Energy Storage and Distributed Energy Resources Stakeholder Initiative Phase 2 (“ESDER 2”)

Revised Straw Proposal

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Market & Infrastructure Policy

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1 Changes from straw proposal

The ISO received comments from stakeholders in all topics areas addressed in the May 24 straw proposal – NGR enhancements, demand response enhancements, multiple-use applications, distinction between charging energy and station power, and review allocation of transmission access charge to load served by distributed energy resources (DER).[1]

The following is a summary of the changes from the straw proposal in consideration of these comments.

NGR enhancements – In ESDER Phase 2 the ISO is working with stakeholders to understand and consider NGR modeling enhancements that best reflect resource use limitations and use characteristics for NGR modeled resources. The ISO received input that resources modeled under NGR should be considered for use limitation resource status. The ISO defines a use limited resource as a resource that is subject to start-up costs, minimum load costs, or megawatt hour limitations. The ISO also received stakeholder input on other use limitations, such as, annual charge and discharge limits,

[1] Stakeholder comments on the May 24 straw proposal were submitted by the California Department of Water Resources (CDWR), California Energy Storage Alliance (CESA), Clean Coalition, California Large Energy Consumers Association (CLECA), Joint Demand Response Parties (JDRP), LS Power Development (LS Power), Pacific Gas & Electric (PG&E), SolarCity, and WeatherBug Home.

physical MW limits based on time of day, and daily limits on cycling, with the ability to change these throughput limitations on a daily basis.

In the area of NGR modeling enhancements to better reflect performance based on SOC, the ISO has had an opportunity to work further with stakeholders and battery manufacturers to better understand and determine SOC impact on ramping and megawatt throughput.

Demand response enhancements – Since the straw proposal, the Load Consumption Working Group (LCWG) has added clarifications and simplifications to its PDR load consumption proposal. Specifically, performance measurement for load consumption will be based on a modification of existing PDR performance measurement practices. The LCWG is abandoning further development of an ISO wholesale market daily load shift product, but will retain the concept of bi-directional PDR. Finally, the LCWG has reconsidered energy settlement for PDR frequency regulation and will support this option, in addition to its prior support for a zero net energy regulation option.

The Baseline Analysis Working Group (BAWG) has narrowed its research and is pursuing changes and updates in the following three areas: (1) use of alternative traditional baseline methods to estimate the load impact of current demand response resources; (2) options for using control groups rather than traditional baselines to estimate the load impacts of demand response resources; and, (3) ways to accurately measure load impacts of resources that are frequently dispatched.

Multiple-use applications – Since the straw proposal, the ISO is continuing its efforts to address multiple-use applications through its participation in the CPUC's energy storage proceeding.[2] The ISO and CPUC began a collaborative stakeholder process on this subject with a joint workshop held on May 2-3 at the CPUC to address multiple-use applications (as well as station power). Many stakeholders made informative presentations at the workshop, and the CPUC and ISO received extensive written comments on May 13 and reply comments on May 20. Based on the workshop presentations and the submitted comments the ISO has not identified any issues or topics that should be addressed in a separate effort under ESDER 2. If further activities in the CPUC proceeding identify issues that require treatment in an ISO initiative or develop proposals appropriate for ISO consideration, refinement and possible adoption, the ISO can open a new initiative or expand ESDER Phase 2.

[2] CPUC Rulemaking 15-03-011.

Distinction between charging energy and station power – Stakeholders support the ISO's straw proposal on station power and thus the ISO retains its proposal in this paper. In addition to offering support, some stakeholders seek additional clarification on the application of station power rules to energy storage resources. The ISO agrees that additional clarification is needed. In addition to the papers produced through this initiative, the ISO will revise its BPMs at the conclusion of this initiative to provide more guidance on station power generally and as applied to energy storage resources.[3]

Review allocation of transmission access charge to load served by DER – In the straw proposal the ISO explained this topic would be taken out of ESDER 2 and addressed through a separate initiative. That separate initiative is now underway.[4] Thus, this is no longer a topic of ESDER 2 and is not discussed in this revised straw proposal.

2 Introduction

The central focus of the ISO's ESDER initiative is to lower barriers and enhance the ability of transmission grid-connected energy storage and the many examples of distribution-connected resources (i.e., distributed energy resources or "DER") [5] to participate in the ISO market. The number and diversity of these resources are growing and they represent an increasingly important part of the resource mix. Integrating these resources is expected to help lower carbon emissions and add operational flexibility.

In 2015 the ISO conducted the first phase of ESDER ("ESDER 1"), which made progress in enhancing the ability of storage and DER to participate in ISO markets. This year the ISO is conducting the second phase of ESDER ("ESDER 2") to continue this important work and make additional progress.

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[3] As commenters point out, to the extent that energy storage resources seek to provide Energy and/or Ancillary Services in the ISO markets, they are situated similarly to conventional generating resources, and are therefore subject to the same rules.

[4] Information about the separate initiative called *Review transmission access charge wholesale billing determinant* may be found at http://www.caiso.com/informed/Pages/StakeholderProcesses/ReviewTransmissionAccessChargeWholesaleBillingDeterminant.aspx

[5] Distributed energy resources 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.

In the March 22 issue paper, the ISO proposed that ESDER 2 comprise the following topic areas: further NGR model enhancements, further demand response enhancements, further work on multiple-use applications, clarify station power for energy storage, and review the allocation of transmission access charge to load served by DER.

In the May 24 straw proposal paper, the ISO refined the scope of topic areas being addressed in ESDER 2 and clarified its proposed direction on these topic areas based on stakeholder feedback (e.g., feedback received from both written comments and the recently held joint workshop with the CPUC). The following describes the scope as of the May 24 straw proposal:

- <u>NGR enhancements.</u> Two areas of NGR enhancement will be considered in ESDER 2: (1) representing use limitations and (2) representing dynamic ramping.
- <u>Demand response enhancements.</u> Two areas of demand response enhancement will be considered in ESDER 2: (1) ability for proxy demand resources (PDRs) to be dispatched to both curtail and increase load and provide regulation and (2) alternative baselines to evaluate PDR performance.
- <u>Multiple-use applications.</u> Based on stakeholder comments submitted following the May 2-3, 2016, joint CPUC-ISO workshop on station power and multiple-use applications, the ISO has not identified specific multiple-use issues or topics that require or would be appropriate for separate treatment in the ESDER 2 initiative. The ISO therefore 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 arises in the course of the CPUC proceeding that should be addressed within ESDER 2 the ISO can still amend the ESDER 2 scope and will develop a response to that issue.
- <u>Resolve the distinction between wholesale charging energy and station power.</u> In this topic area the ISO will continue its collaboration with the CPUC through Track 2 of the CPUC's energy storage proceeding (CPUC Rulemaking 15-03-011) rather than exclusively through ESDER 2.
- <u>Review the allocation of transmission access charge to load served by DER.</u> The ISO has opened a separate initiative to address this topic, titled "Review Transmission Access Charge Wholesale Billing Determinant." Documents related to this initiative are available here: http://www.caiso.com/informed/Pages/StakeholderProcesses/ReviewTransmissionAccessChargeWholesaleBillingDeterminant.aspx

In the July 21 revised straw proposal, the ISO makes further refinements to the topics areas in scope and reports on progress made in developing proposals to address each topic area.

3 Background

The ISO launched ESDER 1 in June 2015 to identify and consider potential enhancements to existing requirements, rules, market products and models for energy storage and DER market participation. The initiative began with identification of a scope of issues and after consulting with stakeholders ESDER 1 ultimately comprised three topic areas:

1. Enhancements to the ISO non-generator resources (NGR) model;
2. Enhancements to demand response performance measures and statistical sampling for the ISO proxy demand resource (PDR) and reliability demand response resource (RDRR) market participation models; and,
3. Clarifications to rules for non-resource adequacy multiple-use applications.

Following determination of the scope, the ISO worked with stakeholders to develop policy proposals, and those triggering the need for tariff change (i.e., topic areas 1 and 2 above) were approved by the ISO Board of Governors at its February 3-4, 2016 meeting.[6] Following Board approval a stakeholder process ensued to develop tariff amendments to implement the proposals. The ISO filed the tariff changes with FERC on May 18, 2016.[7]

The mid-2015 scoping effort also produced an early list of issues for possible consideration in ESDER Phase 2. The mid-2015 list:

1. Additional NGR enhancements
    a. Consider a single participation agreement, rather than the current requirement that an NGR execute both a participating generator agreement (PGA) and a participating load agreement (PLA).

[6] More information about the first phase of the ESDER initiative may be found at: http://www.caiso.com/informed/Pages/StakeholderProcesses/EnergyStorage_DistributedEnergyResourcesphase1.aspx.

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

   b. Evaluate interconnection requirements for non-exporting NGR.
   c. Explore multiple configurations for a single NGR where each configuration is allowed different operating characteristics and economic bid curves based on physical constraints of the resource.
   d. Evaluate expanding bid cost recovery for NGR to potentially cover additional resource types and configurations.
   e. Enhance load management capability and participation under the NGR model (i.e., both increasing and decreasing consumption).

2. Additional PDR/RDRR enhancements – Explore dispatching DR to increase consumption.
3. Address remaining policy issues from the DERP initiative.
4. Evaluate the distinction between wholesale charging energy and station power.
5. Consider additional multiple use applications.
6. Examine alignment between distribution level interconnection and the ISO NRI process.
7. Consider open policy issues from CPUC demand response working groups.

Following publication of this potential list of topics in mid-2015, some stakeholders provided comments addressing the proposed 2016 scope. Southern California Edison (SCE) sought to verify that two issues would be added to the 2016 scope: defining how an NGR with multiple configurations will bid into the market and modeling of use limitations in the NGR model. Pacific Gas & Electric (PG&E) also asked about modeling use limitations in the NGR model as a topic for 2016 (PG&E again reiterated this interest in comments submitted toward the conclusion of ESDER 1). California Department of Water Resources State Water Project (SWP) expressed its support for including the topic of modeling multiple configurations in the NGR model in the 2016 scope. Advanced Rail Energy Storage (ARES) urged that regulation market rules for fast-response storage resources be included in the 2016 scope.

To develop the scope of issues proposed in the March 22 issue paper, the ISO used the mid-2015 list of topics as a starting point and expanded that list to include topics that stakeholders have suggested more recently (e.g., review the allocation of transmission access charge to load served by DER). Then the ISO pared this list down to a feasible scope of issues for potential policy development in 2016. The ISO considered several factors including the perceived priority of each topic, the need to allocate ISO staff resources to Track 2 of the CPUC's energy storage proceeding, and the need to balance development of new storage and DER enhancements against implementation of enhancements previously developed in the ESDER 1 and Expanding Metering and Telemetry Options stakeholder initiatives.

These topic areas have continued to be refined with each ensuing paper in ESDER 2. The current status of each topic area is described in section 4 below.

4 Revised Straw Proposals

4.1 NGR enhancements

During the May 31 stakeholder web conference and in the subsequently submitted written comments, the ISO received valuable inputs to help inform and direct the focus on areas for improving the non-generator resource model. The March 22 issue paper identified two areas that the ISO is proposing to explore for NGR enhancement: (1) representing use limitations in the NGR model, and (2) representing throughput limitations based on a resource's state of charge. Based on stakeholder comments and continued internal ISO review, the ISO uses this revised straw proposal paper to further clarify these areas of NGR enhancement and refine the proposals to focus on facilitating enhancements that provide the highest value to non-generator type resources.

4.1.1 Represent use limitations in the NGR model

Representing use limitations in the NGR model continues to be a high priority among stakeholders. Stakeholder discussion during the May 31 stakeholder web conference and stakeholder comments submitted on the straw proposal have helped to provide information to the ISO in terms of the use limitations of most interest to be considered for NGR model enhancement.

Feedback on representing use limitations is focused in two areas. The first area is in looking at how NGR modeled resources could qualify for use-limited status to be able to submit start-up costs, minimum load costs, and minimum megawatt hour run time. In the existing ISO Commitment Cost Enhancement 3 (CCE3) initiative, storage resources modeled under NGR are not within the scope of that initiative. In ESDER 2, the ISO proposes to create a working group with interested stakeholders and work through the determination of under what conditions NGR resources would qualify for use-limited status. The timeline for this effort will be determined with a goal to establish the working group and begin holding meetings in August or September.

The second area of interest is in looking at annual charge and discharge limitations, physical MW limits based on time of day, and daily limits on cycling, with the ability to change these throughput limitations on a daily basis. At this time, the ISO believes that limitations for total charge and discharge, or depth and frequency of cycling, are best tracked and managed by the resource owner. The ISO's market systems are not designed to track cumulative NGR performance parameters on an individual resource level. In the area of MW limits, the ISO believes that this capability already exists by allowing resource owners and scheduling coordinators to submit operational profiles in the ISO Outage Management System (OMS).

4.1.2 Evaluate model enhancements based on reduced MW throughput at high and low state of charge

Throughout this stakeholder initiative, the ISO has been working with stakeholders and storage subject matter experts to understand the issues faced by storage resource owners in their ability to participate in the ISO wholesale market. Early in the process, the issue paper characterized the issue as the need for some sort of multi-stage configuration. In the straw proposal, the issue was characterized by the need for dynamic ramping based on state of charge to reflect different operating and throughput limitations experienced at both high and low energy states of charge. Since the May 31 stakeholder web conference, a new characterization of the issue has emerged.

For battery storage resources, ramp ability is not directly associated with state of charge. The ability for a battery resource to move from one dispatch control point to the next is more a function of inverter capability than the resource's state of charge. Generally, a storage resource can instantaneously move from one MW dispatch level to the next. The issue for some batteries is that they are not able to sustain that rate of charge or discharge in MW value depending on the resource's state of charge. In some cases the battery management system may halt the charge or discharge, in other cases, the system may throttle back the MW rate of charge or discharge automatically as the resource approaches these high and low energy states. The battery management system may also take different actions at a high SOC than it would at a low SOC depending on built-in battery safeguards designed to optimize performance range over battery degradation or operational safety. For example, a battery may be configured to reach 100 percent SOC, but will be restricted in MW throughput to minimize degradation and maintain battery safety. A battery may never be allowed to reach a true zero percent SOC due to the high degradation impact on the resource.

The NGR model already has the ability for a resource owner to manage MW throughput based on SOC through their bidding strategy.

These more recent findings present a new level of understanding as well as complexity for modeling storage resources. One stakeholder suggestion was to have the ability to submit multiple bid stacks with different MW operating capacities and let the ISO select the best bid based on the most current SOC. At this time, the ISO is not considering the capability for NGRs to provide multiple bids for ISO selection based on resource SOC.

As stated in the issue paper, the intent of this topic is to add functionality to the NGR model that would allow resources to model their operating characteristics in a way that better matches their physical constraints and their physical allowances. With so few NGR resources operating in the ISO market, the ISO proposes to re-evaluate the NGR model capability for improvements once more resources are participating in the ISO market.

4.2 Demand response enhancements

The ISO recommended in the March 22 issue paper that stakeholder-led working groups form to discuss and recommend stakeholder-desired enhancements to proxy demand resource (PDR). Since then, two stakeholder-led working groups have formed and are actively vetting two particular enhancements. The Load Consumption Working Group (LCWG) is exploring the ability for PDR to consume load based on an ISO dispatch, including the ability for PDR to provide regulation service. The Baseline Analysis Working Group (BAWG) is considering additional baseline evaluation methods to assess the performance of PDR when application of the current approved 10-of-10 baseline methodology is sufficiently inaccurate.

Both of these issues – enabling directed load consumption and instituting new performance evaluation methods – require a thorough vetting by stakeholders with special end-use customer and retail ratemaking expertise. Incorporated here for broader stakeholder review and input are the revised straw proposals of the respective working groups. These are not ISO proposals, but are the work product of the respective working groups.

4.2.1 Load Consumption Working Group (LCWG) revised straw proposal

Subsequent to the May 24 straw proposal, the LCWG has had an opportunity to further consider and develop the three elements of load consumption, daily load shift and frequency regulation.

Based on stakeholder input and LCWG review, the main developments since the initial straw proposal are:

- Clarifications and simplifications to the PDR load consumption proposal, particularly that performance measurement would be a modification of existing PDR performance measurement practices.
- Abandoning further development of a ISO wholesale market daily load shift product but retaining the concept of a bi-directional PDR (which supports both load consumption and frequency regulation.
- Inclusion of energy settlement for PDR frequency regulation participation.

To this end, the enhancements of load-increasing PDRs and of PDR Regulation provision are developed further herein. Note that some of the detailed working group discussion that was included in the initial straw proposal is eliminated since, while it informed subsequent working group discussion, it is no longer is necessary to describe the current proposal.

4.2.1.1 Load Consumption

4.2.1.1.1 Opportunity

Market resources should be able to compete to provide value to the grid through price-signals. A key limitation with the PDR design results from its focus solely on demand reduction, rather than a focus on both reducing and increasing demand. Recognizing that oversupply of generation has already resulted in periods of low prices in the middle of the day, there are benefits from incenting additional demand during key periods from as many resources as possible. Growth in load consumption during periods of excess supply could also benefit California by reducing the need to curtail renewable generation.

4.2.1.1.2 ISO Product Construct

This construct would require a provision for “bi-directional” PDR where a single resource is able to offer both consumption and load reduction bids under the same resource ID, which is a functionality already included in the ISO market for NGR, which allows simultaneous bi-directional bidding.[8] Thus, this same functionality could be applied to PDR without extensive market development. This bi-directional construct would be needed to support load consumption by demand response resources that also curtail as well as bi-directional frequency regulation.

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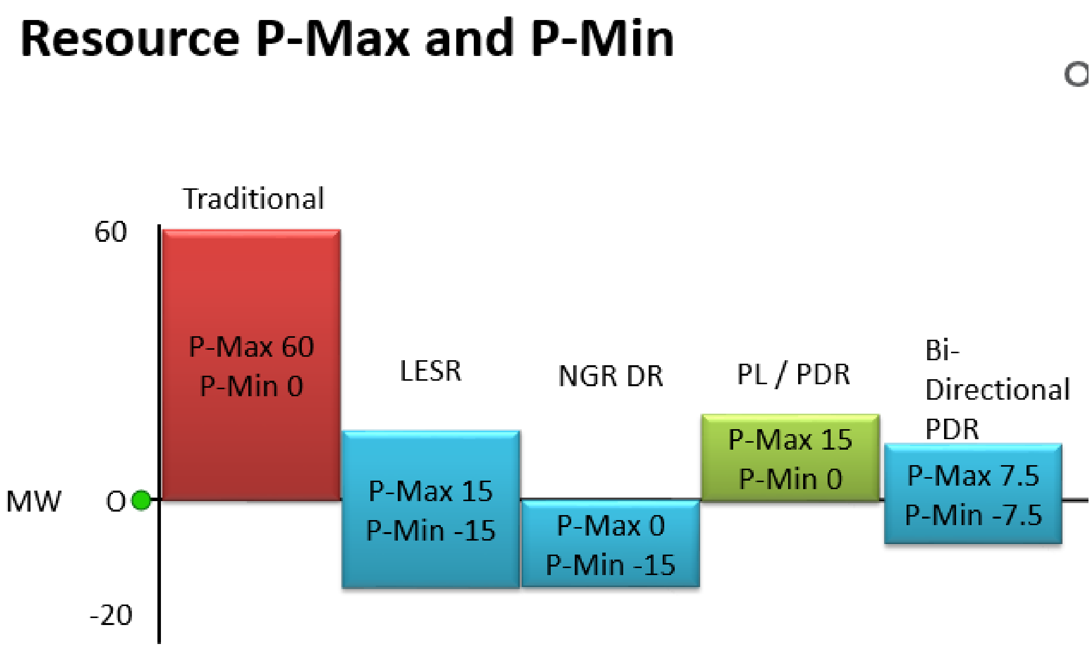
[8] Non Regulation Energy Management (Non REM) NGRs can submit both supply and demand bids under a single resource.

The construct would require that a bi-directional PDR establish a “mid-point”[9] to establish a demarcation between supply and consumption based on directional capability which would likely require a split baseline for energy measurement. The resource range is likely a parameter that would be set in the Resource Data Template (RDT), allowing it to be modified periodically rather than be a daily bidding element.

Traditional generators are defined within a range of zero as a minimum to a positive number as a maximum. When the ISO developed NGR for Limited Energy Storage Resources (LESR), it introduced the concept of resources with a range from negative to positive and at the same time contemplated that NGRs comprised of demand would have a range from a negative value to a maximum of zero. PDRs and participating loads have their capability “inverted” so they can be modeled and treated the same as traditional generation. The extension of the LESR to PDR would allow the statement of a range that would accommodate both additional consumption (negative) and reduction (positive). In the figure below, a PDR with 15 MW of dispatchable range could set half as additional consumption and half as reduction.

[9] While referring to this element as a mid-point, it would not need to be symmetrical since a PDR might have more capability in one direction than the other (e.g. drop more load for supply since it could include processes and house loads while additional consumption might be limited to adding processing loads).



The point of demarcation for NGR supply and demand bids is energy discharge for supply and energy consumption for demand. Currently PDRs are modeled to invert a reduction in load to appear to the market systems as positive generation based on their behavior and that performance is measured against “normal” consumption (baseline) to the consumption when dispatched (event). This construct can be maintained (and even exclusively if there were a use case for a “load increase only” resource) for increases in load as well. Current performance evaluation methodologies could be extended to PDR that includes load consumption or bi-directional PDR.

Just as it is for load reductions, the PDR construct, whether it is applied to “traditional” demand or BTM storage, is an appealing model for instructing additional consumption since the model segregates the roles of scheduling the underlying load from the bidding of the load response capability in the wholesale market. Additionally, the model allows for the aggregation of customers' load response. To deviate from the PDR construct and not allow load consumption to be bid and dispatched by a third party into the wholesale market would either limit participation to the incumbent LSE or raise a set of issues that have not yet been resolved.

Therefore, the working group proposes that the ISO modify its tariff and all relevant practices and procedures to allow PDR resources to place bids for both demand reduction and demand increase. The working group also believes that current performance evaluation methodologies available for demand reduction can be used for load consumption, albeit with the direction reversed, with one needed change: that PDRs be allowed to have a floor below zero, i.e. export.

4.2.1.1.3 Jurisdictional Issues

In developing this market enhancement, the legal authority by which the ISO, regulated by the Federal Energy Regulatory Commission (FERC), “directs” market behaviors such as load-consumption, even when the activity seems wholly unrelated to transmission or the sale of energy for resale (which generally are viewed as setting the parameter of the FERC’s domain under the Federal Power Act), must not interfere with the right of the state to regulate retail rates. Additional consumption on a retail meter that results from a wholesale market dispatch will be recorded as retail consumption. The end-use consumer would pay retail prices for load consumed. The ISO would settle wholesale energy at the wholesale market clearing price, positive or negative. The bid to consume load will simply be a price the bidder is willing to pay or be paid for energy and will be settled in the wholesale market through a scheduling coordinator independently from the retail settlement. The bidder could, for example, structure a negative bid which means the bidder expects to be paid for consumption of energy if negative bids are in the money and clear the market in certain intervals. There is no presumption of “capacity-like” payment to address the challenge of excess energy and over-supply in the forward planning horizon as there is no payment like “installed capacity” or resource adequacy capacity which are not ISO wholesale products. Such capacity is currently procured bi-laterally in California.

This clarification as to the design of the product (no effort to comingle retail and wholesale settlement nor interfere with the LSE relationship with the customer) is presumed to eliminate any jurisdictional issues between wholesale and retail. This presumption must be validated by legal counsel that are well versed in both FERC and CPUC regulations before the proposal proceeds beyond the conceptual phase.

4.2.1.1.4 Enhancement Concept/Design

A requirement for this enhancement is to support performance evaluation methodologies for ‘increasing load’ dispatches. This can build on the existing methodologies. For example, the methodology for load increases can be the methodology for load reductions reversed. These performance evaluation methodologies help differentiate and compensate wholesale behavior from retail behaviors and settlement, a key challenge with PDRs.

The payment for load consumption is in almost all ways just the inverse of demand reduction participation in wholesale markets. Any discussion of jurisdictional issues or some kind of settlement against the retail meter needs to specify why the treatment of load consumption is different than existing rules for demand reduction. A “negative” baseline has been implemented successfully in the PG&E Excess Supply Pilot (XSP) without modifications to the existing processes necessary to collect retail meter data, convert to SQMD and calculate performance.

For this and any aggregation of locations for the makeup of PDR, the operative assumption is that a customer location can only be associated with one aggregation and PDR at any single point in time. There have been previous discussions that at some point single locations could concurrently be associated with multiple aggregations/resources but it isn’t clear if this opportunity would be developed in a timeline to support the elements of this straw proposal.

4.2.1.2 **Daily Load Shift**

4.2.1.2.1 Opportunity

The working group assessed the Daily Load Shift needs and determined that a specific enhancement for this functionality was not appropriate at this time. Instead, the working group’s efforts focused on improving the functionality of PDRs to increase load when directed and also to allow PDRs to provide Regulation. Abandoning a specific product at this time would not preclude a participant from bidding to consume in some hours and bidding to reduce in other hours to the extent that the load consumption model supports bi-directional PDR.

4.2.1.3 **PDR Frequency Regulation**

4.2.1.3.1 Opportunity

Extending frequency regulation participation to PDR would allow a set of DER deployed resources to bring their capability to a regulation market that is ripe for improvement. As new technologies are deployed behind the meter, tapping into storage and other resources that can rapidly respond to an automatic generation control (AGC) signal can serve to increase ISO control performance results. The fleet of regulation resources fell short of reasonable performance as evidenced by the year one pay for performance enhancements which resulted in a reduction of 50% performance to 25% performance before sanctioning a resource. The current ISO frequency regulation market provides a level of revenue through capacity and mileage payments that possibly support the additional technology costs of telemetry for a PDR that could participate. Moreover, allowing PDR resources to provide regulation may improve the competitiveness, depth, and liquidity of ISO markets, thereby improving efficiency.

4.2.1.3.2 Product Construct

Two different types of PDR Regulation are contemplated by the working group.

PDR Regulation with No Energy Settlement

Unlike conventional regulation services which may require sustained energy output across multiple dispatch intervals, some PDR resources might be better suited to provide dispatchable regulation services in a "zero-net energy" (ZNE) structure. Similar to REM, a ZNE dispatch could function by returning a regulating resource to its original energy set-point every so often, e.g. every 15-minutes. As a PDR, the ZNE set point would be the baseline load level or some equivalent scheduling set point. With a ZNE focus, and also to mitigate retail/wholesale rate complications, PDR ZNE Regulation could have no energy settlement since energy deliveries would likely be netted to zero within a small period, implying regulation up and regulation down services could likely occur at similar consecutive 5-minute RTD prices. The PDR ZNE regulation service would respond to AGC signals. Performance would be measured through telemetry. This follows the notion of eliminating wholesale energy settlement since regulation should be tilted toward energy neutrality for bidirectional participation. No specific concessions to the existing requirements for the frequency regulation product would be required. The Working Group initially contemplated that PDRs would need to be at least 500 kW to participate and acquire certification through testing. The resource type construct would have to accommodate the bi-directional design of positive and negative ranges for PDRs as discussed in daily load shift section. There are reasonably defined rules for telemetry aggregation that are applicable DERs. Direct telemetry assures visibility to the ISO and is the basis for determining accuracy and mileage independent of interval metering (point being little revenue would be lost w/o energy settlement).

PDR Regulation with Energy Settlement

For some PDR resources, the idea of hour-long regulation service holds appeal. In these cases, an energy settlement will be needed. For this type of PDR participation, a PDR resource would bid for and compete to provide regulation up or down, rather than just ZNE regulation. The PDR resource could then, when dispatched, expect to receive energy settlements for movements up or down from an initial energy schedule.

Details around the use of MGO-adjusted or other baselines, performance measurements, and AGC responsiveness would need to be included in this enhancement.

4.2.1.3.3 Jurisdictional Issues

In the case of a ZNE PDR Regulation provider, the elimination of wholesale energy settlement largely avoids the possibility of any jurisdictional issues discussed in the two other products discussed in this straw proposal and simplifies wholesale settlement. When a behind-the-meter (BTM) storage device provides ZNE (bi-directional) regulation service, any energy charged/discharged that modifies the customers load would be charged at the retail rate, i.e. there would be no wholesale energy settlement or compensation, only a regulation capacity payment. The regulation capacity bids (and subsequent payment) would have to be structured to cover any retail energy charges that might exist (including the round-trip efficiency of the storage device).

For regulation that includes a wholesale energy settlement, the establishment of performance measurements are required by which to separate and settle wholesale responses from 'regular' retail actions.

4.2.1.3.4 Working Group Discussion

For resources seeking to provide traditional Regulation Down/Up services and exposed up to a full hour of dispatch in one direction (and not ZNE regulation), the costs of retail energy settlements may create barriers to participation. For instance, to provide 1 MW of PDR Regulation Down dispatch for a full hour, a resource could conceivably show an extra 1 MWh on their retail bill if the metering does not adjust for the Regulation-directed energy. Regulation capacity and mileage payments are unlikely to cover such costs. For this reason, ZNE options are preferred. Solutions to hour-long regulation services from PDRs will likely require some form of either a) energy payments from the ISO and/or b) other solutions, maybe involving utility metering adjustments.

As part of this effort, accuracy considerations should inform the design. FERC Order 755 directed rules to compensate regulation resources for being faster and more accurate while also noting that Regulation capacity procurement can be lower through the use of fast and accurate resources. As part of these PDR enhancements to provide regulation, the ISO should also apply the regulation accuracy adjustment to the regulation capacity payments to providers so that the capacity of highly inaccurate resources is more appropriate valued.

Discussion subsequent to the initial straw proposal surfaced the notion that, not all frequency response participation by demand response resources would necessarily be focused on bidirectional zero net energy participation as initially assumed. As such, the notion that exclusion of an energy settlement would be desirable for simplification of implementation has been revisited.

While there still may be specific resources that choose to participate as bi-directional resources offering both regulation up and regulation down service concurrently, there could be other resources that choose to only offer regulation down during one period in the day and regulation up during other periods. This approach to participation is a natural extension of self-directed bidirectional daily load shifting since it allows a participant to be a net load consumer during one period of the day and a net load reduction during a different period. As such, energy settlement becomes an important element of market participation.

The table below illuminates some of the key differences and impacts of energy settlement of the different types of participation.

Frequency Regulation Participation	Wholesale Energy Settlement Impact	Pros	Cons	Comment
Bi-directional	Net Zero Energy (no energy settlement)	Avoids any wholesale vs. retail settlement issues	Managing state of charge for customer applications becomes complicated If customer is on residential TOU then periods of charging and discharging over the course of regulation period has different energy values which is a risk	Most closely aligned with NGR REM but would not be required to have a CAISO meter or be a full time market participant
Regulation Down Only	Net Buyer	Easier to manage state of charge and customer risk	Might raise concerns of double payment when discharging	Best fit for ramp out periods (consume more)

Regulation Up Only	Net Seller	Same	Might raise concerns of double charging for energy consuming when discharging	Best fit for ramp in periods (consume less)

This doesn't alter the expectation that both capacity and mileage payments would apply as it would for any other resource type participation in frequency regulation. But in situations where a demand response resource only chooses to offer either regulation up or regulation down during any given settlement hour, the impact of and result of energy settlement becomes a more significant part of wholesale market participation.

What is not clear at this point and needs further vetting with the ISO is whether or not it would be feasible to exclude symmetrical bi-directional participation from energy settlement and allow single direction frequency regulation to include energy settlement. The working group recognizes that it could be challenging from an implementation standpoint to have separate settlement schema for a single resource type but still sees value in eliminating energy settlement from concurrent bi-directional frequency response if it is feasible.

Initial feedback from the ISO is that energy settlement will happen as normal course of business; however, no energy settlement would be a change. The ISO would have to turn the energy settlement off for ZNE regulation resources. Energy settlement should work for MGO devices since they are directly metered. However, energy settlement for a traditional DR resource providing regulation service may not be feasible using a baseline.

4.2.2 Baseline Analysis Working Group straw proposal

4.2.2.1 Introduction

Currently, the Proxy demand resource (PDR) and reliability demand response resource (RDRR) use a 10 of 10 baseline with a 20% same day adjustment to estimate the load impact achieved by the resource. While research has shown this baseline to be accurate for many medium and large commercial customers, research has also shown that this baseline is not accurate for all customer types. The purpose of the Baseline Analysis Working group (BAWG) is to identify additional settlement methods which, when offered in addition to the 10 of 10 baseline will enable the load impacts from a wider variety of demand response resources to be accurately estimated.

The BAWG has identified three major areas of research.

- The use of alternative traditional baseline methods to estimate the load impact of current demand response resources.
- The option of using control groups rather than traditional baselines to estimate the load impacts of demand response resources.
- Ways to accurately measure load impacts of resources that are frequently dispatched.

4.2.2.1.1 Traditional baselines methodologies for current demand response resources

The research objective is to identify additional traditional baselines that accurately estimate the load impacts of existing demand response resources which are not accurately estimated by the current ISO-approved 10 of 10 baseline. Research has shown that the 10 of 10 baseline underestimates the load impact from residential customers so identifying baselines for residential customers is an important task. In order to address this issue, analysis will be done using data from the air-conditioning cycling programs of all three utilities. The analysis will estimate the effectiveness of the current 10 of 10 baseline and test the effectiveness of alternative baseline methodologies. In addition, the effectiveness of the 10 of 10 baseline on estimating the load impacts of reliability programs such as the Base Interruptible Program (BIP) and Agricultural Pump Interruptible Program has not been rigorously tested and these customers currently do not rely on a 10 of 10 baseline.

The working group will also address the issue of how to determine which baseline should be applied to which resources. Offering more than one baseline option raises the issue of whether or not all baseline options should be available to all customer types. For example, if a particular baseline is more accurate for residential customers than it is for commercial customers, the baseline might only be made available to resource consisting of residential customers. The working group will also identify any other operational barriers that may arise due to offering more than one baseline option.

4.2.2.1.2 Control Groups

Control groups provide an alternative to traditional baseline methodologies for the estimate of load impacts. Control group methodologies use the energy use of a group of customers who do not participate in the demand response event to compare to those who do. There are two main types of control groups: 1) a randomized controlled trial (RCT) and, 2) a matched control group. In the RCT a subset of participants is randomly selected in advance and withheld from curtailment during the event period. A matched control group consists of non-participants with similar characteristics to participants.

The working group will study control group settlement methodologies already in use by other independent system operators and determine if they can be implemented by the ISO. Questions that need to be address in this area include:

1. What requirements would need to be put in place to ensure the energy use of the control group accurately reflects the energy use of the treatment group?
2. What requirements regarding samples sizes or precision should be established?
3. How will the control groups be identified operationally?
4. Is it feasible to allow control groups to vary by events/rotate?
5. How can control group methodologies be established that work for both utilities and third party demand response providers?

4.2.2.1.3 Frequent Dispatch

The current 10 of 10 PDR baseline methodology relies upon historical non-event day data in order to estimate a baseline. It may be challenging to find 10 previous non-event days for resources which are frequently dispatched during a period within a reasonable proximity of the event day. In particular, behind the meter storage which is not separately metered and participating in a PDR or RDRR product may participate frequently in the market. The working group will explore how the load impact of frequently dispatched resources can be accurately estimated using only data from the premise. Cases in which meter generator output is available and used for settlement will be considered out of the scope of this working group because it has been addressed in the ESDER Phase 1 initiative. Research will be conducted to examine how many days are necessary to establish an accurate baseline and review existing rules in place for scenarios in which limited non-event data is available and consider changes if appropriate.

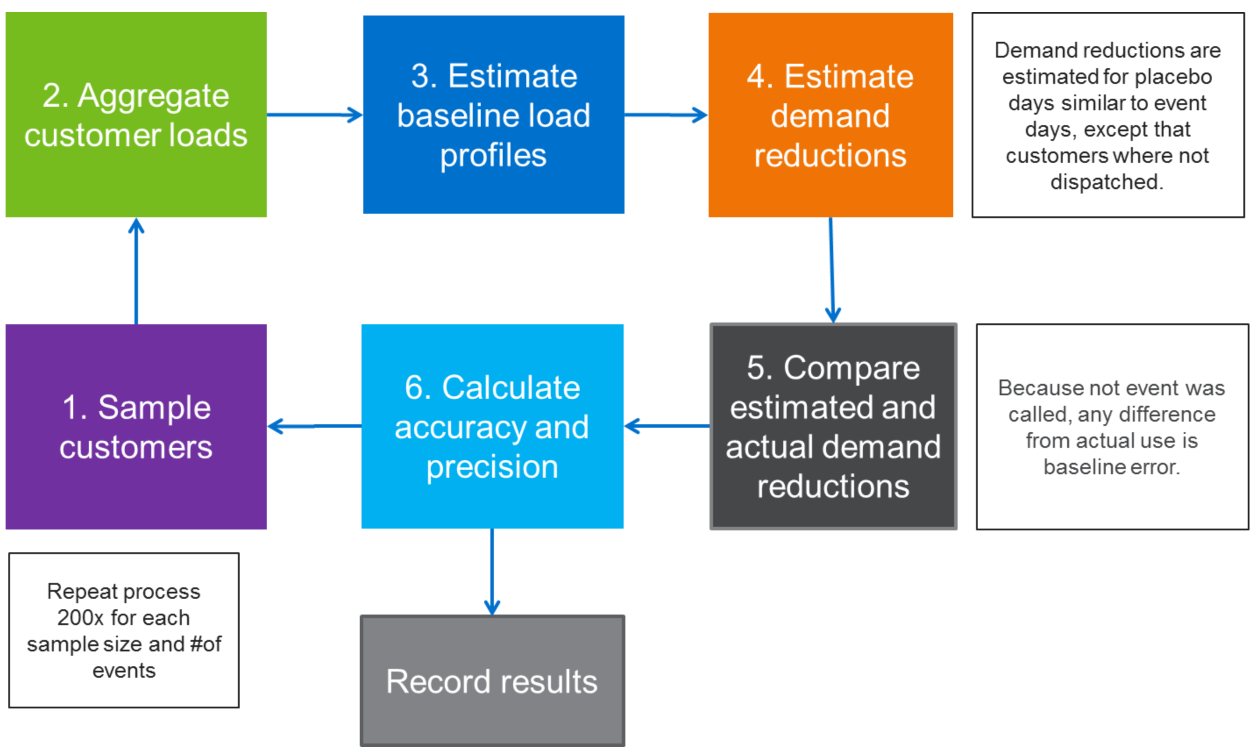
4.2.2.2 **Method for Assessing Baseline Accuracy**

To assess the accuracy of the estimated values, one needs to know the correct values. When the correct answers are known, it is possible to assess if each alternative settlement option correctly measures the demand reduction and, if not, by how much it deviates from the known values. Figure 1 summarizes the approach for assessing accuracy and precision. The basic approach is used to address all three primary areas of research.

The objective is to test different baselines with different samples using actual data from participants in order to identify the most accurate analysis method. Baseline accuracy is assessed on placebo days, which are treated as event days. Because no event was called, any deviation between the baseline and actual loads is due to error.

The process will be repeated hundreds of times, using slightly different samples – a procedure known as bootstrapping – to construct the distribution of baseline errors. In addition, the accuracy of the baselines is tested at granular geographic levels, such as sublaps, to mimic market settlement. A key question is the degree to which more or less aggregation influences the accuracy and precision of the estimates. This is assessed by repeating the below process using different subsets of customers so the relationship between the amount of aggregation and baseline accuracy is quantified. Another important question is how high frequent dispatch, which limits baseline days, affects baseline accuracy. This is assessed by using the same process described below for different number of event days per year, thus producing a plot of accuracy and precision as a function of the number of events.

Figure 1: Method for Testing Baseline Accuracy



4.2.2.3 Metrics of Identifying Suitable Baselines

For both the accuracy of the baseline and the demand reduction, the BAWG will identify the best baselines as those that are both accurate and precise. The figure below illustrates the difference between accuracy and precision. An ideal model is both accurate and precise (example #1). Baselines can be accurate but imprecise when errors are large but cancel each other out (#2). They can also exhibit false precision when the results are very similar for individual events but are biased (#3). The worst baselines are both imprecise and inaccurate, the individual event results vary substantially and they are also biased.

Figure 2: Precision versus Accuracy

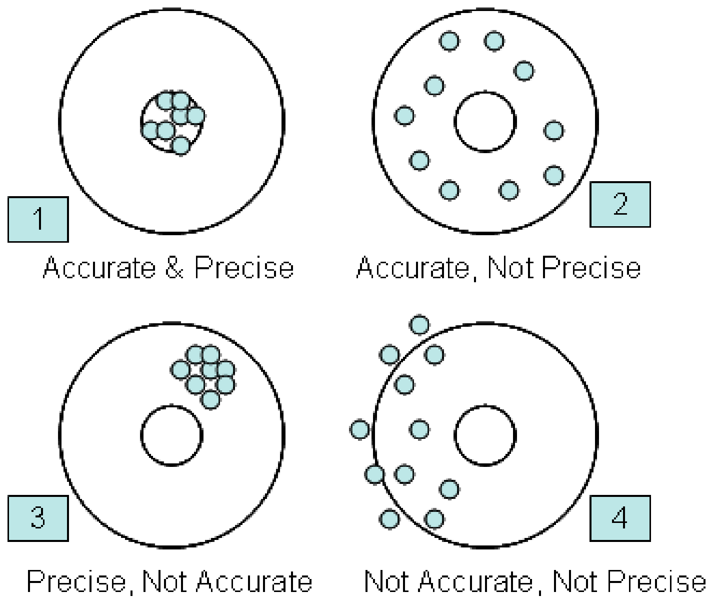


Figure 3 summarizes metrics for accuracy (bias) and precision (goodness-of-fit) that will be produced to assess the different baseline alternatives. Bias metrics measure the tendency of different approaches to over or under predict (accuracy or lack of bias) and are measured over multiple days. The BAWG will use the mean percent error since it describes the relative magnitude and direction of the bias. A negative value indicates a tendency to under predict and a positive value indicates a tendency to over predict. This tendency is best measured using multiple days. Baselines that exhibit substantial bias will be eliminated from consideration.

Precision metrics describe the magnitude of errors for individual events days and are always positive. The closer they are to zero, the more precise the results. The primary metric for precision will be CVRMSE. Among baselines which exhibit little or no bias, more precise metrics will be favored. Last, but not least, multiple baselines can prove to be both relatively accurate and precise. In which case, the BAWG may submit its recommendation based on practical considerations such ease of implementation or potential for gaming.

Figure 3: Accuracy and Precision Metrics Used to Identify Best Performing Baselines

Type of Metric	Metric	Description	Mathematical Expression
Accuracy (Bias)	Mean Percent Error (MPE)	Indicates the percentage by which the measurement, on average, over or underestimates the true demand reduction.	$MPE = \frac{\frac{1}{n}\sum_{i=1}^{n}(\hat{y}_i - y_i)}{\bar{y}}$
Precision (Goodness-of-Fit)	Mean Absolute Percentage Error (MAPE)	Measures the relative magnitude of errors across event days, regardless of positive or negative direction.	$MAPE = \frac{1}{n}\sum_{i=1}^{n}\left\lvert\frac{\hat{y}_i - y_i}{y_i}\right\rvert$
	CV(RMSE)	This metric normalizes the RMSE by dividing it by the average of the actual demand reduction.	$CV(RMSE) = \frac{RMSE}{\bar{y}}$

4.2.2.4 Baselines Included for Testing

There are a variety of approaches for measuring the magnitude of demand reduction with different degrees of complexity, data sources, and metering requirements. In addition, each method can be varied based on differences in the number of eligible days used to develop baselines, the type of days used to develop baselines, caps on the magnitude of adjustments, use of different sample sizes, and the granularity of estimates.

At a high level, however, the baselines under consideration by the BAWG can be classified under three broad categories:

Day Matching — Day-matching baselines estimate what electricity use would have been in the absence of curtailment by relying electricity use in the days leading up to the event. It does not include information from a control group. A subset of non-event days in close proximity to the event day are identified and averaged to produce baselines. A total of 13 day matching baselines are being tested.

Weather Matching — The process for weather matching baselines is similar to day-matching except that the baseline load profile is selected from non-event days with similar temperature conditions and then calibrated with an in-day adjustment. In general, weather matching tends to include wider range of eligible baseline days, which are narrow to the ones with weather conditions closest to those observed during events. A total of 7 weather matching baselines are being tested.

Control Groups — An ideal control group has nearly identical load patterns in aggregate and experiences the same weather patterns and conditions. The only difference being that on some days, one is groups has loads curtailed while the control group does not. The control group is used to establish the baseline of what load patterns would have been absent the curtailment event. This approach is the primary method for settlement of residential AC cycling and thermostat programs by Texas' system operator, ERCOT. There are three basis ways to establish control valid control groups: random assignment of customers; random assignment of clusters (for one way devices that are not directly addressable) and matching. For the purpose of the BAWG, the focus is on random assignment of customers.

For all baseline methods, the analysis will test unadjusted baselines and the use of same day adjustments with caps of 20%, 30%, 40%, 50% and unlimited caps. Same day adjustments assume that any difference between baselines and loads in the hours leading up to the event are due to estimation and calibrate the baseline based on hours leading up to the event, with buffer between the calibration period and the actual event. In total 120, different baseline rules are being tested (21 baseline methods x 6 level of same adjustments).

Figure 4 provides additional details about the baselines being tested. These baselines were identified by reviewing the best performing baselines for past studies, inside and outside of California, for residential, industrial, and commercial loads.

Figure 4: Baselines to be Tested and Compared

Control group	Day Matching	Weather Matching
1. Comparison of means	2. Average 3 of last 3 eligible days 3. Use 3 of last 3 eligible days; more recent days receive higher weight 4. Average the top 3 of the last 5 eligible days 5. Use top 3 of the last 5 eligible days; more recent days receive higher weight 6. Average 3 of last 5 eligible days and adjust upward by 5% for all customers 7. Average top 4 of the last 5 eligible days 8. Average top 5 of the last 5 eligible days 9. Average top 3 of the last 10 eligible days 10. Average top 5 of the last 10 eligible days 11. Average 10 of the last 10 eligible days 12. Average top 3 of the last 20 eligible days 13. Average top 5 of the last 20 eligible days 14. Average top 10 of the last 20 eligible days	15. Average 3 days with most similar weather during the last three months 16. Average 4 days with most similar weather during the last three months 17. Average 5 days with similar weather during the last three months 18. Average top 3 of last 14 eligible days (including weekends); discard days that don't have similar weather based on temperature-humidity index (THI) 19. Assign days with high temperatures exceeding 80°F to 3 bins based on maximum temperature; baseline equals the average peak-period load on non-event days in a similar bin 20. Assign days with high temperatures exceeding 80°F to 3 bins based on CDD for the day; baseline equals the average peak-period load on non-event days in a similar bin 21. Assign days with high temperatures exceeding 80F to 3 bins based on the total CDH for the day; baseline equals the average peak-period load on non-event days in a similar bin

4.3 Multiple-use applications

Multiple-use applications are those where an energy resource or facility provides services to and receives compensation from more than one entity. DER could potentially provide and be compensated for many services to customers, the distribution system and the wholesale markets as new markets and services evolve across the energy supply chain.

4.3.1 Progress made in ESDER 1

In ESDER 1, the ISO addressed two broad categories or types of multiple-use applications: (1) DER providing reliability services to the distribution grid and services to the wholesale market; and (2) DER providing services such as demand management to end-use customers while participating in the wholesale market. ESDER 1 limited its treatment of these multiple-use applications to circumstances where the resource either is not providing resource adequacy (RA) capacity or can set aside a portion of its installed capacity not providing RA capacity. The criterion "not providing RA capacity" was defined to apply on a monthly basis for purposes of the initiative; i.e., the capacity in question should not be included in a load-serving entity's RA plan for the given month.

In the case of DER providing services to the distribution system and participating in the wholesale market (the first category of multiple use applications examined in ESDER Phase 1), the ISO posed three questions and developed a proposed approach to each.

First, if DER is procured by the distribution utility to provide a grid service and bids into the ISO market, how should conflicting real-time needs of the distribution utility and the ISO be managed? The ISO proposed that it would settle a DER dispatch as other generating resources are settled – i.e., that if the DER deviates from an ISO dispatch instruction to provide service to the distribution system or for another reason, its deviation will be settled as uninstructed imbalance energy. Rather than establish a priority among conflicting needs, the ISO proposed to leave it to the resource owner or operator to decide how to respond in light of the settlement consequences for deviating from an ISO dispatch instruction.

Second, for any market interval in which the DER follows an ISO dispatch instruction that aligns with the service the same DER is providing to the distribution utility, is there a double payment concern that must be addressed? The ISO proposed not to implement any provisions to address potential double payment situations where a DER is compensated by the distribution utility and is also settled through the ISO market for responding to an ISO dispatch. Instead, the ISO indicated that although it may reconsider this position, it did not believe the issue is ripe for resolution because distribution-level services have not yet been defined. The ISO's position is that double payment concerns from both the distribution utility for distribution-level services and the ISO for wholesale market participation must be based on an understanding of the specific distribution-level services involved and how they are procured, utilized and compensated by the distribution utility. These questions are being considered in CPUC proceedings[10] and may or may not be ripe for consideration by the ISO in ESDER 2.

Third, the ISO considered whether there should be limitations on the provision of distribution-level services by a multi-pricing node DER aggregation or the sub-resources of a single-pricing node or multi-pricing node DER aggregation that is an ISO market

[10] See in particular the CPUC Distribution Resources Plan (DRP) proceeding (R.14-08-013) and the Integration of Distributed Energy Resources (IDER) proceeding (R.14-10-003).

participating resource? If so, what limitations are appropriate? The ISO proposed not to impose any such limitations. This is because under the ISO's proposed DER aggregation framework[11], the ISO will require no specific performance by sub-resources that comprise either a multi-pricing node or single-pricing node DER aggregation. The ISO's requirement is that when the ISO issues a dispatch instruction to a DER aggregation, the net response at each constituent pricing node be in the direction of the dispatch and the net response across constituent pricing nodes be in proportion to the DER aggregation's distribution factors. As long as the DER aggregation complies with this requirement, the operational behavior of individual sub-resources will not be subject to ISO requirements. An individual sub-resource could respond to the needs of the distribution system as long as the DER provider who operates the DER aggregation delivers the net response at the associated pricing node that is in the same direction as the dispatch instruction and aligns with the distribution factors for the DER aggregation.

With DER that provide services to end-use customers and participate in the wholesale market (the second category of multiple use applications examined in ESDER Phase 1), the ISO determined that no additional new provisions were needed beyond the provisions developed in ESDER Phase 1 for PDR/RDRR involving behind-the-meter generation devices. To accommodate the proliferation of behind-the-meter generation devices involved in demand response, the ISO developed an alternative performance evaluation methodology that directly meters the behind-the-meter generation device to measure the demand response provided by the device separate from the facility load. The demand response performance is the demand reduction resulting from the output of the behind-the-meter generation device for the dispatch interval. Under the ISO's proposal, the resource's response is evaluated based on the physical meter generator output for the dispatch interval and reduced by an estimate of the typical energy output of the device used for retail load-modifying purposes and benefits. This adjustment appropriately removes an estimated quantity of energy delivered by the device to the facility for its retail load-modifying purposes, i.e., energy not produced in response to an ISO dispatch. The adjustment is intended to mitigate issues of wholesale and retail service overlap and the potential for double compensation present in this multiple use application scenario. The adjustment is calculated by taking an average of the energy delivered by the generation device during a prescribed number of prior non-event hours. This proposed solution to address this PDR-related multiple-use application

[11] See the ISO's filing with the Federal Energy Regulatory Commission at this link: http://www.caiso.com/Documents/Mar4_2016_TariffAmendment_DistributedEnergyResourceProvider_ER16-1085.pdf

scenario was approved by the ISO Board of Governors during its February 3-4, 2016 meeting.

4.3.2 Effort in ESDER 2

In ESDER 2 the ISO is continuing its efforts to address multiple-use applications through its participation in the CPUC's energy storage proceeding.[12] The ISO and CPUC began a collaborative stakeholder process on this subject with a joint workshop held on May 2-3 at the CPUC to address station power (see section 3.4) and multiple-use applications. Many stakeholders made informative presentations at the workshop, and the CPUC and ISO received extensive written comments on May 13 and reply comments on May 20. Based on the workshop presentations and the submitted comments the ISO has not identified any issues or topics that should be addressed in a separate effort under ESDER 2. If further activities in the CPUC proceeding identify issues that require treatment in an ISO initiative or develop proposals appropriate for ISO consideration, refinement and possible adoption, the ISO can open a new initiative or expand ESDER Phase 2.

4.3.1 Additional background from the ESDER 2 issue paper

The viable revenue streams available to energy storage resources will drive the number and variety of energy storage use-cases and configurations that will appear in the evolving DER marketplace. Revenue or "value streams" reflect the energy and capacity services energy storage resources can or will be able to provide and be compensated for as new markets and energy services evolve across the energy supply chain.

Rocky Mountain Institute ("RMI") published a study on the economics of battery storage to address what services exist or may exist that will drive multi-use applications and the value proposition for energy storage. The study identified 13 services that energy storage can provide to three distinct stakeholder segments or areas of the supply chain, summarized in the table below.[13]

STAKEHOLDER GROUPS	SERVICES
ISO/RTO SERVICES	• Energy Arbitrage • Frequency Regulation

[12] CPUC Rulemaking 15-03-011.

[13] Rocky Mountain Institute Economics of Battery Storage study may be found here: http://www.rmi.org/Electricity

	• Spin / Non-Spin Reserves • Voltage Support • Black Start
UTILITY SERVICES	• Resource Adequacy • Distribution Deferral • Transmission Congestion Relief • Transmission Deferral
CUSTOMER SERVICES	• Time-of-Use Bill Management • Increased PV Self-Consumption • Demand Charge Reduction • Back-up Power

The list can be augmented in the future by distribution-level operational services being considered in the Commission's Distribution Resources Plan proceeding, services such as local voltage support and power quality that would be additional utility services in the above table. Definition of distribution-level services that can be provided by storage and other DER is also being considered in the More Than Smart working group, which is an ongoing venue for stakeholders interested in the growth of DER and their impacts to discuss related planning and implementation issues.

Although some are not yet fully specified and ready to be turned into revenue streams, the list reflects existing and potential future revenue opportunities storage and other DERs can participate in if they have the right characteristics and, importantly, are interconnected where needed. In particular, a key insight of the RMI study is that it matters where the resource is interconnected, because it affects services and value streams the device can provide across the energy supply chain.

RMI points out that if a resource is interconnected to the ISO/RTO operated transmission system, it can offer only the ISO/RTO services, i.e., five of the thirteen services. However, if interconnected on the distribution system, in front of the customer meter, it can offer all four utility services, plus all five ISO/RTO services. Finally, a resource located behind the customer meter can offer all 13 services, four customer services and the other nine utility and ISO/RTO services. A resource's potential value and service offerings increase when it interconnects further out at the edge of the grid. This means we should expect to see use cases and configurations involving storage devices behind the customer meter designed to provide services directly to the customers where they are located and to the distribution and transmission systems. Because most of the distribution-level services identified in concept have not yet been specified in sufficient detail for implementation, we should expect configurations that serve end-use customers and participate in the ISO/RTO markets to dominate the multi-use arena in the near term.

Multi-use scenarios reflect distributed energy resource owners offering combinations of these thirteen (or perhaps more) services to the three identified stakeholders: the ISO, UDC, and end-use customer. As an industry, we need to define each service, its rules, performance requirements, measurement, etc., so the incremental value each service provides is fairly paid to each resource that provides the service while safeguarding against fraud, manipulation, and unearned revenue.

For instance, interconnecting a device at the edge of the grid enables the resource owner to capture multiple value streams, between the customer and ISO/RTO. Two problematic multi-use scenarios emerge, including variations on these scenarios, which include offering services mutually exclusive, and selling the same energy or capacity twice without adding incremental value.

Mutually Exclusive Capacity and Energy

The offering of capacity and energy services can be mutually exclusive. An example from the ISO market is that a successful bidder in the ancillary services market cannot resell the energy behind the ancillary services capacity award. For a spinning or non-spinning reserve award, the energy must be bid into the ISO market and must remain available so the ISO can dispatch it if and when needed in a contingency. The ISO has a means to monitor such activity and employs a no-pay settlement rule to subtract the ancillary services capacity payment if it finds that the energy behind an ancillary services capacity award was unavailable.

Another example of this mutual exclusivity between energy and capacity is when the capacity of a storage resource located behind a customer's meter is sold as resource adequacy capacity to an LSE, making that resource's capacity subject to a must-offer obligation. Because a storage resource has limited energy production capability, conflict can raise if the same capacity is also used to manage its host customer's demand charges and perform retail rate arbitrage. Because resource adequacy capacity comes with a must offer obligation, the energy is dedicated to the ISO, but if the resource exhausts its charge before the ISO needs to dispatch it, it will have violated its resource adequacy obligation to the ISO.

Selling the Same Energy Twice

The sale and export of energy sourced in the distribution system and sold into the bulk power system via a Wholesale Distribution Access Tariff ("WDAT") is an approved and acceptable means of providing energy services. The WDAT enables the safe and reliable interconnection of a distribution connected resource to sell its energy into the wholesale market. Other scenarios may exist that require no WDAT, but still allow resources behind the meter to export energy onto the grid, such as with Net Energy Metering (“NEM”). What must be avoided is a resource getting paid two or more times for the same energy delivered, capturing unearned value by simultaneously selling and banking the same energy.

Suppose a resource owner sells energy to the ISO/RTO from a large solar resource behind its facility meter, while the facility is enrolled under a utility’s NEM tariff. The owner of the resource sets the resource up for participation in the ISO market and bids the excess energy from the resource into the wholesale market. Simultaneously, the owner “banks” the excess energy from the resource under the NEM tariff to be withdrawn and consumed by the facility at a different time. In this simple example, the resource owner would receive a double value or compensation: paid once by the ISO for wholesale energy and a second time for the value of energy withdrawn and consumed at a later time via the NEM tariff, receiving two value streams for the same energy.

In its opening comments in Track 2 of the energy storage proceeding, the ISO recommended the following to the CPUC:

1. <u>Refine and assess the list of energy and capacity services</u>: Start with the 13 services identified by RMI and the distribution-level services being considered in the DRP proceeding, and then refine the list in ways meaningful to the CPUC and the market structures in California. Each service type can then be evaluated against different use-cases to test for new rules, incompatibilities, and requirements, ensuring every identified service delivers incremental value when bundled with other energy and capacity services under a multi-use scenario.
2. <u>Identify energy and capacity services already compensated</u>: The CPUC should identify what incentives, tariffs, and rates exist that already compensate for certain energy and capacity services as identified in the RMI study and refined in this proceeding. If a multi-use scenario emerges where one or more of these services are already compensated, then such multi-use applications should be modified or rejected to account for the services already compensated.
3. <u>Establish guiding principles</u>: The ISO recommends CPUC staff work with interested parties to develop a set of principles that can test the validity of different multi-use scenarios. Does each service in a multi-use scenario provide incremental value, or is the same energy or capacity service being sold twice with no added benefit. Questions like these can be turned into guiding principles and are instructive for evaluating myriad different multi-use scenarios that will emerge.

4.4 Distinction between charging energy and station power

4.4.1 Background

Under this topic the ISO is working to resolve the distinction between wholesale charging energy and station power. The ISO 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.

The ISO tariff 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."[14]

The ISO 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.[15] Importantly, because the ISO tariff allows for netting of consumption against output within a five-minute interval, station power under the ISO tariff is only measured as the amount of consumption that exceeds output within a five-minute interval.[16]

As part of the ISO's new resource implementation process, the ISO verifies that new resources have a load serving entity in place to meet station power needs prior to commercial operation. Similarly, an energy storage facility owner should consult with its load serving entity to determine how retail charges may apply to its station power consumption.

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[14] Appendix A to the ISO tariff.

[15] Station power does not include any energy used to power synchronous condensers; used for pumping at a pumped storage facility; provided during a black start procedure; or to serve loads outside the ISO BAA.

[16] See Sections 10.1.3, 10.2.9.2, and 10.3.2.2 of the ISO tariff.

The ISO recognizes the need to further evaluate methods to distinguish between wholesale charging energy and station power and address such issues as the merits and drawbacks of treating battery temperature regulation as wholesale charging or station power; possible metering and battery configurations that would enable distinguishing among traditional station power uses, charging, and battery regulation; and any other areas where additional clarifications or enhancements to ISO rules are warranted. Revising the definition of station power to allow for energy consumed to regulate battery temperature could require revision to the ISO tariff's definition of station power, which would require FERC approval. The Federal Power Act requires equal treatment of similarly situated customers, so there would have to be a compelling difference between, for example, energy consumed to regulate battery temperature and energy consumed to start a combustion generator in order to consider one wholesale and the other retail.

The ISO also recognizes that its efforts in re-defining station power from a wholesale perspective could be unproductive if a different determination is made from the retail perspective by the CPUC.[17] The same energy could incur both wholesale and retail charges, resuscitating the years of litigation that preceded the current station power framework.[18] The ISO recognizes that its determinations regarding station power should be consistent with the CPUC's, and vice versa.

4.4.2 May 24 Straw Proposal

The ISO definition of station power is broad, but has some specific exclusions, such as energy used for pumping at a pumped storage facilities. The ISO proposes to modify its definition of station power to also exclude energy used to charge batteries for later resale. This charging load would include "efficiency losses," which are energy drawn from the grid to charge the battery for later resale, but ultimately lost because of the physics of the battery. Excluding charging load from settlements for station power would require a separate meter to distinguish the charging load from station power.

At this time, the ISO does *not* propose to modify its definition of station power further to allow energy drawn from the grid to be consumed in support of the production of energy to be subject to a wholesale rate (e.g., for temperature regulation). As explained below, the ISO lacks the authority to do so, and therefore defers to the CPUC and state-

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

[18] 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).

jurisdictional tariff process. The ISO takes no position on whether energy consumed for the production of energy should be subject to a wholesale rate such as the ISO LMP. In this initiative the ISO will seek Board approval so that if state-jurisdictional tariffs are revised to exclude auxiliary load, temperature regulation, or any other uses of energy for the production of energy, the ISO may modify its tariff for consistency at that time.

Until then, amending the ISO tariff to attempt to claim certain uses as wholesale would be futile. The Federal Power Act gives FERC jurisdiction over the transmission of electric energy in interstate commerce and the "sale of electric energy at wholesale," which the Federal Power Act defines as "a sale of electric energy to any person *for resale*."[19] The ISO tariff therefore only applies to transmission and sales for resale, which would exclude even those sales of power to be consumed to support the production of energy (i.e., station power). For this reason FERC held that "state-jurisdictional retail sales of station power are properly the subject of state tariffs"[20] after the U.S. Court of Appeals for the D.C. Circuit rejected FERC's monthly netting period to determine what level of consumption would be subject to wholesale settlement or retail charges.[21]

As many commenters point out, the Federal Power Act also requires that the ISO treat similarly situated customers similarly. While the ISO agrees with commenters that neither generation nor transmission are perfect analogs for storage, the ISO believes that generation is the appropriate analog unless and until FERC chooses to mandate the creation of a new and separate model for storage. Storage resources generally seek to provide supply and ancillary services to the ISO market, and do not transmit electric energy over any meaningful distance. As such, storage resources are similarly situated to generation resources for most purposes, including station power. The ISO cannot therefore create separate station power rules on the consumption of power to support producing power without also amending the station power rules for all generation resources. As stated above, because neither FERC nor the ISO has jurisdiction to resolve questions on consumed energy such as station power, the ISO defers on whether this amendment would be appropriate.

Accordingly, the ISO does not propose to address questions regarding the principles that would guide potential new station power rules, such as whether the load is for

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[19] 16 U.S.C. § 824(d) (emphasis added).

[20] *Duke Energy Moss Landing v. CAISO*, 132 FERC ¶ 61,183 at P 2 (2010).

[21] *Southern California Edison Co. v. FERC*, 603 F.3d 996, 1000-1 (D.C. Cir. 2010).

discretionary purposes or consumed when the storage device is charging, discharging, idle, or off.

4.4.3 Revised Straw Proposal

Commenters support the ISO's straw proposal on station power. In addition to offering support, some commenters seek additional clarification on the application of station power rules to energy storage resources. The ISO agrees that additional clarification is needed. In addition to the papers in this initiative, the ISO will revise its BPMs at the conclusion of this initiative to provide more guidance on station power generally and as applied to energy storage resources.[22] This will be especially prudent considering that the ISO's Metering Rules Enhancements ("MRE") stakeholder initiative plans to revise tariff provisions regarding metering intervals to memorialize that all Scheduling Coordinators may submit metering data in 5, 15, or 60 minute intervals, depending on their meters.[23]

CESA comments that "the CAISO should affirm that charge and discharge netting at at-least 5-minute resolution is allowed as well as self-supply of station load by the storage system." Likewise, LS Power states that "the CAISO should move quickly to make it clear that energy storage is allowed to net their station power from output across their whole range of operation, just as conventional thermal assets net their station power from output while generating." The ISO confirms that energy storage resources (including storage/conventional generation hybrid resources, such as a solar plant with a battery) may self-supply their station power needs just as conventional generators do.[24] It should be noted, however, that these generators do the "netting" themselves in that they simply deliver less energy to the ISO grid than they would if they were not self-supplying energy for their station power load. In other words, the ISO does not "net" generation and consumption as part of the resource's settlement process, and the settlement interval generally is therefore immaterial.[25]

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[22] As commenters point out, to the extent that energy storage resources seek to provide Energy and/or Ancillary Services in the ISO markets, they are situated similarly to conventional generating resources, and are therefore subject to the same rules.

[23] http://www.caiso.com/informed/Pages/StakeholderProcesses/MeteringRulesEnhancements.aspx.

[24] *See* Section 10.1.3.1. of the tariff.

[25] Section 10.1.3.2 of the tariff states that "CAISO Metered Entities or Scheduling Coordinators may not net values for Generating Unit output and Load."

For example, a generator may be capable of delivering 100 MW to the ISO grid, and its typical station power load requires 5 MW. At start-up, the generator draws its 5 MW for station power from its local energy provider at retail rates. Once the generator ramps up, it ceases drawing from the grid and self-supplies from its generation to its self-supply load, such that it delivers 5 MW less to the ISO than it is physically capable. If this generator were at full output and self-supplying its station power needs, the ISO would settle the generator for 95 MW at the wholesale LMP, and the local energy provider would settle the generator for 0 because nothing is drawn from the grid.[26]

Energy storage resources and hybrid resources are subject to the same rules regardless of whether they are charging, discharging, idle, or off. To the extent they can self-supply their station power needs, they would not draw energy from the grid and avoid retail charges, but at the expense of less energy delivered to the grid at the wholesale LMP. The ISO currently does not believe that tariff changes are necessary to clarify these rules, but agrees that it can provide significantly more guidance on station power in its BPMs at the conclusion of this stakeholder initiative.

5 Stakeholder process schedule

The following table outlines the schedule for the policy development portion of ESDER Phase 2. This schedule does not include implementation steps including development and filing of tariff amendments, changing business process manuals, and making and implementing changes to market system software and models.

Stakeholder Process Schedule

Step	Date	Activity
Issue Paper	March 22	Post issue paper
	April 4	Stakeholder web conference
	April 18	Stakeholder comments due
Straw Proposal	May 24	Post straw proposal
	May 31	Stakeholder web conference
	June 9	Stakeholder comments due

[26] To be sure, this is a simplified example of netting and the generator could still incur charges from standby service depending on its arrangement with its local utility.

Stakeholder Process Schedule		
Step	**Date**	**Activity**
Revised Straw Proposal	July 21	Post revised straw proposal
	July 28	Stakeholder web conference
	August 11	Stakeholder comments due
Draft final proposal	TBD	Post draft final proposal
	TBD	Stakeholder web conference
	TBD	Stakeholder comments due
Board approval	TBD	ISO Board meeting