the ratio is less than 1/1.4 = 0.71, limit it to 0.71	Cap the ratio between +/- 2x. If the ratio is larger than 2.0, limit it to 2.0. If the ratio is less than 1/2 = 0.50, limit it to 0.50
Adjusted baseline	Apply the capped same day adjustment ratio to the unadjusted baseline to calculate the final adjusted baseline. The ratio is applied to all 24 hours of the unadjusted baseline	

C.2 Non-Residential

	Weekday Baseline Highest 10 of 10	Weekend Baseline Highest 4 of 4
Baseline calculation process	11. Identifying eligible baseline days that occurred prior to an event 12. Calculate the aggregate hourly participant load for the event day and for each eligible baseline day 13. Calculate total MWh during the event period for each eligible baseline day 14. Rank the baseline days from largest to smallest based on MWh consumed over the event period 15. Select the baseline days out of the pool of eligible days 16. Average hourly customer loads across the baseline days to generate the unadjusted baseline. Apply weighted average, if appropriate. 17. Calculate the same-day adjustment ratio based on the adjustment period hours. 18. If the same day adjustment ratio exceeds adjustment limit, limit the adjustment ratio to the cap. 19. Apply the same day adjustment ratio to the overall unadjusted baseline to produce the adjusted baseline. Application of the baseline adjustment is not optional. It must be employed to calibrate the unadjusted baseline. 20. Calculate the demand reduction as the difference between the adjusted baseline and actual electricity use for each event hour.	
Eligible baseline days	10 weekdays immediately prior to event, excluding event days and federal holidays	4 weekend days, including federal holidays, immediately prior to the event
Baseline day selection criteria	Keep all 10 eligible days	Keep all 4 eligible days
Application of weights (if needed)	Not applicable	Not applicable
Event	Per CAISO, the event period includes any phase-in or phase-out ramp defined by the schedule coordinator, in addition to hours where the resource is dispatched.	
Unadjusted baseline	The weighted hourly average of the resource's electric load during baseline days. The unadjusted baseline includes all 24 hours in day.	
Adjustment hours	Two hours immediately prior to the event period with a two hour buffer before the event and two hours after the event with a two hour buffer. For example, if an event went from 1pm to 4pm, the adjustment hours would be 9am-11am and 6-8pm.	
Same day adjustment ratio	Calculate the ratio between the resources load and the unadjusted baseline during the adjustment hours. $\text{Adjustment ratio} = \frac{\text{Total kWh during adjusment hours}}{\text{Unadjusted baseline kWh over adjustment hours}}$	
Adjustment Limit	Cap the ratio between +/- 1.2x. If the ratio is larger than 1.2, limit it to 1.2. If the ratio is less than 1/1.2 = 0.83, limit it to 0.83	Cap the ratio between +/- 1.2x. If the ratio is larger than 1.2, limit it to 1.2. If the ratio is less than 1/1.2 = 0.83, limit it to 0.83
Adjusted baseline	Apply the capped same day adjustment ratio to the unadjusted baseline to calculate the final adjusted baseline. The ratio is applied to all 24 hours of the unadjusted baseline	